Final Environmental Impact Statement

Design, Construction and Operation of One or More Pilot Test Facilities for Assembled Chemical Weapons Destruction Technologies at One or More Sites

April 2002

Program Manager
Assembled Chemical
Weapons Assessment

Anniston Army Depot, Alabama
Pine Bluff Arsenal, Arkansas
Blue Grass Army Depot, Kentucky
Pueblo Chemical Depot, Colorado

Assembled Chemical Weapons Assessment

APPROVAL AUTHORITY: U.S. Department of Defense, Program Manager Assembled Chemical Weapons Assessment

DOCUMENT DESIGNATION: Final Environmental Impact Statement (FEIS)

AFFECTED JURISDICTIONS: State of Alabama, State of Arkansas, State of Colorado, and Commonwealth of Kentucky.

PREPARER:

Jon Ware
Jon Ware
Environmental Team Leader ACWA

APPROVED BY:

Michael Parker
Program Manager for Assembled Chemical Weapons Assessment

REVIEWED BY:

William J. Pehlivanian
Deputy Program Manager for Assembled Chemical Weapons Assessment

APPROVED BY:

Raymond J. Fatz
Raymond J. Fatz
Deputy Assistant Secretary of the Army (Environment, Safety and Occupational Health), OASA (I&E)

COVER SHEET

LEAD AGENCY: U.S. Department of Defense (DOD), Program Manager Assembled Chemical Weapons Assessment (PMACWA)

COOPERATING AGENCIES: None

TITLE OF PROPOSED ACTION: Design, Construction and Operation of One or More Pilot Test Facilities for Assembled Chemical Weapons Destruction Technologies at One or More Sites

POINT OF CONTACT: Information concerning this environmental impact statement can be obtained by calling 1-888-482-4312 or by writing to PMACWA, Attn: AMSSB-PM-ACWA, 5183 Blackhawk Rd., Aberdeen Proving Ground, MD 21010-5424.

APPROVAL AUTHORITY: U.S. Department of Defense, Program Manager Assembled Chemical Weapons Assessment

DOCUMENT DESIGNATION: Final Environmental Impact Statement (FEIS)

AFFECTED JURISDICTIONS: State of Alabama, State of Arkansas, State of Colorado, Commonwealth of Kentucky

ABSTRACT: The U.S. Congress established the ACWA Program as part of the *Omnibus Consolidated Appropriations Act* of 1997 (Public Law [P.L.] 104-208). This authorizing legislation instructed DOD to "demonstrate not less than two alternatives to the baseline incineration process for the demilitarization of assembled chemical munitions." The primary purpose of ACWA is to pilot test alternative systems for destroying assembled chemical weapons (ACWs). The actual destruction of chemical munitions is not the primary function of the ACWA Program. The Program Manager for Chemical Demilitarization (PMCD), as mandated under P.L. 99-145, is charged with the systematic construction and operation of facilities or processes to reduce the chemical weapons stockpile.

This EIS analyzes the potential environmental impacts of a proposed action to pilot test one or more alternative systems for the destruction of ACWs at one or more alternative Army installations that are storing ACWs. The four installations included in this EIS are Anniston Army Depot (ANAD) in Anniston, Alabama; Pine Bluff Arsenal (PBA) in Pine Bluff, Arkansas; Pueblo Chemical Depot (PCD) in Pueblo, Colorado; and Blue Grass Army Depot (BGAD) in Richmond, Kentucky. The four destruction systems that are assessed in the document are those that successfully completed the initial demonstration testing. The systems are (1) neutralization followed by biological treatment (Neut/Bio), (2) neutralization followed by supercritical water oxidation (Neut/SCWO), (3) neutralization followed by gas-phase chemical reduction and transpiring wall supercritical water oxidation (Neut/GPCR/TW-SCWO), and (4) electrochemical oxidation (Elchem Ox). The no action alternative is also assessed. The preferred alternative is to pilot test ACWA technologies at one or more locations. The substantive impact areas that are considered include the following broad categories: land use, infrastructure, waste management, air quality, noise, human health and safety, visual resources, water use and quality, soils, biological resources, cultural resources, socioeconomics, environmental justice, accidents, agriculture, and cumulative effects. In addition to facility construction and operation, decommissioning and closure are also addressed.

CONTENTS

CONTENTS (Cont.)

CONTENTS (Cont.)

CONTENTS (Cont.)

CONTENTS (Cont.)

CONTENTS (Cont.)

CONTENTS (Cont.)

CONTENTS (Cont.)

CONTENTS (Cont.)

CONTENTS (Cont.)

CONTENTS (Cont.)

CONTENTS (Cont.)

CONTENTS (Cont.)

CONTENTS (Cont.)

CONTENTS (Cont.)

CONTENTS (Cont.)

CONTENTS (Cont.)

CONTENTS (Cont.)

TABLES

TABLES (Cont.)

TABLES (Cont.)

TABLES (Cont.)

TABLES (Cont.)

TABLES (Cont.)

TABLES (Cont.)

TABLES (Cont.)

TABLES (Cont.)

TABLES (Cont.)

TABLES (Cont.)

TABLES (Cont.)

TABLES (Cont.)

TABLES (Cont.)

TABLES (Cont.)

TABLES (Cont.)

TABLES (Cont.)

FIGURES

FIGURES (Cont.)

FIGURES (Cont.)

FIGURES (Cont.)

FIGURES (Cont.)

NOTATION

ACRONYMS AND ABBREVIATIONS

1X, 3X, 5X	U.S. Army system for material safety hazard classification (X, XXX, and XXXXX, respectively)
AADT	annual average daily traffic
ACA	*Arkansas Code Annotated*
ACW	assembled chemical weapon
ACWA	Assembled Chemical Weapons Assessment
ADECA	Alabama Department of Economics and Community Affairs
ADEM	Alabama Department of Environmental Management
ADEQ	Arkansas Department of Environmental Quality
agl	above ground level
AHPA	*Archaeological and Historic Preservation Act*
AIRFA	*American Indian Religious Freedom Act*
AMC	Army Material Command
ANAD	Anniston Army Depot
ANCA	Anniston Chemical Activity
ANSI	American National Standards Institute
APEN	air pollutant emission notice
AQCR	Air Quality Control Region
AR	Army Regulation
ASA	Ammunition Storage Area
ATSDR	Agency for Toxic Substances and Disease Registry
AWS	Ammunition Workshop
BACT	best available control technology
BGAD	Blue Grass Army Depot
BGCA	Blue Grass Chemical Activity
Bio	biological treatment or biotreatment as used in Neut/Bio
BLM	Bureau of Land Management
BLS	U.S. Bureau of Labor Statistics
BR	business route
BRAC	Base Realignment and Closure
CAA	*Clean Air Act*
CAAA	*Clean Air Act Amendments*
Cabinet	Kentucky Natural Resources and Environmental Protection Cabinet
CAIRA	Chemical Accident or Incident Response and Assistance
CatOx	catalytic oxidation unit
CBDCOM	Chemical and Biological Defense Command
CCR	*Code of Colorado Regulations*
CDC	Centers for Disease Control and Prevention

CD EIS	chemical demilitarization environmental impact statement
CDPHE	Colorado Department of Public Health and Environment
CEQ	Council on Environmental Quality
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
CFR	*Code of Federal Regulations*
CHB	Container Handling Building
CIC	Central Incinerator Complex
CLA	Chemical Limited Area
CNHP	Colorado Natural Heritage Program
CO	carbon monoxide
COE	U.S. Army Corps of Engineers
CR	county road
CSEPP	Chemical Stockpile Emergency Preparedness Program
CWA	*Clean Water Act*
CWC	Chemical Weapons Convention *(Convention on the Prohibition of the Development, Production, Stockpiling, and Use of Chemical Weapons)*
DAB	Defense Acquisition Board
DAE	Defense Acquisition Executive
DAPC	Division of Air Pollution Control
DCE	dichloroethylene
DDT	dichlorodiphenyltrichloroethane
DEIS	draft environmental impact statement
DOC	U.S. Department of Commerce
DOD	U.S. Department of Defense
DOI	U.S. Department of the Interior
DOT	U.S. Department of Transportation
DRMO	Defense Reutilization and Marketing Office
EIS	environmental impact statement
Elchem	electrochemical as used in Elchem Ox
EMIS	Emergency Management Information System
EOC	emergency operations center
EPA	U.S. Environmental Protection Agency
EPCRA	*Emergency Planning and Community Right-to-Know Act*
EVAWS	enhanced visual/audio warning system
FDA	U.S. Food and Drug Administration
FEC	Foothill Engineering Consultants, Inc.
FEIS	final environmental impact statement
FEMA	Federal Emergency Management Agency
FR	*Federal Register*
FRRA	Front Range Research Associates, Inc.
FTE	full-time-equivalent
FY	fiscal year

GB	sarin, a nerve agent
GPCR	gas-phase chemical reduction
H	mustard, a blister agent
H_2S	hydrogen sulfide
HAP	hazardous air pollutant
HC	hydrocarbon
HD	mustard, a blister agent
HEPA	high-efficiency particulate air
HF	hydrogen fluoride
HQ	hazard quotient
HSWA	*Hazardous Solid Waste Amendments of 1984*
HT	mustard, a blister agent
HVAC	heating, ventilation, and air conditioning
I	interstate
ICAGRS	interim corrective action groundwater remediation system
ICB	immobilized cell bioreactor
IIPT	Integrating Integrated Product Team
IMPA	isopropyl methylphosphonic acid
IOC	Industrial Operations Command
IPT	Integrated Product Team
ISCST3	Industrial Source Complex Short-Term 3 (model)
IWTP	Industrial Waste Treatment Plant
JACADS	Johnston Atoll Chemical Agent Disposal System
KAR	*Kentucky Administrative Regulation*
KDEP	Kentucky Department of Environmental Protection
KPDES	Kentucky Pollutant Discharge Elimination System
KRS	*Kentucky Revised Statute*
KSNPC	Kentucky State Nature Preserves Commission
KYNHP	Kentucky Natural Heritage Program
LEPC	Local Emergency Planning Committee
LOAEL	lowest observed adverse effect level
LP	load platform
MCE	maximum credible event
MCL	maximum contaminant level
MDB	Munitions Demilitarization Building
MOA	memorandum of agreement
MOU	memorandum of understanding
MPA	methylphosphonic acid
MPT	metal parts treater

MSA	Metropolitan Statistical Area
MSL	mean sea level
NAAQS	National Ambient Air Quality Standards
NAGPRA	*Native American Grave Protection and Repatriation Act*
NCTR	National Center for Toxicological Research
NEPA	*National Environmental Policy Act*
NESHAP	National Emission Standards for Hazardous Air Pollutants
Neut	neutralization as used in Neut/Bio, Neut/SCWO, and Neut/GPCR/TW-SCWO
NHPA	*National Historic Preservation Act*
NO_2	nitrogen dioxide
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no observed adverse effects level
NOI	Notice of Intent
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRHP	*National Register of Historic Places*
NSPS	New Source Performance Standards
O_3	ozone
OB/OD	open burning/open detonation
OIPT	Overarching Integrated Product Team
OMB	Office of Management and Budget
ONC	on-site container
OSC	Operations Support Command
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
Ox	oxidation as used in Elchem Ox
PA	programmatic agreement
PAD	Pueblo Army Depot
PAH	polycyclic aromatic hydrocarbon
PAPR	powered air-purifying respirator
PAR	protective action recommendation
PAZ	protective action zone
Pb	lead
PBA	Pine Bluff Arsenal
PBCDF	Pine Bluff Chemical Demilitarization Facility
PCB	polychlorinated biphenyl
PCD	Pueblo Chemical Depot
PCP	pentrachlorophenyl
PDA	Pueblo Depot Activity
PDADA	Pueblo Depot Activity Development Authority

PEPS	plasma energy pyrolysis system
P.L.	Public Law
PM	particulate matter
PM_{10}	coarse, inhalable PM with a mean aerodynamic diameter of 10 μm or less
$PM_{2.5}$	fine, inhalable PM with a mean aerodynamic diameter of 2.5 μm or less
PMACWA	Program Manager Assembled Chemical Weapons Assessment
PMCD	Program Manager for Chemical Demilitarization
POD	Pueblo Ordnance Depot
POM	polycyclic organic matter
PPE	personal protective equipment
PSD	Prevention of Significant Deterioration (of air quality)
PTFMC	Power Train Flexibility Maintenance Center
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
R&D	research and development
RBC	running buffalo clover
RCRA	*Resource Conservation and Recovery Act*
RD&D	research, development, and demonstration
RDF	rotary deactivation furnace
RDX	an explosive
RFP	request for proposal
RI	remedial investigation
RMP	risk management plan
ROD	Record of Decision
ROI	region of influence
SAAQS	State Ambient Air Quality Standards
SAFE	Serving Alabama's Future Environment
SAIC	Science Applications International Corporation
SARA	*Superfund Amendments and Reauthorization Act*
SBCCOM	Soldier and Biological Chemical Command
SCWO	supercritical water oxidation
SDWA	*Safe Drinking Water Act*
SET	solvated electron technology
SHPO	State Historic Preservation Officer
SIA	Southeast Industrial Area
SIC	Standard Industrial Classification
SIP	state implementation plan
SO_2	sulfur dioxide
SR	state route
SVOC	semivolatile organic compound
SWMU	solid waste management unit

TACOM	Tank Automotive Command
TAF	time after functioning
TCE	trichloroethylene
TCLP	Toxicity Characteristic Leaching Procedure
TDG	thiodiglycol, a mustard degradation product
TEAD	Tooele Army Depot
TNT	trinitrotoluene
TOCDF	Tooele Chemical Agent Disposal Facility
TRBP	thermal reduction batch processor
TRI	Toxics Release Inventory
TSCA	*Toxic Substances Control Act*
TSDF	treatment, storage, and disposal facility
TTC	Transportation Technology Center
TW	transpiring wall as used in Neut/GPCR/TW-SCWO
US	U.S. highway
USAEHA	U.S. Army Environmental Hygiene Agency
USC	*United States Code*
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	volatile organic compound
VRM	Visual Resources Management
VX	a nerve agent
Western	Western Area Power Administration
WIPT	Working Integrated Product Team
WVRU	waste volume reduction unit
WWTP	wastewater treatment plant

UNITS OF MEASURE

^{o}C	degree(s) Celsius
cm	centimeter(s)
d	day(s)
dB	decibel(s)
^{o}F	degree(s) Fahrenheit
ft	foot (feet)
ft^3	cubic foot (feet)
g	gram(s)
G	gravity
gal	gallon(s)

GWh	gigawatt-hour(s)
h	hour(s)
ha	hectare(s)
in.	inch(es)
K	kelvin
kg	kilogram(s)
km	kilometer(s)
km^2	square kilometer(s)
kV	kilovolt(s)
L	liter(s)
lb	pound(s)
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
mg	milligram(s)
MHz	megahertz
mi	mile(s)
mi^2	square mile(s)
min	minute(s)
mm	millimeter(s)
mo	month(s)
mph	mile(s) per hour
MWh	megawatt-hour(s)
ng	nanogram(s)
Nm^3	normal cubic meter(s)
ppm	part(s) per million
psi	pound(s) per square inch
psia	pounds per square inch absolute
s	second(s)
tonne(s)	metric ton(s)
wk	week(s)
yd^3	cubic yard(s)
yr	year(s)
μg	microgram(s)
μm	micrometer(s)
μS	microsievert(s)

SUMMARY

S.1 INTRODUCTION

This environmental impact statement (EIS) assesses the U.S. Department of Defense (DOD) proposed action to design, construct, and operate one or more pilot test facilities for assembled chemical weapon (ACW) destruction systems at one or more chemical weapons stockpile installations.

S.1.1 Background

The U.S. Congress has mandated the destruction of the U.S. chemical weapons stockpile (Volume 50, page 1521 of the *United States Code* [50 USC 1521]). The destruction is necessary in order to comply with the *Convention on the Prohibition of the Development, Stockpiling, and Use of Chemical Weapons and Their Destruction*. This convention, commonly known as the Chemical Weapons Convention or CWC, is an international treaty that entered into force on April 29, 1997, the same day it was ratified by the U.S. Congress. The CWC (Article IV, Paragraph 6) established the date for the destruction of chemical weapons stockpiles as 10 years after the entry into force of the convention, or April 29, 2007. The CWC also contains a provision for submitting a request to the Organization for the Prohibition of Chemical Weapons to extend the destruction completion date for five years, until April 29, 2012. As part of the *Omnibus Consolidated Appropriations Act of 1997* (Public Law [P.L.] 104-208), the U.S. Congress established the Assembled Chemical Weapons Assessment Program (ACWA).

S.1.2 Purpose and Need

DOD defines ACWs as munitions containing both chemical agent and energetic material (explosives and propellants) that are stored in the U.S. chemical weapons stockpile. (The agent is in the form of either blister agent [mustard agent H, HD, or HT] or nerve agent [GB, also known as Sarin, or VX]).

The purpose of the proposed action is to pilot test alternative systems that do not involve incineration for destroying the ACWs stockpiled in the United States. Such testing is necessary in order to respond adequately to the *National Defense Appropriations Act for Fiscal Year 1999*. In this legislation, Congress directed the Program Manager of ACWA (PMACWA) to plan for the pilot-scale testing of alternative technologies.

S.1.3 Scope of the EIS

Scope refers to the range of actions, alternatives, and impacts to be considered in an EIS.

The ACW destruction systems analyzed in the EIS are those that have completed successfully the demonstration phase of development: neutralization/biological treatment (Neut/Bio), neutralization/supercritical water oxidation (Neut/SCWO), neutralization/gas-phase chemical reduction/transpiring wall supercritical water oxidation(Neut/GPCR/TW-SCWO), and electrochemical oxidation (Elchem Ox). Potential locations for pilot testing include Anniston Army Depot (ANAD) in Alabama, Pine Bluff Arsenal (PBA) in Arkansas, Pueblo Chemical Depot (PCD) in Colorado, and Blue Grass Army Dept (BGAD) in Kentucky (Figure S.1-1).

The scope of the EIS includes the impacts from constructing and operating each of the ACW destruction systems successfully demonstrated by ACWA as a pilot test at each of the four installations under consideration. These activities could occur simultaneously with any existing chemical demilitarization programs and schedules at these installations. Appropriate ACW destruction systems could be piloted at more than one installation. Whether a particular system is appropriate for initial consideration at an installation is determined by the system's applicability to the components of the installation's stockpile. The rationale used to arrive at the EIS alternatives is described in more detail in Chapter 2 of the EIS. At ANAD and BGAD, all four systems are considered. At PBA, all technologies are considered except Neut/Bio, because this installation has no ACWs with blister agent. At PCD, which has only blister agent, the technologies considered are limited by P.L. 106-398 to those demonstrated by ACWA on or before May 1, 2000. These are Neut/Bio and Neut/SCWO. This EIS also addresses a no action alternative: continued storage at the stockpile installations until a destruction system can be constructed and implemented (PCD and BGAD) or until the ACW stockpile can be destroyed at the baseline incineration facility already being used for other demilitarization activities (ANAD and PBA). The process used to arrive at the proposed action and alternative systems and installations is described in more detail in Chapter 2. Table S.1-1 links the alternative destruction systems proposed for pilot testing to the types of agent at each installation.

The substantive impact areas that are considered for each installation include the following broad categories: land use, infrastructure, waste management, air quality, noise, human health and safety, visual resources, geology and soils, water use and quality, biological resources, cultural resources, socioeconomics, environmental justice, agriculture, accidents, and cumulative effects. Discussions of the affected environment and the impact of facility construction and routine operation for each installation are found in Chapters 4 (ANAD), 5 (PBA), 6 (PCD), and 7 (BGAD) of the EIS.

Since the eventual size (throughput) of the pilot facility has not been determined, for purposes of the EIS analysis, a full-sized facility is assumed. A full-sized facility is considered to be comparable to the incineration facilities being constructed by the U.S. Army Program Manager for Chemical Demilitarization (PMCD) at ANAD and PBA. The EIS also assumes that

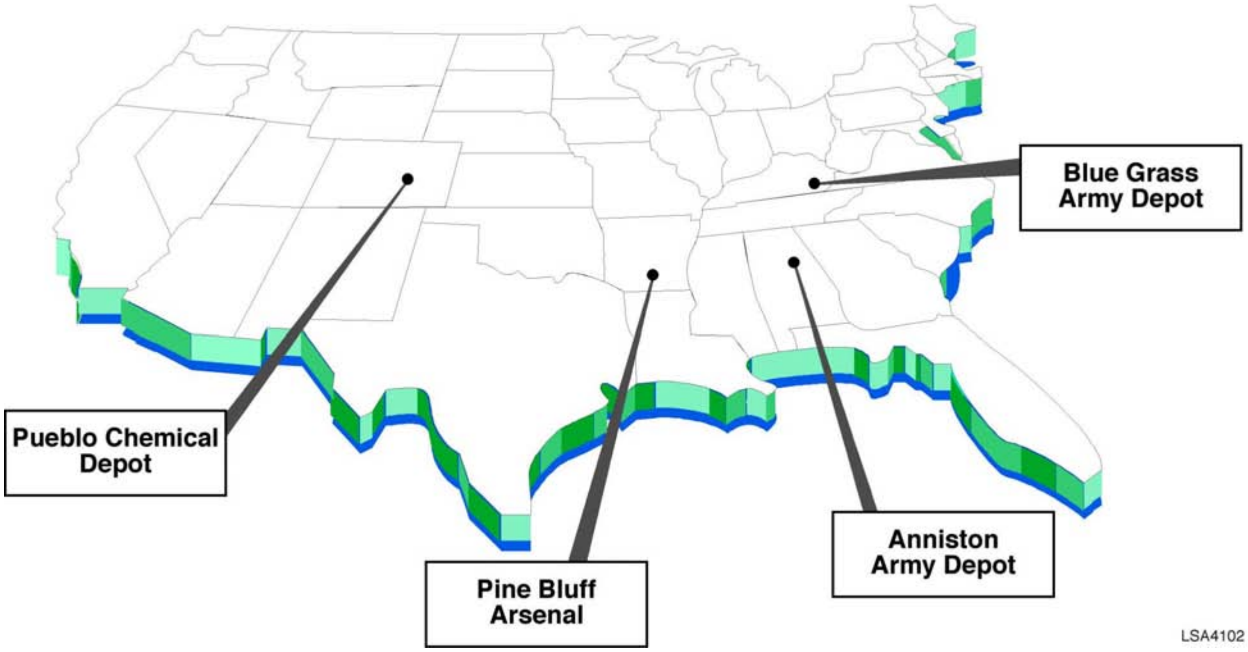

FIGURE S.1-1 Locations of the U.S. Army's Stockpile of Lethal Unitary Chemical Munitions Included in the EIS

TABLE S.1-1 Applicability of Alternative Destruction Systems to Installation Stockpiles[a]

Installation and Agent	Neut/Bio	Neut/SCWO	Neut/GPCR/ TW-SCWO	Elchem Ox
Anniston Army Depot				
Blister	Yes	Yes	Yes	Yes
Nerve	No	Yes	Yes	Yes
Pine Bluff Arsenal				
Blister[b]	None	None	None	None
Nerve	No	Yes	Yes	Yes
Pueblo Chemical Depot				
Blister	Yes	Yes	NC	NC
Nerve	None	None	None	None
Blue Grass Army Depot				
Blister	Yes	Yes	Yes	Yes
Nerve	No	Yes	Yes	Yes

[a] Yes = There are ACWs with this agent at this installation. None = There are no ACWs with this agent at this installation. No = The technology is not applicable to this agent. NC = This technology is not considered at this installation on the basis of P.L. 106-398.

[b] PBA does have bulk quantities of blister agent, but pilot testing would not apply to bulk agent.

the pilot tests will operate at design throughputs. The design throughput is the maximum capacity of the overall destruction system. These parameters allow for the assessment of a reasonable worst-case scenario. The amount of time assumed for facility construction is about 34 months, and up to 36 months is assumed for facility operations.

For the EIS analysis, it would be premature to assume that a proposed technology would be used to destroy the entire inventory at an installation. Any use of a proposed technology beyond pilot testing is beyond the scope of the EIS. For this reason, closure and decommissioning of pilot test facilities are also addressed in the EIS scope.

S.1.4 Public Involvement

S.1.4.1 General Public Involvement

DOD has invited full public participation and has promoted open communication with the public in order to facilitate better decision making. All persons and organizations that have a potential interest in the proposed action, including minority, low-income, disadvantaged, and Native American groups, have been urged to participate. The scoping and public involvement processes have helped DOD focus the EIS on issues of importance to the public and other interested agencies and organizations.

The public participation process for this EIS is guided by (1) the President's Council on Environmental Quality (CEQ) implementing regulations; (2) DOD Directive 6050.1, *Environmental Effects in the United States of DOD Actions*; and (3) Army Regulation (AR) 200-2, *Environmental Effects of Army Actions.* These three regulations provide for public participation and notification through the following: (1) the notice of intent (NOI), (2) public scoping, (3) public review of the draft EIS (DEIS), (4) public meetings on the DEIS, (5) public release of the final EIS (FEIS) and a 30-day waiting period, and (6) publication of the Record of Decision (ROD). These steps are discussed in Sections S.1.4.3 through S.1.4.6.

S.1.4.2 ACWA Dialogue

In addition to receiving guidance from the general public participation process established by CEQ implementing regulations, DOD has instituted the ACWA Dialogue to foster additional public participation opportunities in areas such as perspectives on the ACWA Program, development of ACWA technologies, and the *National Environmental Policy Act* (NEPA) process. The goal of the Dialogue is to draw on a wide range of experience, perspectives, and expertise to help identify and demonstrate safe, effective, and broadly acceptable methods for the destruction of chemical munitions and the disposal of the resulting materials or waste streams.

Participants in the Dialogue include representatives of affected communities, state regulatory and tribal representatives, U.S. Environmental Protection Agency (EPA) staff, DOD staff from affected installations and headquarters, representatives from national citizens' groups that regularly work on the chemical demilitarization issue, and other concerned entities.

S.1.4.3 Notice of Intent and Public Scoping

The NOI for the EIS was published in the April 14, 2000, issue of the *Federal Register* (Attachment 1 in the FEIS). This was followed by a 45-day scoping period. Public scoping meetings were held in May 2000 in Pueblo, Colorado; Pine Bluff, Arkansas; Anniston, Alabama; Richmond, Kentucky; and Washington, D.C. The written comments obtained through this process were taken into consideration in developing the scope of the EIS.

S.1.4.4 Draft Environmental Impact Statement (DEIS)

Copies of the DEIS were made available for review and comment. A Notice of Availability was published in the *Federal Register* on May 9, 2001, to notify the public of the DEIS release. A 45-calendar-day comment period (starting on the date of publication of the notice of availability [NOA] in the *Federal Register*) was established to give all agencies, organizations, and individuals the opportunity to comment on the DEIS. The comment period was subsequently extended by DOD for 45 days in response to public request, and it ended on August 9, 2001. During the comment period, DOD collected written comments and held public meetings at each of the four installations considered in the EIS.

S.1.4.5 Final Environmental Impact Statement (FEIS)

DOD assessed and considered the comments on the DEIS provided by agencies, organizations, and individuals. This FEIS incorporates changes suggested in these comments, as appropriate, and contains written responses to the comments received during the DEIS review period. Copies of the comments and their responses are provided in Volume 2 of this FEIS. The NOA for the FEIS was published in the *Federal Register* and in local and regional newspapers to inform the public of the FEIS release. The notices also identified where the FEIS would be available and informed people how they could obtain copies.

S.1.4.6 Record of Decision (ROD)

At least 30 days after the publication of the FEIS NOA, a ROD will be signed and published in the *Federal Register* by the Army. The ROD will describe DOD's decision regarding the proposed action, identify potential problems, explain any uncertainties, and identify the type and extent of impacts that might occur. The ROD will also describe the actions to be taken by DOD to reduce or mitigate any significant adverse impacts associated with its decision.

S.2 PROPOSED ACTION

DOD proposes to design, construct, and operate one or more pilot test facilities for ACW destruction systems at one or more chemical weapons stockpile installations. The action would occur simultaneously with any existing chemical weapons destruction or demilitarization programs and schedules at these installations. The ACWA pilot test facilities are further described in Chapter 3 of the EIS.

S.3 DESCRIPTION OF ALTERNATIVE DESTRUCTION SYSTEMS AND NO ACTION

The ACWs to be destroyed exist in a variety of forms, each with a different combination of components. All consist of a metal casing, within which there is some type of chemical agent. By definition, ACWs also contain some type of explosive (known as a burster) for chemical agent dispersal. This burster may be accompanied by a fuze (an initiating mechanism) and a supplemental charge.

Artillery projectiles, mortar projectiles, rockets, and land mines are the major forms of ACWs (Figure S.3-1). The chemical agents contained in these forms fall into two main categories: nerve agents and chemical blister agents. GB (Sarin) and VX are the two types of nerve agents in ACWs. Three closely related types of blister agents are used in ACWs: the mustard agents H, HD, and HT. Table S.3-1 lists the types and locations of the ACWs that are considered in the EIS and the types of components that may be associated with each type of munition. Any single ACW contains one type of agent and one or more types of energetic material (explosives and propellants). Each stockpile location has a different combination of ACW types.

Four systems for ACW destruction are being considered for pilot testing: neutralization/ biotreatment (Neut/Bio), neutralization/supercritical water oxidation (Neut/SCWO), neutralization/gas-phase chemical reduction/transpiring wall supercritical water oxidation (Neut/GPCR/TW-SCWO), and electrochemical oxidation (ElChem Ox). Each of the technology systems being considered for pilot testing is designed to treat four categories of material: agent, energetics, metal parts, and dunnage. These four systems are described briefly below and in greater detail in Chapter 3 of the EIS.

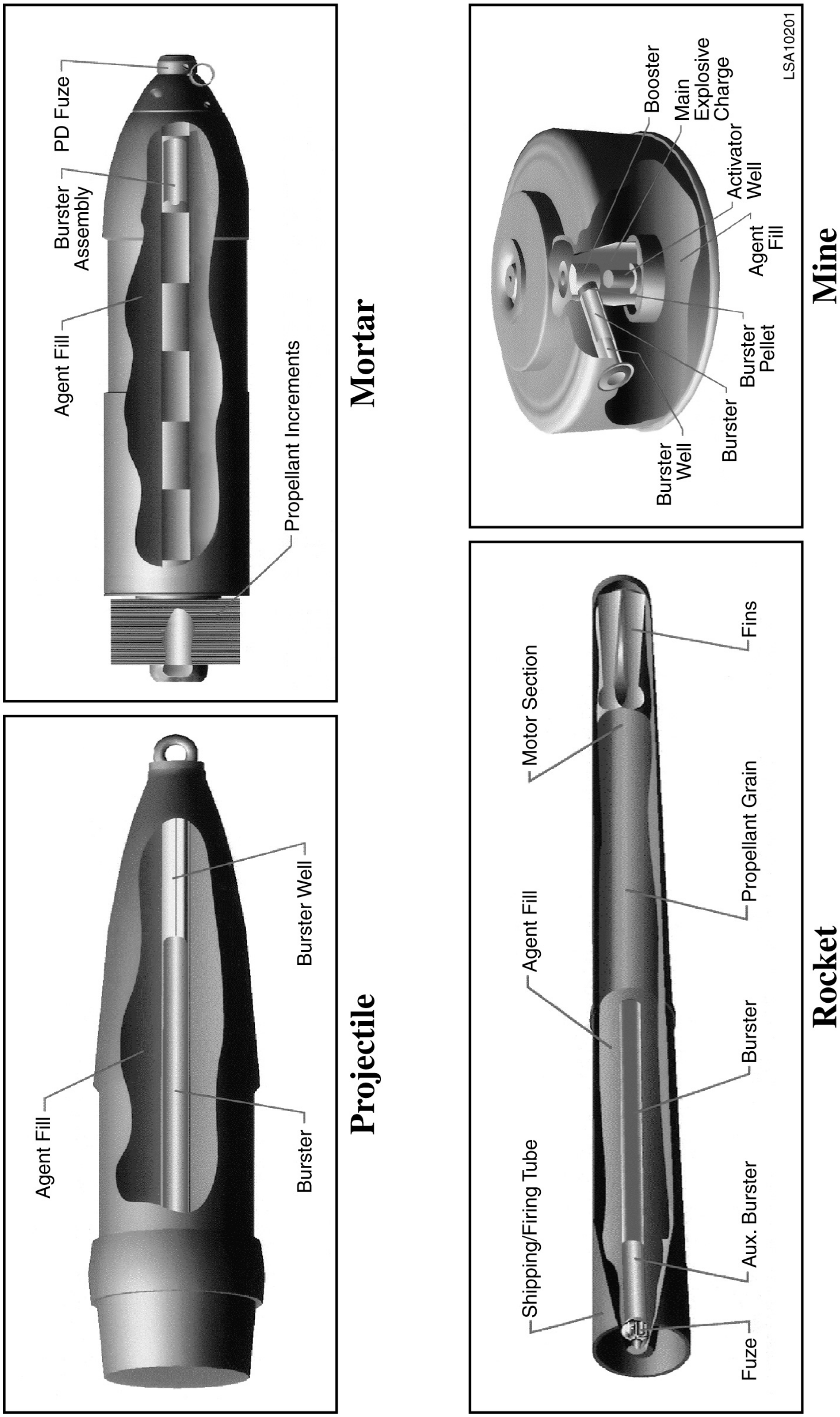

FIGURE S.3-1 General Diagrams of a Projectile, Mortar, Rocket, and Mine

TABLE S.3-1 Agent, Burster, and Propellant Types That May Be Associated with Each Munition Type

ACW Form and Munition Type	Agent Type	Burster and Supplemental Charge Type	Fuze[a]	Propellant[b]	Applicable Location[c]
155-mm projectiles M121, M121A1, M104, M110, M122	GB, VX, H, HD	Composition B4, tetrytol, TNT	No	No	ANAD, PCD,[d] BGAD
105-mm projectiles M60, M360	HD, GB	Tetrytol, Composition B4	Yes	No	ANAD, PCD[d]
105-mm cartridges M60, M360	HD, GB	Tetrytol, Composition B4	Yes	Yes	ANAD, PCD[d]
8-in. projectiles M426	GB, VX	Composition B4, TNT	No	No	ANAD, BGAD
4.2-in. mortars M2, M2A1	HD, HT	Tetryl, tetrytol	Yes	Yes	ANAD, PCD[d]
Rockets M55, M56[e]	GB, VX	Composition B4, tetrytol	Yes	Yes[e]	ANAD, PBA, BGAD
Land mines M23	VX	Composition A5, Composition B4, tetryl	Yes	No	ANAD, PBA

[a] Fuzes are mechanical devices that trigger the detonation of a small explosive charge (commonly lead azide), which, in turn, detonates the larger supplemental and burster charges.

[b] Propelling charges are predominately nitrocellulose compounds with nitroglycerin added.

[c] Only for those locations included in this EIS.

[d] Only the mustard agents HD and HT are contained in munitions at PCD.

[e] The M56 is a rocket warhead without a rocket motor (i.e., propellant) attached.

Source: U.S. Army (1988).

S.3.1 Neutralization Followed by Biological Treatment (Figure S.3-2)

This alternative process would disassemble the munitions to access the agent and energetics and subsequently neutralize the blister agent and energetics with water and caustic chemicals. The products of neutralization would then be destroyed in a biological treatment (i.e., biotreatment) process operated at near ambient temperatures and pressures. Air emissions would be passed through an air pollution control process. Recovered metal parts and dunnage would be

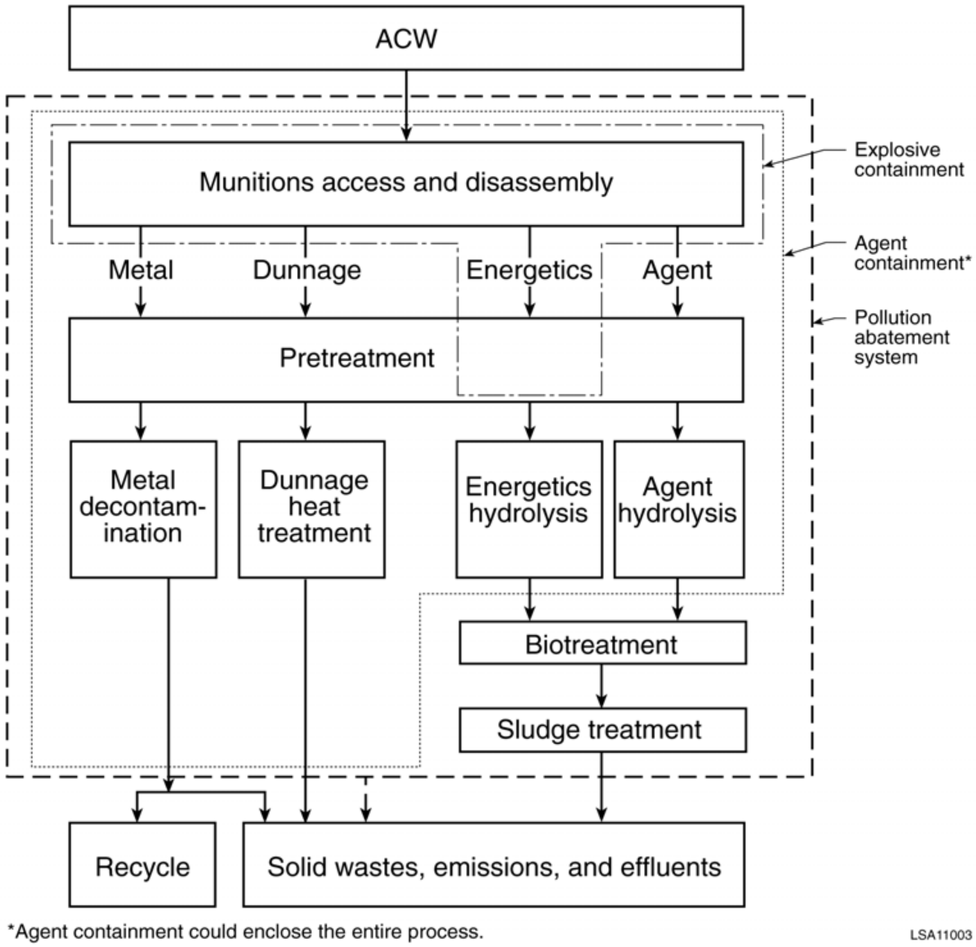

FIGURE S.3-2 Neutralization/Biotreatment System

treated at high temperatures. Effluents could be held and tested before being released to pollution control processes. Process water would be reused, and remaining solid residues would be disposed of in an appropriate landfill. The PMACWA considers this a viable solution for the destruction of ACWs containing mustard agents but not for ACWs containing nerve agents (PMACWA 1999). The ACW destruction system based on this technology is described in greater detail in Chapter 3 of the EIS.

S.3.2 Neutralization Followed by Supercritical Water Oxidation (Figure S.3-3)

This alternative would disassemble the munitions to access the agent and the energetics. They would then be neutralized with water and caustic chemicals. The products of the neutralization and the shredded dunnage would then be destroyed by the SCWO process. SCWO mineralizes the resulting chemicals at temperatures and pressures above the critical point of water (705.2°F and 3,204.6 pounds per square inch absolute [psia]). Recovered metal parts

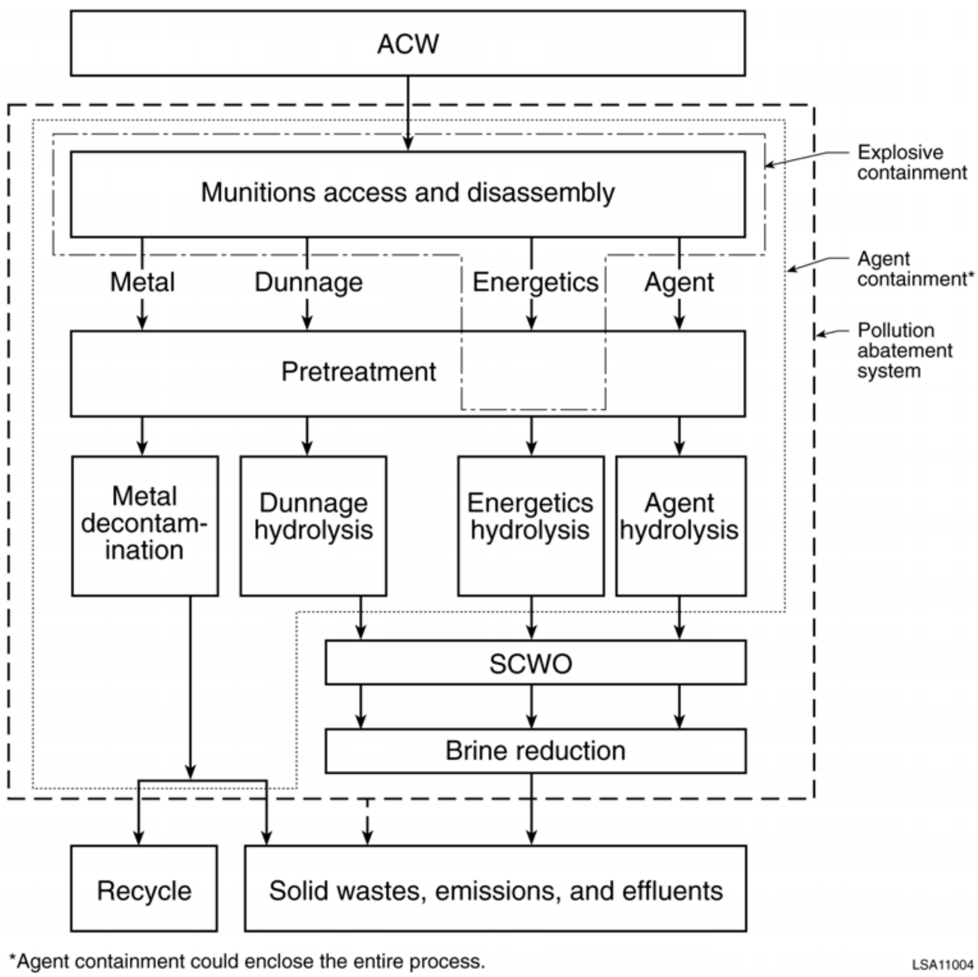

FIGURE S.3-3 Neutralization/SCWO System

would be washed with caustic chemicals and treated at high temperatures. Effluents could be held and tested before being released to pollution control processes. Process water would be reused, and remaining solid residues would be disposed of in an appropriate landfill. The PMACWA considers this technology a viable solution for the destruction of all ACWs (PMACWA 1999).

S.3.3 Neutralization Followed by Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation (Figure S.3-4)

The Neut/GPCR/TW-SCWO process consists of the neutralization of agents and energetics, gas-phase chemical reduction (GPCR) of solids and gasses, and treatment of hydrolysate using transpiring wall (TW) supercritical water oxidation (SCWO). As envisioned, the system would use the baseline reverse assembly process or a modification of this process for

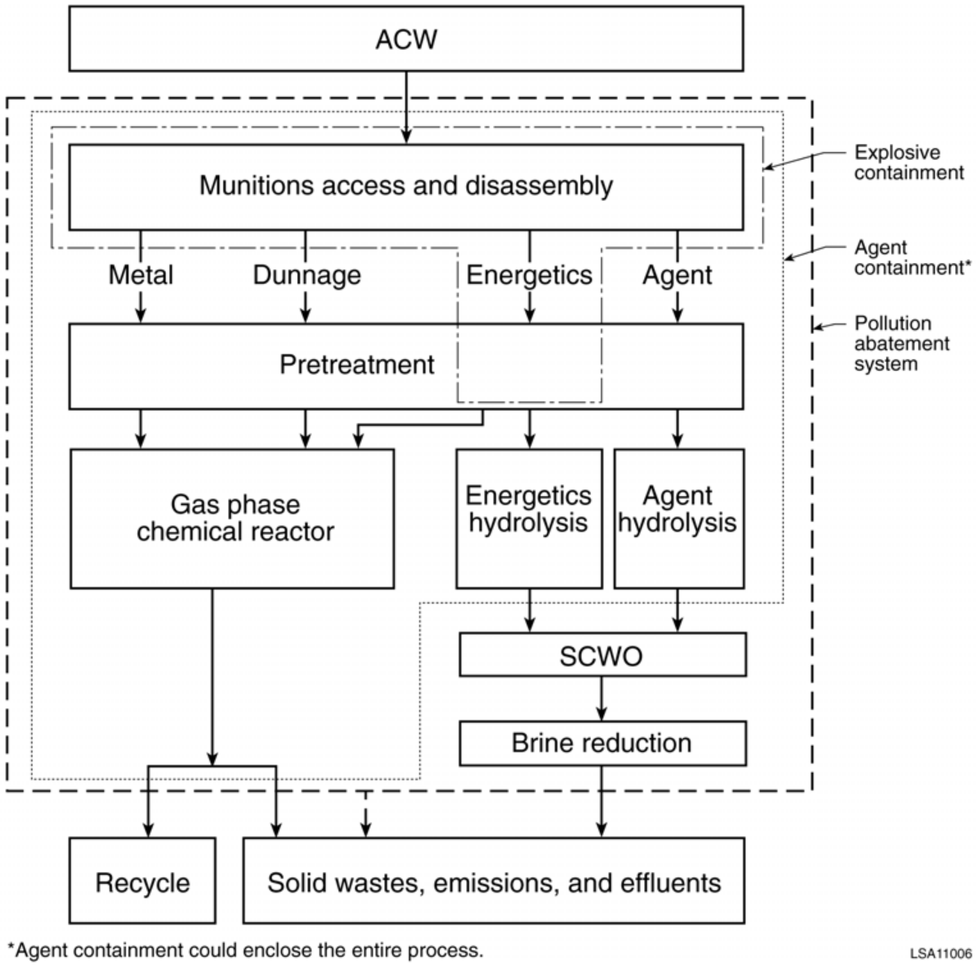

FIGURE S.3-4 Neutralization/GPCR/TW-SCWO System

ACW disassembly, after which materials would be prepared for neutralization. Agents and energetics would be neutralized in separate hydrolysis systems by using a caustic solution for nerve agent and energetics and by using water followed by caustic for mustard agent.

To decrease other hazards and chemical compounds of concern that might remain after neutralization, the agent and energetic hydrolysates would be combined and treated by SCWO. This process takes place in a vessel with a transpiring wall through which water would be continuously pumped to prevent corrosion and the buildup of solids. Metal parts would be treated by caustic hydrolysis and washed. Then metals parts and dunnage would be thermally treated in a hydrogen and steam atmosphere to ensure that agents and energetics were destroyed. The PMACWA considers this technology to be a viable solution for the destruction of all ACWs (PMACWA 2001).

S.3.4 Electrochemical Oxidation (Figure S.3.5)

The electrochemical oxidation system (SILVER II™) employs silver nitrate in a concentrated nitric acid bath to which electric current is applied to oxidize organic substances. Thermal decontamination is used for metal parts and dunnage. As currently envisioned, the system would use the baseline reverse assembly process or a modification of this process for ACW disassembly. After disassembly, materials would be prepared for treatment. To completely eliminate other hazards and chemical compounds of concern, agents and energetics would be treated in separate oxidation systems. Nitrogen oxides formed as a result of the oxidation process would be converted to nitric acid. Dunnage would be size-reduced and then would be thermally treated. Metals parts also would be thermally treated to ensure that agents and energetics were removed. The PMACWA considers this technology a viable solution for the destruction of all forms of ACWs (PMACWA 2001).

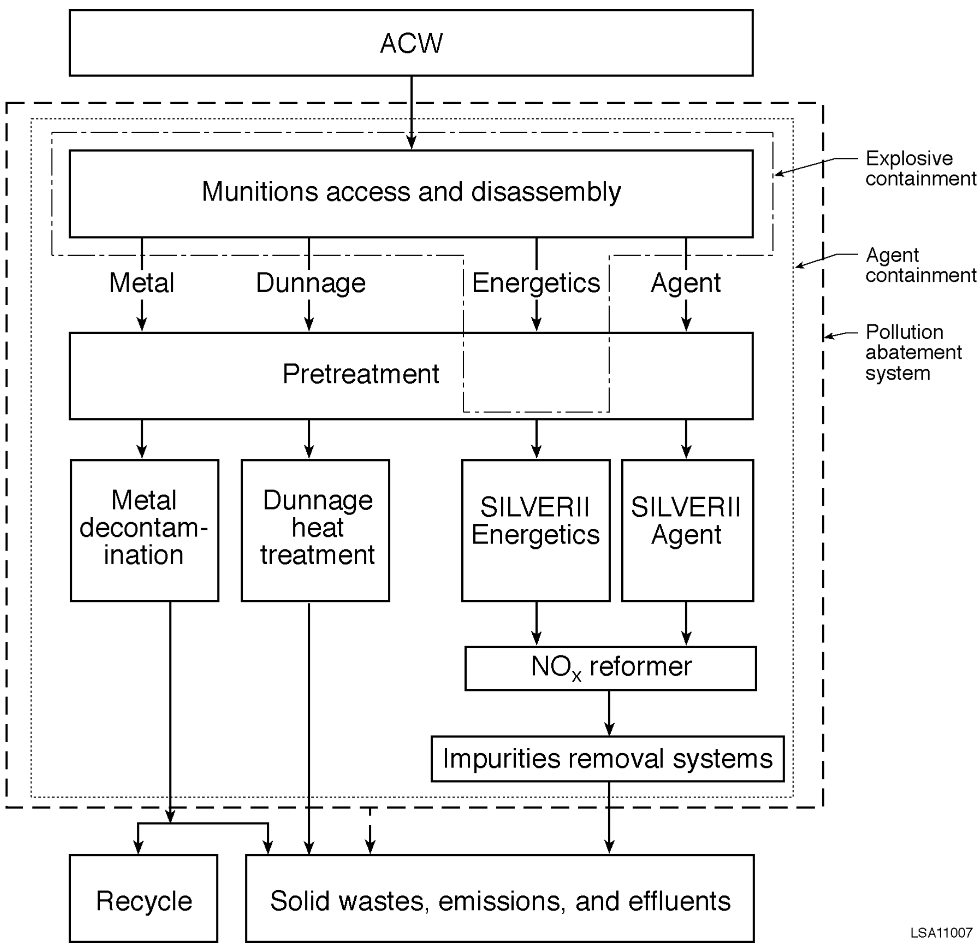

FIGURE S.3-5 Electrochemical Oxidation System

S.3.5 No Action Alternative

If the PMACWA decides not to proceed with the design, construction, and operation of a pilot facility at an installation, no ACWA pilot plant facilities would be constructed or operated there. In that situation, the portion of the ACW stockpile that would be used for pilot testing would remain in storage, as would the rest of the ACW stockpile. Under either the proposed action or the no action alternative, ACWs would continue to be stored until their destruction. The means of destruction available for the ACW stockpile would depend on the completion of construction of incinerators at ANAD and PBA and on the results from the evaluation of alternatives being included in the PMCD EISs for PCD and BGAD. Munitions being stored until their destruction would remain in their existing storage location and be maintained under existing conditions. It is assumed that the current munitions management procedures would continue to be followed and that the munitions would be safeguarded against any release to the environment.

S.4 ANNISTON ARMY DEPOT

A more detailed discussion of the affected environment and potential consequences from the proposed action and no action at ANAD is provided in Chapter 4 of the EIS.

S.4.1 Affected Environment

ANAD is located in a rural area of northeastern Alabama in Calhoun County, about 90 miles west of Atlanta, Georgia; 49 miles east of Birmingham, Alabama; and about 10 miles west of the city of Anniston. ANAD covers 15,279 acres of land.

For the EIS, three candidate locations for an ACWA pilot test facility were selected for assessment: Area A, the current location of Building 88 between C-Block and G-Block; Area B, adjacent and to the west of the incinerator presently under construction; and Area C, to the east of Elwood Road close to the center of ANAD. Figure S.4-1 locates these areas on the installation. The following describes ANAD in terms of the affected environment for each impact area.

Land Use: Current land use at ANAD includes industrial and related activities primarily associated with the maintenance of combat vehicles. The most dominant feature of the installation is more than 11,000 acres of woodland and 5 acres of lakes and streams. Surrounding land use is primarily rural, with land cover dominated by forest.

Infrastructure: ANAD purchases power from the Alabama Power Company. The incinerator is served by a 44-kV line and a substation. A main gas pipeline supplies natural gas from Alagasco. ANAD purchases water from the City of Anniston; the water distribution system is currently being upgraded to support the incinerator. ANAD treats domestic sewage at an existing sewage treatment plant that also is being upgraded.

Waste Management: ANAD generates a variety of wastes associated with its three missions: (1) vehicle maintenance, (2) munitions management, and (3) hazardous material management. Most of these wastes are packaged and shipped off post to appropriate treatment and disposal facilities. ANAD also generates a variety of nonhazardous wastes that are collected and disposed of off post in a *Resource Conservation and Recovery Act* (RCRA) Subtitle D landfill or are recycled. Sanitary wastes are treated in an on-site sewage treatment plant.

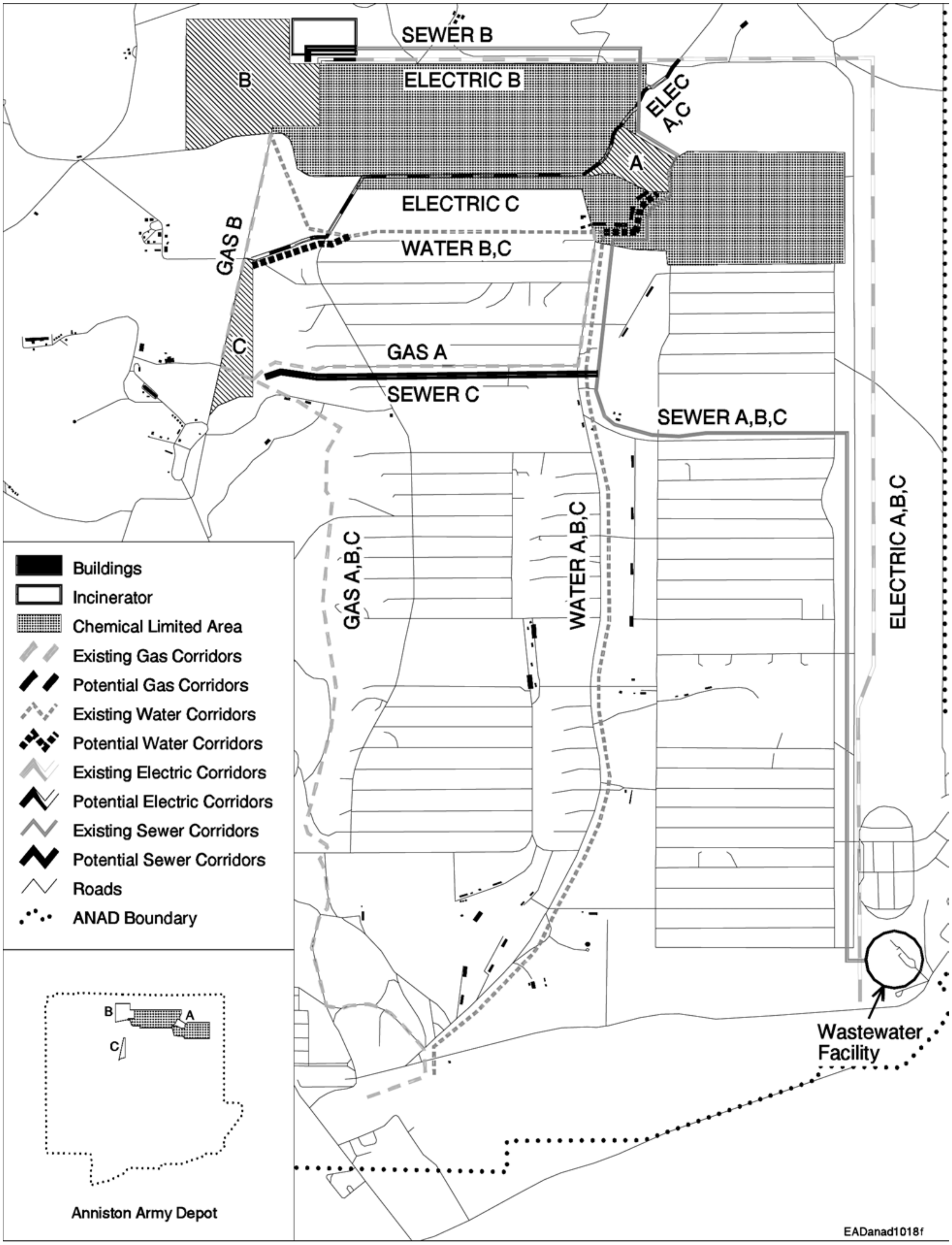

FIGURE S.4-1 Assessment Areas at ANAD

Air Quality: The climate of the surrounding area is temperate and characterized as subtropical. The existing sources of criteria pollutant emissions and volatile organic compounds (VOCs) at ANAD include boilers, degreasing operations, paint booths, fuel storage and dispensing, and open burning/open detonation. The combined emissions are large enough for ANAD to be designated as a major stationary source. Calhoun County complies with all National Ambient Air Quality Standards (NAAQS). Concentrations of particulate matter that is 2.5 micrometers or less in diameter ($PM_{2.5}$), however, are close to the proposed standard. Under Title V of the *Clean Air Act*, ANAD is classified as a major source emitter for VOCs.

Human Health and Safety: No existing contamination has been identified at areas being considered for an ACWA pilot test facility.

Noise: Most areas surrounding ANAD are suitable for noise-sensitive land uses (e.g., residential). No noise-sensitive receptors are located near the installation, and the nearest residence is located about 1.2 miles east of the installation. There are no off-post noise problems associated with on-post activities. The dense forests within and around ANAD are likely to decrease noise levels.

Visual Resources: The landscape is characterized by woodlots or forests on low mountains and hills with scattered open land areas. Industrial and administrative development is confined mostly to the southern and southeastern portions of the post.

Geology and Soils: In the Anniston area, bedrock consists of Cambrian to Ordovician-age clastic and carbonate rocks composed of sandstones, shales, cherty limestones, dolomites, and quartzites. Numerous faults are present in the ANAD vicinity, but none of them are considered capable of producing an earthquake.

Water: The quality of water in Calhoun County is generally good, and approximately 90% of the water consumed in the county is groundwater. The majority of the municipal water is groundwater supplied by Coldwater Spring, which also supplies ANAD. ANAD is located in the Coosa River Basin; water quality in the river is generally good and is satisfactory for domestic, agricultural, and most industrial uses. The proposed areas for the ACWA facility are located above the floodplain, except for 12 acres in Area A.

Biological Resources: ANAD lies within the Central Appalachian Ridges and Valleys Ecoregion, which is characterized by a mosaic of agricultural land and woodland or forest on low mountain hills. ANAD is predominantly undeveloped; 75% of the installation is unimproved.

Terrestrial communities in the vicinity consist primarily of broadleaf deciduous forest and pine forest. Tennessee yellow-eyed grass is a federal endangered species; eight colonies occur in Alabama, and two of these populations are on ANAD. Approximately 112 acres of wetland occur at ANAD.

Cultural Resources: Because ANAD presented few opportunities for permanent settlement, and because there is significant history of ground disturbance, the potential for archaeological resources is limited.

Socioeconomics: The region of influence (ROI) includes Calhoun County, Etowah County, and Talladega County. More than 90% of ANAD workers currently reside in these counties. The population of the ROI in 2000 was 296,000. From 1990 to 2000, the population grew slightly. The economy of the ROI is dominated by trade and services.

Environmental Justice: The 2000 census recorded that 22.0% of the residents of Calhoun County were minority, and the 1990 census indicated that 15.7% of the county residents were below the poverty level. The latter level was higher than that for the United States as a whole.

Agriculture: The agricultural ROI surrounding the installation contains 4.7 million acres, of which 20% were farmland in 1997. There were 6,500 farms in the ROI, of which about one-third were operated by full-time farmers. Agriculture was traditionally only a moderately significant local source of employment in the ROI, and its importance declined somewhat during the 1990s.

S.4.2 Consequences of the Proposed Action and No Action

Table S.4-1 summarizes the impacts associated with the location of each of the four technologies at ANAD and those associated with the decision to take no action. For almost all impact areas, the consequences associated with construction and normal operations for the technologies would be the same among the four technologies and no action. Some differences in impacts would occur in the areas of utility requirements, water use, human health, and socioeconomics. There would be no significant impacts in any of the impact areas.

TABLE S.4-1 ANAD Summary Table[a]

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/ Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Land use	All systems: Land requirements for the facility and additional infrastructure could total 30 to 77 acres. Impacts on and off the installation would be negligible because proposed activities would take place in the Chemical Limited Area. Normal operations would be consistent with installation use and would not significantly adversely affect other continuing installation operations.				No impacts
Infrastructure					
Electric power supply	All systems: Current infrastructure would not be able to meet the needs for the pilot facility. New service connections would have to be added, and a new substation would need to be constructed. The new power supply infrastructure would be independent of the other ANAD power supply.				No impacts.
	36 GWh/yr would be required.	60 GWh/yr would be required.	26 GWh/yr would be required.	105 GWh/yr would be required.	
Natural gas and fuel oil supply	All systems: The current infrastructure would be likely to meet the needs, although new pipelines might be needed to extend the system The fuel oil requirement is 48,000 gal/yr.				No impacts.
	50 million scf/yr of natural gas would be required.	69 million scf/yr of natural gas would be required.	130 million scf/yr of natural gas would be required.	48 million scf/yr of natural gas would be required.	
Water supply and use					
Construction	All systems: Construction would require water for a variety of uses. These needs have not been quantified; however, estimated use would be small compared with existing capacity. The existing system could meet these needs.				No impacts since there would be no construction.
Operations	All systems: The existing water supply system would be sufficient if pipeline extensions were built. The existing system would not be adequate to meet peak water demands for emergencies. About 7.5 million gal/yr of sanitary sewage would be produced. Current sewage treatment capacity would need to be expanded.				No impacts.
	7 million gal/yr of process water required; 6.4 million gal/yr of potable water required.	8.3 million gal/yr of process water required; 6.4 million gal/yr of potable water required.	18 million gal/yr of process water required; 6.4 million gal/yr of potable water required.	1 million gal/yr of process water required; 6.4 million gal/yr of potable water required.	

TABLE S.4-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/ Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Waste management and facilities					
Construction	All systems: No changes in ANAD waste management systems would be needed for management and disposal of these construction wastes. Construction would generate solid and liquid nonhazardous waste.				No impacts since there would be no construction.
	It would also generate 80 yd^3 of solid hazardous waste and 32,000 gal of liquid hazardous waste.	It would also generate 80 yd^3 of solid hazardous waste and 34,000 gal of liquid hazardous waste.	It would also generate 90 yd^3 of hazardous solid waste and 36,000 gal of liquid hazardous waste.	It would also generate 100 yd^3 of hazardous solid waste and 39,000 gal of liquid hazardous waste.	
Operations	All systems: Hazardous and nonhazardous solid wastes would be generated during the treatment processes. These solid wastes would be collected and disposed of off post at appropriately permitted facilities. Quantities of brine salts produced by all technologies would vary, depending on the agent to be destroyed. Nonprocess solid wastes could be contaminated with agent and would also require treatment. If these treatment residual wastes are defined as RCRA hazardous waste, the estimated volume of hazardous waste would be larger, and additional treatment might be necessary before disposal. Process and nonprocess liquid wastes would be recycled within the treatment process. The only liquid waste associated with ACWA facilities that would be discharged would be domestic sanitary wastewater.				No impacts.

TABLE S.4-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/ Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Operations (Cont.)	Treatment of ACWs would produce 970 tons of residual brine, which is a hazardous waste, and 550 tons of hazardous biomass. No significant impacts are expected.	Treatment of ACWs would produce brine salts ranging from 1,000 to 1,900 tons. No significant impacts are expected.	The TW-SCWO system and GPCR unit would produce hazardous salts as waste. The total salts produced would range from 1,000 to 2,200 tons. No significant impacts are expected.	Silver chloride salt cake would be produced and sent for silver recovery. The remaining salts, solids, and other impurities would be disposed of as hazardous waste. The amount would vary from 250 to 1,200 tons). Small amounts of dilute nitric acid would be neutralized and disposed of as a hazardous liquid. Treatment of ACWs would result in additional residual brine waste of 110 to 170 tons.	
Air quality — criteria pollutants					
Construction	All systems: Emissions of criteria pollutants would include fugitive dust from earth-moving activities and exhaust emissions from equipment and vehicles. Exhaust emissions would be relatively small when compared with fugitive dust. PM_{10} and $PM_{2.5}$ concentration increments would be relatively small fractions of applicable NAAQS. The total 24-hour and annual concentrations of $PM_{2.5}$ (background and incremental) would be below but close to applicable NAAQS as a result of high background concentrations.				No impacts since there would be no construction.
Operations	All systems: Estimated maximum concentration increments would contribute less than 9% of applicable NAAQS for all pollutants. Except for 8-hour CO and $PM_{2.5}$, total concentrations of criteria pollutants (background plus incremental) would be less than or equal to 53% of NAAQS. CO and $PM_{2.5}$ would be close to, but still below, standards because of high background levels.				Impacts on air quality expected to be minimal.

TABLE S.4-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/ Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Air quality — toxic air pollutants					
Construction	All systems: Impacts would be negligible. Minor emissions would result from construction equipment.				No impacts since there would be no construction.
Operations	All systems: <u>Routine operations</u>: Pilot facility would not be a major source of HAP emissions and would not fall under any of the source categories regulated by the EPA under NESHAP. <u>Fluctuating operations</u>: No agent emissions would be expected. Modeling of worst-case emissions resulted in estimated ambient agent concentrations of less than 1% of the allowable concentrations for general population exposure established by the CDC.				No impacts.
Human health and safety — routine operations					
Construction	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 18	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 23	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 23	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 24	No impacts since there would be no construction.
	All systems: <u>Other on-post workers</u>: There would be no adverse health impacts. <u>Off-post public</u>: There would be no adverse health impacts.				
Operations	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 31	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 31	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 31	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated Annual injuries: 31	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 4

TABLE S.4-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/ Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Operations (cont.)	All systems: Other on-post workers: Estimated hazard indices and carcinogenic risks from inhalation of toxic air pollutants are well below benchmarks considered representative of negligible risk levels. No agent emissions are expected. Even under hypothetical worst-case emission levels, the maximum estimated on-post concentration would be less than 1% of the allowable concentration for general public exposures. The maximum estimated incremental cancer risk from the inhalation of hypothetical mustard emissions is well below the benchmark risk value. Off-post public: Estimated hazard indices and carcinogenic risks from inhalation of toxic air pollutants are well below benchmarks considered representative of negligible risk levels. No agent emissions are expected, but even under hypothetical worst-case emission levels, the maximum estimated off-post concentration would be less than 1% of the allowable concentration for general public exposures. The maximum estimated incremental cancer risk from the inhalation of hypothetical mustard emissions is well below the benchmark risk value.				No impacts.
Noise					
Construction	All systems: Construction activities would result in maximum estimated noise levels of approximately 48 dBA at the installation boundary closest to a proposed construction site. This level is below the EPA guideline of 55 dBA for residential zones. Potential noise impacts are expected to be minor to negligible at the nearest residence.				No impacts since there would be no construction.
Operations	All systems: Noise levels generated by operation should have negligible impacts on the residence located nearest to the proposed facility and would be well within EPA guideline limits for residential areas.				Levels of noise generated by current stockpile maintenance activities would be part of the background noise levels.
Visual resources					
Construction	All systems: No effect on visual character.				No impacts since there would be no construction.
Operations	All systems: ACWA facility would be consistent with surrounding land uses and would not adversely affect visual character. Operation would not create significant visible emissions.				No impacts.

TABLE S.4-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/ Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Geology and soils					
Construction	All systems: Approximately 25 acres of ground could be disturbed to some degree from construction of the pilot facility. Development of utilities could cause additional soil disturbance. This could result in increased potential for erosion, which, in turn, could affect surface water bodies and biological resources. Best management practices would be used to minimize potential for erosion.				No impacts since there would be no construction.
Operations	All systems: Concentrations of contaminants from operations would be so low that they would have no impact on surface soils.				No impacts.
Groundwater					
Construction	All systems: Impacts would be none to negligible, and if impacts did occur, they would be temporary and short-lived. Water use during construction is estimated to be 7 million gal over three years. This is about 0.02% of the minimum yield of Coldwater Spring and would have a negligible impact on the water supply from the spring. Impacts on the groundwater aquifer would also be negligible. Construction would generate 4.5 million gal of sanitary waste over the same period of time.				No impacts since there would be no construction.
Operations	Use of 14 million gal/yr is about 0.04% of the minimum flow of Coldwater Spring.	Use of 15 million gal/yr is slightly more than 0.04% of the minimum flow of Coldwater Spring.	Use of 24 million gal/yr is slightly more than 0.2% of the minimum flow of Coldwater Spring.	Use of slightly more than 7 million gal/yr is about 0.02% of the minimum flow of Coldwater Spring.	No impacts.
Surface water					
Construction	All systems: Construction impacts on surface flow would be negligible to minor and could be naturally mitigated by standard construction practices. There would be no impacts on off-post surface water.				No impacts since there would be no construction.
Operations	All systems: Impacts on both on-post and off-post surface water would be negligible to low. Estimated sewage discharge of 7.5 million gal/yr would be small compared with surface water flows and would not significantly change flow conditions in the vicinity of the treatment plant. The additional withdrawals at Coldwater Spring would not be significant and would have negligible impacts on the surface water environment downstream of the spring.				No impacts.

TABLE S.4-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/ Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Terrestrial habitats and vegetation					
Construction	All systems: The pilot facility would require approximately 25 acres; however, up to 11 acres might be disturbed as a result of infrastructure additions for Area A, up to 6 acres for Area B, and up to 52 acres for Area C. Biotic communities occurring in undeveloped land in all three areas are relatively common and well represented. Disturbance of communities within existing corridors would be temporary.				No impacts since there would be no construction.
Operations	All systems: During routine operations, biota in the vicinity of the facility would be exposed to emissions from the boiler and the process stack. Emissions would be within applicable standards. Maximum annual average air concentrations of organic compounds due to facility emissions would be considerably lower than levels known to be harmful to biota.				No impacts.
Wildlife					
Construction	All systems: The loss of habitat would not be expected to threaten local populations of any wildlife species since similar habitat would be available nearby.				No impacts since there would be no construction.
Operations	All systems: Deposition from atmospheric emissions would result in very low concentrations of trace metals and organic compounds, well below levels known to be harmful to biota. Consequently, routine operations would result in negligible impacts on wildlife.				No impacts.
Aquatic habitats and fish					
Construction	All systems: Rerouting or culverting the streams in Area A could result in loss of stream habitat. Because of the limited diversity of aquatic habitat and lack of undisturbed habitat in Area A, disturbances could constitute a minor adverse impact. Aquatic habitats do not occur in Areas B or C.				No impacts since there would be no construction.
Operations	All systems: Water withdrawal from surface waters, as well as wastewater discharge, would result in negligible changes to surface water levels. These changes would result in only negligible impacts on aquatic ecosystems. Depositions from atmospheric emissions would result in very low concentrations of trace metals and organic compounds, well below levels known to be harmful to biota.				No impacts.

TABLE S.4-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/ Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Protected species					
Construction	All systems: None of the sites assessed for the pilot facility or the routes for infrastructure corridors are located in the immediate vicinity of populations of Tennessee yellow-eyed grass. Therefore, the direct impact on this species from construction would be negligible. Implementation of storm-water control measures would greatly reduce the potential for indirect impacts.				No impacts since there would be no construction.
Operations	All systems: During routine operations, biota in the vicinity of the pilot facility would be exposed to atmospheric emissions from the boiler stack and the process stack. Facility emissions would be within applicable air quality standards. The maximum annual average concentration of trace metals would be well below levels known to result in adverse impacts on biota through biouptake and biomagnification. Routine operations would not affect Tennessee yellow-eyed grass.				No impacts.
Wetlands					
Construction	All systems: The loss of up to 1.2 acres of palustrine wetland, up to 1,912 ft of riverine wetland, and up to 12 acres of floodplain as a result of construction in Area A would constitute a moderate to large adverse impact. Wetlands do not occur in Areas B or C.				No impacts since there would be no construction.
Operations	All systems: Water withdrawals from surface waters for the pilot plant as well as wastewater discharge would result in negligible changes in surface water levels. These changes would result in only negligible impacts on aquatic ecosystems, including wetlands located on the periphery of the surface water bodies.				No impacts.
Cultural resources					
Construction	All systems: The probability of adverse effects on cultural resources as a result of construction is very small. The potential for archaeological sites is low in most areas of ANAD. Each of the construction areas is a considerable distance from known archeological sites. No traditional cultural properties are known to exist within the proposed construction areas. Only Area A includes an existing structure, which is scheduled for demolition.				No impacts since there would be no construction.
Operations	All systems: Routine operations should have no impact on archaeological resources, traditional cultural properties, or historic structures.				No impacts.

TABLE S.4-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/ Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Socioeconomics					
Construction	All systems: The impact on the ROI would be relatively small. In-migration would have only a marginal effect on population growth. No significant impact on public finances or public service jobs would be expected. On-post employee commuting patterns would have no impact on levels of service in the local transportation network.				No impacts since there would be no construction.
	Increases: Employment: 640 direct jobs 540 indirect jobs Income: $35 million In-migrating population: 640	Increases: Employment: 730 direct jobs 520 indirect jobs Income: $37 million In-migrating population: 890	Increases: Employment: 740 direct jobs 580 indirect jobs Income: $39 million In-migrating population: 970	Increases: Employment: 790 direct jobs 620 indirect jobs Income: $42 million In-migrating population: 1,100	
Operations	All systems: The impact on the ROI would be relatively small.				Negligible impact on the ROI.
	Increases: Employment: 660 direct jobs 580 indirect jobs Income: $46 million In-migrating population: 740	Increases: Employment: 660 direct jobs 580 indirect jobs Income: $46 million In-migrating population: 740	Increases: Employment: 660 direct jobs 590 indirect jobs Income: $46 million In-migrating population: 740	Increases: Employment: 660 direct jobs 820 indirect jobs Income: $53 million In-migrating population: 930	Continued storage produces: Employment: 90 direct jobs 60 indirect jobs Income: $7 million
Environmental justice					
Construction	All systems: The socioeconomic impacts from construction would primarily increase short-term employment and income. They would also increase demand for housing, schools, and public services. None of these impacts would be high or adverse for local governments, and the existing housing stock should be able to meet the demand. Similarly, no high and adverse impacts are anticipated during construction of an ACWA facility. As a result, environmental justice impacts are not anticipated from construction.				No impacts since there would be no construction.

TABLE S.4-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/ Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Operations	All systems: During operations, there would be no high and adverse socioeconomic impacts associated with the facility. In addition, the risk of noncancer health effects and the risk of cancer from hazardous chemicals released during normal operations would be very low for both workers and the public. Neither of these impacts would be considered high and adverse. As a consequence, no environmental justice impacts are anticipated.				No impacts.
Agriculture					
Construction	No impacts are likely as a result of construction.				No impacts since there would be no construction.
Operations	During routine operations, facility emissions would be within applicable air quality standards. A screening-level agricultural risk assessment was conducted. The results indicated negligible risk from maximum concentrations on post and even lower risk off post. There is no evidence of bioaccumulation.				No impacts.

[a] Abbreviations: CDC = Centers for Disease Control and Prevention, CO = carbon monoxide, HAP = hazardous air pollutant, NESHAP = National Emission Standards for Hazardous Air Pollutants, PM_{10} = particulate matter with a mean aerodynamic diameter of 10 micrometers or less, $PM_{2.5}$ = particulate matter with a mean aerodynamic diameter of 2.5 micrometers or less, ROI = region of influence, scf = standard cubic foot (feet).

S.5 PINE BLUFF ARSENAL

More detailed discussion of the affected environment and potential consequences from the proposed action and no action at PBA is found in Chapter 5 of the EIS.

S.5.1 Affected Environment

PBA is located in Jefferson County, Arkansas, approximately 30 miles south and slightly east of the state capital, Little Rock. PBA is about 15,000 acres in size. The U.S. Food and Drug Administration's National Center for Toxicological Research (NCTR), which employs 670 workers, occupies an area in the northern portion of PBA that is approximately 500 acres in size. In addition to storing chemical weapons, PBA performs a variety of conventional munitions production and maintenance operations, and a chemical weapons incinerator is currently under construction there.

The two potential areas selected for the proposed ACWA pilot facility are located in the northern part of PBA, near the chemical storage area. Figure S.5-1 shows the locations of these areas. The topography around these areas is flat to gently rolling hills, with both proposed areas in relatively flat locations. The areas were chosen on the basis of their suitability for construction, access to the chemical storage area, proximity to other structures and boundaries, and availability of required utilities. Area A is located immediately east of the chemical storage area; it is wooded. Area B is approximately halfway between the chemical storage area and the PMCD Pine Bluff Chemical Demilitarization Facility (PBCDF), which is currently under construction; it is not wooded. The following text describes PBA in terms of the affected environment in each impact area.

Land Use: The northern boundary of PBA borders privately owned agricultural lands and timberlands with scattered residences. The southern boundary borders developed and undeveloped industrial property. The University of Arkansas, Pine Bluff, is located 2 miles to the southeast. The town of Redfield, with a population of about 1,100, is 5 miles northwest of the PBA boundary. The NCTR is on the northeast boundary. The eastern boundary of PBA is the Arkansas River. The western boundary adjoins the Union-Pacific Railroad right-of-way, residential properties, and the town of Whitehall, with approximately 5,000 residents. Land use immediately east and north of PBA is primarily rural, in an area known for agricultural crops and livestock, including soybeans, rice, wheat, hay, cotton, and beef cattle. Agricultural land is interspersed with residential areas (communities and isolated residences) and mixed forest. To the west and south of PBA are built-up bedroom communities and a major urban area.

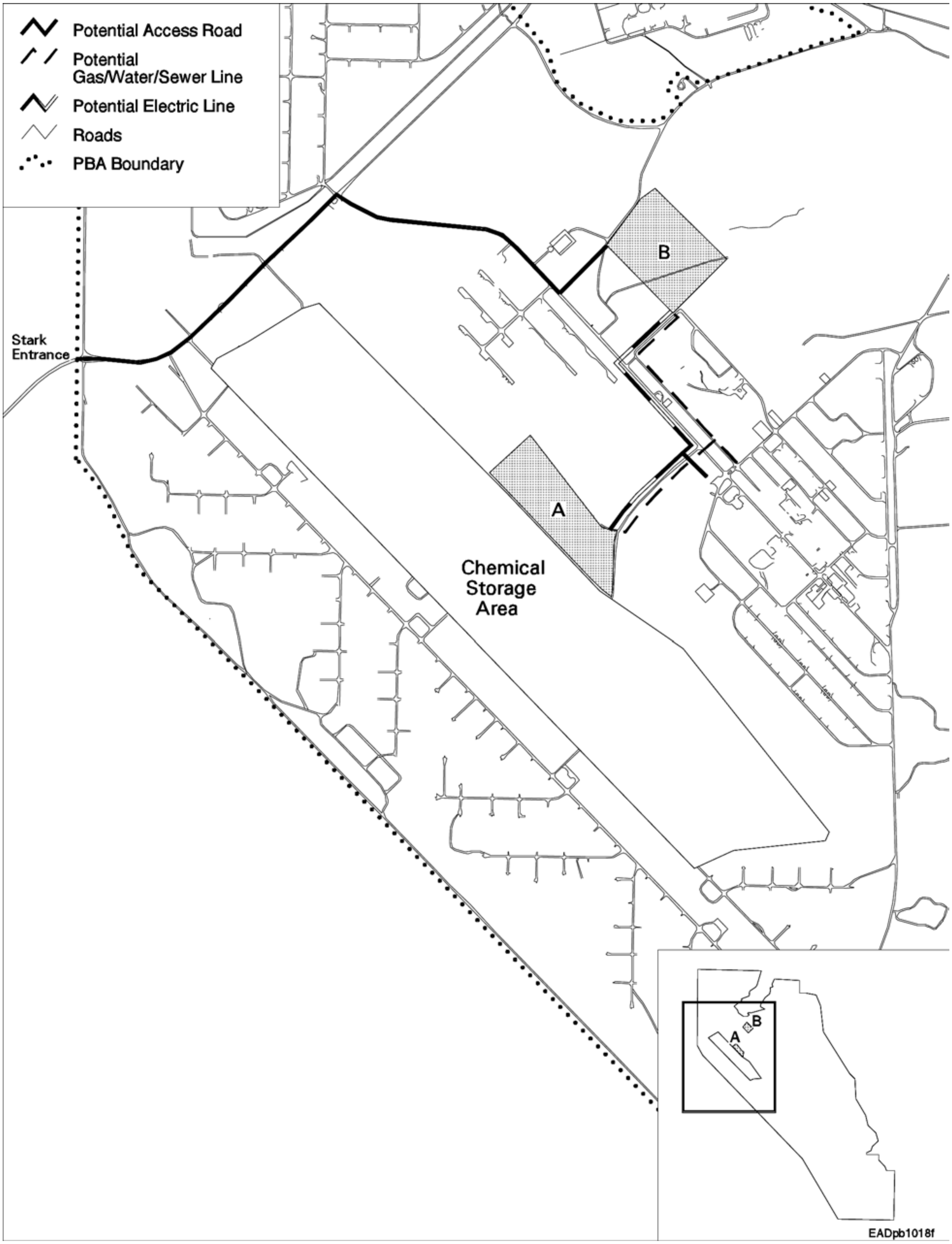

FIGURE S.5-1 Assessment Areas at PBA

Infrastructure: The current electricity supplier is Entergy Systems, which has sufficient capacity to meet current and projected needs at the installation. The natural gas supplier for PBA is Reliant Energy, which also has sufficient capacity to meet current and projected needs. Water at PBA is supplied by 12 on-post wells that have sufficient capacity to meet current and projected needs.

Waste Management: PBA currently has an incinerator under construction for use in the destruction of some or all of the chemical munitions held in inventory at the installation. PBA generates a variety of hazardous wastes associated with its missions for the Army. Most hazardous wastes generated at PBA are packaged and transported off post to appropriately permitted treatment and disposal facilities. Some wastes (off-specification conventional munitions) are treated in PBA permitted facilities. PBA also generates a wide variety of nonhazardous solid wastes. These wastes are collected and disposed of off post in a permitted landfill or recycled if possible. Sanitary wastes are treated in an on-post sewage treatment plant.

Air Quality: The state of Arkansas is divided geographically into two regions: the interior highlands and the flat lowlands, where PBA is located. The climate of the area surrounding PBA is modified continental. The summer season is marked by prolonged periods of warm and humid weather. Precipitation is normally abundant.

PBA is located in the Central Arkansas Intrastate Air Quality Control Region, which is designated as being in attainment for all NAAQS. PBA emission sources are being operated in accordance with permits issued by the Arkansas Department of Environmental Quality (ADEQ). PBA is classified as a major stationary source for Prevention of Significant Deterioration (PSD) purposes, for which actual or potential emissions are above the applicable source threshold. The only reportable source emission from PBA for 1999 under the EPA's Toxics Release Inventory (TRI) regulations was hydrochloric acid. No other toxic air pollutant emissions exceeded reporting limits under TRI.

Human Health and Safety: Contamination of groundwater was detected, and remedial action was completed.

Noise: No sensitive noise receptors are located near the installation. In the general PBA area, sound levels are typical of rural areas. Near the western boundary of PBA, the background accoustical environment may be higher because of highway and railroad traffic.

Visual Resources: PBA is located in a rural, wooded environment. Privately owned farms and timberland lie north of the installation. To the west is the Union-Pacific Railroad right-of-way and a sparse number of residential properties. The land south and west of PBA consists primarily of undeveloped industrial property and the Mid-Atlantic Packaging Facility. The Arkansas River is the eastern boundary of PBA. Viewing distances are short on PBA, restricted by heavy vegetation and small hills. The town of Redfield is about 5 miles northwest of PBA, the town of Whitehall lies to the west, and the city of Pine Bluff lies 2 miles to the south.

Geology and Soils: PBA is located in the Gulf Coastal Plain Physiographic Province. The topography is fairly flat. The soils at PBA tend to be loamy, level to gently sloping, and poorly to moderately well drained.

PBA lies within the Ouachita Seismic Zone. There are no known faults at or near PBA. The nearby New Madrid Seismic Zone, located about 120 miles northeast of the installation, is the dominant source of major earthquakes in the area. The maximum earthquake that could occur at PBA would be a repetition of the New Madrid earthquake. PBA is located in Seismic Probability Zone I. Within this zone, minor earthquake damage may be expected to occur at least once in 500 years.

Water: Most water used in Jefferson County, Arkansas, is from groundwater sources. Other deeper aquifers exist but have not been developed because of low yield and poor quality. The Sparta Formation is the major groundwater source near PBA and supports both the city of Pine Bluff and industry. The on-post water supply for PBA is also from the Sparta Aquifer and is provided by 12 on-post wells. Water table declines in the Pine Bluff area are large and have been caused by the large withdrawals in the area.

Surface water flow at PBA is typified by sluggish, meandering streams, abandoned meanders, and oxbow lakes. The gentle topography and slow stream flow result in numerous wetland areas or bayous. PBA is located within the Caney Bayou-Arkansas River watershed.

The water quality of the streams on PBA is generally fair, and the quality of the surface waters is generally good. Water quality of bayous around PBA is generally poor, with low levels of dissolved oxygen. There are no developed areas on PBA that are subject to flooding. In Jefferson County, no surface water sources are used for public water supply.

Biological Resources: Vegetation at PBA is mostly representative of native plant communities found within the Western Gulf Coastal Plain Physiographic Province. Natural plant communities range from forested communities in the Arkansas River floodplain to upland, drier forest and grassland areas. Diverse wildlife species have been documented. Recreational fishing occurs at several locations on the installation. No federal listed species are known to occur at PBA.

Palustrine forested wetlands (hardwood bottomland forests) occur extensively along streams near PBA. The predominant hydrologic regimes in these wetland communities are seasonally and temporarily flooded. Wetland types range from permanently flooded ponds to intermittent streams.

Cultural Resources: A comprehensive cultural resources survey conducted at PBA in 1990 identified 90 locations. Forty-six of the locations were designated as sites by the Arkansas Archaeological Survey; seven sites were determined to be potentially significant. No archaeological resources have been identified within the proposed alternative construction areas for the ACWA pilot test facility.

No traditional cultural properties are known to occur within the proposed construction areas. No PBA structures were found to meet Army criteria for designation as important historical structures or eligibility criteria for the *National Register of Historic Places* (NRHP).

Socioeconomics: The Pine Bluff region of influence (ROI) surrounding the installation is composed of four counties: Grant County, Jefferson County, Lincoln County, and Pulaski County. Ninety percent of PBA workers currently reside in these counties. The population of the ROI in 2000 was almost 477,000; it grew slightly over the period 1990–2000. The economy of the county is dominated by the trade and service industries.

Environmental Justice: Of the Jefferson County residents recorded in the 2000 census, 52.0% were minority. This percentage is well in excess of the minority representation for the United States as a whole. The 1990 census recorded 23.9% of the Jefferson County population as being below the poverty level; this number also is greater than the figure for the United States as a whole.

Agriculture: The ROI includes 11 counties. This area contains 4.6 million acres of land, of which 1.6 million acres (35%) was in farms in 1997. The ROI contained 3,800 farms, with more than half operated by full-time farmers. Agriculture was historically only a moderately significant local source of employment in the ROI, and its importance declined somewhat during the 1990s.

S.5.2 Consequences of the Proposed Action and No Action

Table S.5-1 summarizes the impacts associated with the location of each of the three technologies at PBA and the decision to take no action. For all impact areas, the consequences associated with construction and normal operations of the technologies would be very similar. There would be no significant impacts associated with any of the technologies or with no action.

TABLE S.5-1 PBA Summary Table[a]

Environmental Consequence	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Land use	All systems: Actions would be consistent with current and planned installation use. Up to 37 acres would be disturbed.			No impacts.
Infrastructure				
Electric power supply	All systems: Additional electric power lines would be required.			No impacts.
	60 GWh/yr would be required.	26 GWh/yr would be required.	120 GWh/yr would be required.	
Natural gas	All systems: Construction of additional gas pipelines required. Natural gas supplier has sufficient capacity to meet current and future demand.			No impacts.
	52 million scf/yr would be required.	140 million scf/yr would be required.	48 million scf/yr would be required.	
Water supply and use				No impacts.
Construction	All systems: Impacts on water supply and sewage treatment systems would be negligible.			
Operations	The ACWA facility would have a negligible impact on water supply systems. Sewage systems have sufficient capacity to meet the additional requirements of an ACWA facility.			
	6 million gal/yr of process water would be required; 5.5 million gal/yr of potable water would be required.	18 million gal/yr of process water would be required; 6.4 million gal of potable water would be required.	900,000 gal/yr of process water would be required; 6.4 million gal/yr of potable water would be required.	
Waste management and facilities				
Construction	All systems: Hazardous and nonhazardous wastes would be generated during construction. All wastes would be collected and disposed of off post in accordance with all applicable regulations. Nonhazardous wastes would be collected and disposed of in a local landfill. Sanitary wastes would be treated in an on-post sewage treatment plant. No significant impacts are expected.			No impacts since there would be no construction.

TABLE S.5-1 (Cont.)

Environmental Consequence	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Operations	All systems: Hazardous and nonhazardous solid wastes would be generated during the treatment processes. These solid wastes would be collected and disposed of off post at appropriately permitted facilities. Quantities of brine salts produced by all technologies would vary, depending on the agent to be destroyed. Nonprocess solid wastes could be contaminated with agent and would also require treatment. If these treatment residual wastes are defined as RCRA hazardous waste, the estimated volume of hazardous waste would be larger, and additional treatment might be necessary before disposal. Process and nonprocess liquid wastes would be recycled within the treatment process. The only liquid waste associated with ACWA facilities that would be discharged would be domestic sanitary wastewater.			No impacts.
Air quality — criteria pollutants				
Construction	All systems: Concentration increments of criteria air pollutants and fugitive dust emissions would be relatively small fractions of applicable NAAQS. Total estimated annual concentration of $PM_{2.5}$ would be below but close to applicable NAAQS primarily because of high background concentration levels.			No impacts since there would be no construction.
Operations	All systems: Estimated maximum concentration increments due to operation would contribute less than 2% of applicable NAAQS for all pollutants. Except for $PM_{2.5}$, maximum estimated concentrations of criteria pollutants would be less than or equal to 54% of NAAQS. $PM_{2.5}$ would be close to standards but still below them.			No impacts.
Air quality — toxic air pollutants				
Construction	All systems: Impacts would be negligible. Minor emissions would result from construction equipment.			No impacts since there would be no construction.
Operations	All systems: <u>Routine operations:</u> Pilot facility emissions would not be a major source of HAP emissions and would not fall under any of the source categories regulated by the EPA under NESHAP. <u>Fluctuating operations:</u> No agent emissions would be expected. Modeling of worst-case emissions resulted in estimated ambient agent concentrations of less than 1% of the allowable concentrations for general population exposure established by the CDC.			No impacts.

TABLE S.5-1 (Cont.)

Environmental Consequence	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Human health and safety — routine operations				
Construction	Facility workers: Estimated annual fatalities: < 1 Estimated annual injuries: 22	Facility workers: Estimated annual fatalities: < 1 Estimated annual injuries: 23	Facility workers: Estimated annual fatalities: < 1 Estimated annual injuries: 24	No impacts since there would be no construction.
	All systems: Other on-post workers and residents: There would be no adverse health impacts. Off-post public: There would be no adverse health impacts.			
Operations	Facility workers: Estimated annual fatalities: < 1 Estimated annual injuries: 35	Facility workers: Estimated annual fatalities: < 1 Estimated annual injuries: 35	Facility workers: Estimated annual fatalities: < 1 Estimated annual injuries: 35	Facility workers: Estimated annual fatalities: <1 Estimated annual injuries: 5
	All systems: Other on-post workers and residents: Estimated hazard indices and carcinogenic risks from inhalation of toxic air pollutants are well below benchmarks considered representative of negligible risk levels. No agent emissions are expected. Even under hypothetical worst-case emission levels, the maximum estimated on-post concentration would be less than 1% of the allowable concentration for general public exposures. Off-post public: Estimated hazard indices and carcinogenic risks from inhalation of toxic air pollutants are well below benchmarks considered representative of negligible risk levels. No agent emissions are expected. Even under hypothetical worst-case emission levels, the maximum estimated off-post concentration would be less than 1% of the allowable concentration for general public exposures.			No impacts.

TABLE S.5-1 (Cont.)

Environmental Consequence	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Noise				
Construction	All systems: Impacts on nearest residents would be negligible. Noise level would be below EPA guidelines for residential zones.			No impacts since there would be no construction.
Operations	All systems: Impacts on nearest residents would be negligible. Noise level would be below EPA guidelines for residential zones.			No impacts.
Visual resources				
Construction	All systems: Temporary impacts would result from increased traffic and construction dust. Impacts would be negligible.			No impacts since there would be no construction.
Operations	All systems: Impacts would be negligible. Facility would not be visible from off post. Steam from the facility might be visible on and off post during cold weather, which would be consistent with the industrial character of the area.			No impacts.
Geology and soils				
Construction	All systems: Approximately 25 acres could be affected to some degree during construction. Additional ground would be disturbed for development of site infrastructure. Best management practices would minimize adverse impacts of potential soil erosion.			No impacts since there would be no construction.
Operations	All systems: Potential impact could occur in the event of an accidental spill or release of hazardous material. Containment actions would be taken to limit migration and contaminated soils would be removed. No significant impact on soils would result from air emissions.			No impacts.
Groundwater				
Construction	All systems: Impacts would be none to negligible and would be short-lived. No contamination of groundwater is expected. Existing water supply wells have the capacity to meet construction demand.			No impacts since there would be no construction.
Operations	All systems: Increase in potable water use would not be significant, and existing wells have capacity to meet additional demand. Increased drawdown would not be permanent. Procedures exist to preclude spills and to address them should they occur.			No impacts.

TABLE S.5-1 (Cont.)

Environmental Consequence	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Surface water				
Construction	All systems: Construction impacts on surface flow would be negligible to minor and could be naturally mitigated by standard construction practices. During incident-free construction, no contamination of surface water would be expected. Berms should be placed to restrict surface runoff. If spills or leaks would occur, procedures would exist to quickly remove contaminants before they could be transported to existing surface or groundwater resources. There would be no impacts on off-post surface water.			No impacts since there would be no construction.
Operations	All systems: Impacts would be negligible. Estimated sewage discharge would be small compared with surface water flows and would not significantly change flow conditions. There would be no impacts on off-post surface water.			No impacts.
Terrestrial habitats and vegetation				
Construction	All systems: Construction would disturb about 25 acres for the pilot facility plus another 4–12 acres for infrastructure.			No impacts since there would be no construction.
Operations	All systems: Impacts on vegetation would be negligible because levels of air pollutant release would be low. Deposition levels on soil and vegetation downwind of the ACWA facility would be negligible.			No impacts.
Wildlife				
Construction	All systems: The presence of construction crews and traffic would cause some species to avoid areas near construction sites during construction period. Less mobile species would be killed during vegetation clearing. Loss of habitat is not expected to eliminate any wildlife species since similar habitat is relatively common elsewhere on the installation.			No impacts since there would be no construction.
Operations	All systems: Increase in human activity and associated traffic would increase number of roadkills. Wildlife species would not be affected by releases of trace metals and organic compounds because food chain transfer via plants would be minimal. The potential for bioaccumulation is low.			No impacts.
Aquatic habitats and fish				
Construction	All systems: No impacts would be likely because erosion control measures would be used to control runoff during construction of the ACWA facility and infrastructure.			No impacts since there would be no construction.

TABLE S.5-1 (Cont.)

Environmental Consequence	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Operations	All systems: No impacts would be likely because emission rates of all trace constituents and particulates are expected to be at levels well below those that would affect ecosystems through biouptake or biomagnification in the food chain.			No impacts.
Protected species				
Construction	All systems: No impacts on protected species are anticipated. No federal endangered or threatened species are known to exist at PBA.			No impacts since there would be no construction.
Operations	All systems: There would be no impacts because no federal endangered or threatened species are known to exist at PBA.			No impacts.
Wetlands				
Construction	All systems: Construction at Area A could potentially eliminate the small palustrine wetlands on the southwest margin of the area. Grading for preparation of Area B could disturb wetlands and alter drainage patterns within the area. Construction on Area B could eliminate two wetlands.			No impacts since there would be no construction.
Operations	All systems: Deposition from atmospheric emissions would result in very low concentrations of trace metals and organic compounds, well below levels known to be harmful to biota. The impact on wetlands would be negligible.			No impacts.
Cultural resources				
Construction	All systems: There would be small probability for adverse effects. Area A has not been surveyed, but there is considerable disturbance and waste disposal within the area. The potential for finding intact cultural deposits is low. Areas B and C were surveyed, and no cultural sites were recorded. No traditional cultural properties and no standing structures are located in any of the areas.			No impacts since there would be no construction.
Operations	All systems: There are no cultural resources in the area, so there should be no impacts.			No impacts.
Socioeconomics				
Construction	All systems: Impact on ROI would be relatively small. In-migration would have only a marginal effect on population growth. No significant impact on public finances or public service jobs would be expected. On-post employee commuting patterns would have no impact on levels of service in the local transportation network.			No impacts since there would be no construction.

TABLE S.5-1 (Cont.)

Environmental Consequence	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Construction (Cont.)	Increases: Employment: 730 direct jobs 570 indirect jobs Income: $40 million In-migrating population: 210	Increases: Employment: 740 direct jobs 610 indirect jobs Income: $42 million In-migrating population: 220	Increases: Employment: 780 direct jobs 660 indirect jobs Income: $45 million In-migrating population: 250	
Operations	All systems: Impacts on the ROI would be relatively small. Increases: Employment: 720 direct jobs 760 indirect jobs Income: $53 million In-migrating population: 580	Increases: Employment: 720 direct jobs 760 indirect jobs Income: $53 million In-migrating population: 580	Increases: Employment: 720 direct jobs 850 indirect jobs Income: $56 million In-migrating population: 640	Negligible impacts on the ROI. Continued storage produces: Employment: 100 direct jobs 80 indirect jobs Income: $8 million
Environmental justice				
Construction	All systems: The socioeconomic impacts from construction would primarily increase short-term employment and income. They would also increase demand for housing, schools, and public services. None of these impacts would be high or adverse for local governments, and the existing housing stock would likely meet the demand. Similarly, no high and adverse impacts are anticipated during construction of an ACWA facility. As a result, environmental justice impacts are not anticipated from construction.			No impacts since there would be no construction.
Operations	All systems: During operations, there would be no high and adverse socioeconomic impacts associated with the facility. In addition, the risk of noncancer health effects and the risk of cancer from hazardous chemicals released during normal operations would be very low for both workers and the public. Neither of these impacts would be considered high and adverse. As a consequence, no environmental justice impacts are anticipated.			No impacts.

TABLE S.5-1 (Cont.)

Environmental Consequence	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Agriculture				
Construction	No impacts would be likely from construction.			No impacts since there would be no construction.
Operations	Facility emissions would be within applicable air quality standards. A screening-level agricultural risk assessment indicated that the risks from maximum concentrations of emissions from operations would be negligible.			No impacts.

[a] Abbreviations: CDC = Centers for Disease Control and Prevention, CO = carbon monoxide, HAP = hazardous air pollutant, NESHAP = National Emission Standards for Hazardous Air Pollutants, PM_{10} = particulate matter with a mean aerodynamic diameter of 10 micrometers or less, $PM_{2.5}$ = particulate matter with a mean aerodynamic diameter of 2.5 micrometers or less, ROI = region of influence, scf = standard cubic foot (feet).

S.6 PUEBLO CHEMICAL DEPOT

More detailed discussion of the affected environment and potential consequences from the proposed action and no action at PCD are provided in Chapter 6 of the EIS.

S.6.1 Affected Environment

Pueblo Chemical Depot (PCD) is located in southeastern Colorado, approximately 14 miles east of the center of the City of Pueblo in Pueblo County and about 2 miles north of the Arkansas River. The installation encompasses approximately 23,000 acres and includes a variety of buildings, structures, and undeveloped areas. PCD's primary function is the storage of chemical weapons.

It is assumed that any ACWA pilot test facilities would be constructed within the area near Munitions Storage Area A where the chemical weapons are stored. The areas along the western, southern, and eastern edges of Munitions Storage Area A were considered appropriate for construction of an ACWA pilot test facility and are labeled A, B, and C. These are shown in Figure S.6-1. The following text describes PCD in terms of the affected environment.

Land Use: Current land use at PCD is primarily industrial and includes the storage of chemical munitions, environmental restoration, and related activities. Existing facilities include buildings used for administrative, housing, maintenance, and storage. In addition, PCD has igloos originally constructed for the storage of munitions. Surrounding lands are primarily rural and are used for grazing.

Infrastructure: PCD purchases power from the Western Area Power Administration, West Plains Energy Corporation, and Southern Colorado Power Company. A main gas pipeline supplies natural gas from Excel Energy. PCD obtains water from seven active water supply wells located on the installation. In most years, the right to use this water must be purchased from more senior water rights holders. Sanitary wastewater is treated on the installation.

Waste Management: PCD generates a variety of hazardous wastes associated with environmental restoration, vehicle and facility maintenance, munitions management, and hazardous material management. Most of these wastes are packaged and shipped off post to appropriate treatment and disposal facilities. Groundwater from environmental remediation operations is treated and discharged on the installation. PCD also generates a variety of nonhazardous wastes that are collected and disposed of off post in a RCRA Subtitle D landfill or are recycled.

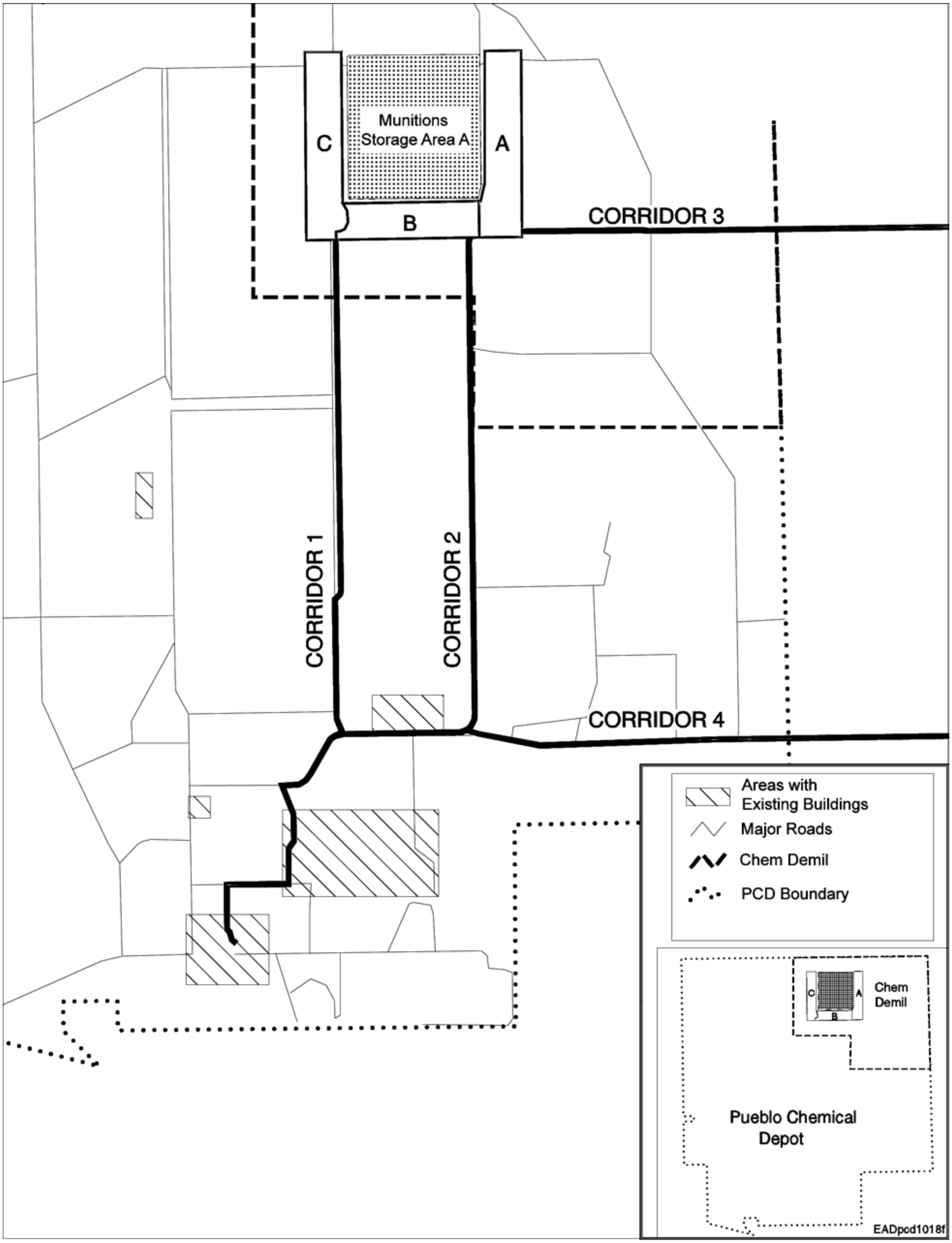

FIGURE S.6-1 Assessment Areas at PCD

Air Quality: The climate of the surrounding area is semiarid and marked by large daily temperature variations. Pueblo County is in attainment for all NAAQS. The existing sources of criteria pollutant emissions at PCD include building heaters, boilers, and emergency generators. Under Title V of the *Clean Air Act*, PCD is classified as “a synthetic minor source” (i.e., a source with potential emissions of less than 250 tons/yr for all criteria pollutants or less than 100 tons/yr for each individual pollutant) with respect to hazardous air pollution (HAP) emissions. Primary sources of these emissions include fuel storage, degreasing activities, and landfills. HAP emissions have decreased since 1994.

Human Health and Safety: No past contamination has been identified at areas being considered for an ACWA pilot test facility.

Noise: There are no on-post or off-post noise problems associated with on-post activities. Current noise levels are comparable to the residual sound levels of typical rural areas.

Visual Resources: The landscape is characterized by rolling, open pasture land. Industrial and administrative development is confined mostly to the southern portion of the installation. Although there are mountain vistas, there are no areas of significant scenic quality within the installation.

Geology and Soils: PCD is situated on a terrace in the western part of the Colorado Piedmont section of the Great Plains. Underlying PCD are deposits of sand, gravel, and clay over a layer of shale. Mineral resources are not known to be present. Faults occur in the PCD vicinity, but PCD is located in a zone where only minor earthquake damage is estimated to occur once in 500 years.

Water: Except in the southern portion of the installation, the quality of the groundwater is good. Groundwater contamination from past industrial operations is present in the southern portion of PCD. Groundwater treatment systems are being operated in this area to mitigate off-post migration of the contaminants. PCD is located in the Arkansas River Valley; water quality in the river is generally good and is satisfactory for domestic, agricultural, and most industrial uses. The proposed areas for the ACWA facility are located above the floodplain.

Biological Resources: PCD is characterized as gently sloping prairie or shortgrass steppe. The black-tailed prairie dog and the mountain plover, both of which are proposed federal threatened species, occur at PCD. The burrowing owl, ferruginous hawk, northern harrier, black tern, and loggerhead shrike are considered federal sensitive species and are found on PCD.

Wetlands occur along stream courses throughout the installation, especially in the eastern and western portions.

Cultural Resources: There are no known archaeological or Native American cultural properties within PCD. There are historical structures at PCD, but a programmatic agreement among the U.S. Army, Colorado State Historic Preservation Officer, and Advisory Council on Historic Preservation states that documentation of the facilities on PCD has been completed and no further documentation is required to mitigate actions involving the facilities.

Socioeconomics: The region of influence (ROI) is Pueblo County. The population in 2000 was about 141,000. From 1990 to 2000, the annual population growth rate was less than 1.4%. The economy of the ROI is dominated by trade and services.

Environmental Justice: The 2000 census recorded that 42.3% of the residents of Pueblo County are minority, and the 1990 census recorded that 20.2% of the county residents are below the poverty level. Both of these levels are higher than those for the United States as a whole.

Agriculture: The agricultural ROI includes five counties surrounding the installation. This area contains 5.9 million acres, of which 4.3 million acres (73%) were farmland in 1997. There were approximately 2,700 farms in the ROI, of which more than half were operated by full-time farmers. Traditionally, agriculture was only a moderately significant source of employment in the ROI, and its importance declined somewhat in the 1990s.

S.6.2 Consequences of the Proposed Action and No Action

Table S.6-1 summarizes the impacts associated with the location of the two technologies considered at PCD and the decision to take no action. For almost all impact areas, the consequences associated with the construction and normal operations of the technologies would be the same. There would be some differences in utility requirements and impacts on human health. None of the impacts would be significant.

TABLE S.6-1 PCD Summary Table[a]

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	No Action
Land use	Both systems: There would be no impacts. Construction would be within the industrial area. The maximum area disturbed for the facility and associated infrastructure would be 85 acres. Land use would be consistent with the reuse plan.		No impacts.
Infrastructure			
Electric power supply			
Construction	Both systems: Power lines and substations would be required. Supply would be adequate to meet increased demand. There would be no impacts.		No impacts.
Operations	36 GWh/yr would be required.	60 GWh/yr would be required.	No impacts.
Natural gas supply	New gas pipeline would be required. Supply would be adequate to meet increased demand. 94 million scf/yr would be required.	149 million scf/yr would be required.	No impacts.
Water supply and use			
Construction	Both systems: New water pipelines required. Supply would be adequate to meet increased demand of 8.6 acre-ft/yr. Additional water rights would need to be purchased. There would be no impact.		No impacts since there would be no construction.
Operations	Both systems: Additional water rights would need to be purchased. Supply is adequate to meet demand. Existing sewage lagoons might need to be expanded.		No impacts.
	Supply would be adequate to meet increased demand of 13 million gal/yr of process water[b] and 6.4 million gal/yr of potable water.	Supply would be adequate to meet increased demand of 18 million gal/yr of process water[b] and 6.4 million gal/yr potable water.	
Waste management and facilities			
Construction	Both systems: Existing waste management facilities would be adequate to handle hazardous solid wastes. No significant impacts would result from the generation of hazardous and nonhazardous wastes during construction.		No impacts since there would be no construction.

TABLE S.6-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	No Action
Operations	Both systems: Hazardous and nonhazardous solid wastes would be generated during the treatment processes. These solid wastes would be collected and disposed of off post at appropriately permitted facilities. Quantities of brine salts produced by the technologies would vary. Nonprocess solid wastes could be contaminated with agent and would also require treatment. Chemical weapons are RCRA listed wastes in Colorado; therefore, all treatment residues are also listed wastes and, if not delisted under RCRA, must be managed and disposed of as hazardous waste. Process and nonprocess liquid wastes would be recycled within the treatment process. The only liquid waste associated with ACWA facilities that would be discharged would be domestic sanitary wastewater.		Waste would be generated from occasional leaks. Facilities and procedures would be adequate to handle leaks.
Air quality — criteria pollutants			
Construction	Both systems: Emissions would include fugitive dust from earth-moving activities and exhaust from equipment and vehicles. Concentration increments would be relatively small fractions of applicable NAAQS. Overall ambient air quality would be good. Impacts would be minor.		No impacts since there would be no construction.
Operations	Both systems: Concentration increases due to operation would contribute approximately 2% of NAAQS/SAAQS. Overall ambient air quality would be good. Impacts would be negligible.		Stockpile maintenance activities would generate very small emissions from boilers and vehicular traffic in the area of Munitions Storage Area A. Impact would be negligible.
Air quality — toxic air pollutants			
Construction	Both systems: Impacts would be negligible. Minor emissions would result from construction equipment.		No impacts since there would be no construction.
Operations	Both systems: Normal: Pilot facility would not be a major source of HAP emissions and would not fall under any of the source categories regulated by the EPA under NESHAP. Fluctuating: No agent emissions would be expected. Modeling of worst-case emissions resulted in estimated ambient agent concentrations of less than 1% of the allowable concentrations for general population exposure.		No impacts.

TABLE S.6-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	No Action
Human health and safety — routine operations			
Construction	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 17	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 21	No impacts since there would be no construction.
	Both systems: <u>Other on-post workers and residents:</u> There would be no adverse health impacts. <u>Off-post public:</u> There would be no adverse health impacts.		
Operations	Both systems: <u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 30		<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 4
	<u>On-post workers and residents:</u> Estimated hazard indices and carcinogenic risks from inhalation of toxic air pollutants are well below benchmarks considered representative of negligible risk levels. No agent emissions are expected. Even under hypothetical worst-case emission levels, the maximum estimated on-post concentration would be less than 1% of the allowable concentration for general public exposures. The maximum estimated incremental cancer risk from the inhalation of hypothetical mustard emissions is well below the benchmark risk value.		No impacts.
	<u>Off-post public:</u> Estimated hazard indices and carcinogenic risks from inhalation of toxic air pollutants are well below benchmarks considered representative of negligible risk levels. No agent emissions are expected. Even under hypothetical worst-case emission levels, the maximum estimated off-post concentration would be less than 1% of the allowable concentration for general public exposures. The maximum estimated incremental cancer risk from the inhalation of hypothetical mustard emissions is well below the benchmark risk value.		No impacts.
Noise			
Construction	Both systems: Noise levels would be within local/state limits. Potential noise impacts are expected to be comparable to background levels at the nearest residence. Impacts would be negligible.		No impacts since there would be no construction.

TABLE S.6-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	No Action
Operations	Both systems: Estimated noise level at the nearest residence from the proposed facility (less than 35 dBA) would be within residential noise standards (55 dBA). Impacts would be negligible.		Noise generated by stockpile maintenance would be part of background and within legal limits.
Visual resources			
Construction	Both systems: Some decrease in visibility would result from dust emissions. Impacts would be small, intermittent, and temporary.		No impacts since there would be no construction.
Operations	Both systems: ACWA facility would be consistent with surrounding landscape. Operations would not create significant, visible emissions. There would be no impacts.		No impacts.
Geology and soils			
Construction	Both systems: As many as 85 acres of soil could be affected from construction of pilot facilities and associated infrastructure. Best management practices for soil erosion would mitigate potential adverse impacts.		No impacts since there would be no construction.
Operations	Both systems: No contamination of soils would be expected. Facilities are designed to contain small accidental releases. There would be no impacts.		Potential impacts would be limited primarily to leaks of petroleum-based products from vehicles. Impacts would be negligible.
Groundwater			
Construction	Both systems: Water use would be relatively small compared with historical use. Impacts would be negligible.		No impacts since there would be no construction.
Operations	Both systems: Water use would be relatively small compared with historical use. Impacts from water withdrawals would be negligible. Facilities are designed to contain small accidental releases of agent.		No impacts.

TABLE S.6-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	No Action
Surface water			
Construction	Both systems: Construction impacts on surface flow would be negligible to minor and could be naturally mitigated by standard construction practices. No contamination of surface water would be expected. Facilities are designed to contain small accidental releases.		No impacts since there would be no construction.
Operations	Both systems: No contamination of surface water would be expected. Facilities are designed to contain small accidental releases. There would be no impacts.		No impacts.
Terrestrial habitats and vegetation			
Construction	Both systems: As much as 85 acres of vegetative and terrestrial habitats could be disturbed. Most disturbances would be short-term and would be mitigated through revegetation. Small amount of permanent loss would occur. Negligible impacts.		No impacts since there would be no construction.
Operations	Both systems: Metals and organic compounds in emissions would be deposited on the ground in very low concentrations and would not adversely affect terrestrial biota. No impacts.		No impacts.
Wildlife			
Construction	Both systems: Less mobile burrowing species could be killed during construction and site preparation. Some losses would occur because of roadkills. Noise, human activity, and habitat loss would have no impact on the continued survival of the species because of the abundance of similar habitat next to proposed construction areas.		No impacts since there would be no construction.
Operations	Both systems: Noise, human activity, and habitat loss would have little impact because of the abundance of similar habitat next to proposed facility sites. Annual emission rates of all trace constituents and particulates would be well below levels affecting ecosystems through biomagnification or biouptake. There would be no impacts.		No impacts.
Aquatic habitats and fish			
Construction	Both systems: No aquatic resources in the areas be would affected by construction. There would be no impacts.		No impacts since there would be no construction.

TABLE S.6-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	No Action
Operations	Both systems: Concentrations of organic compounds and trace metals would not be at levels that would adversely affect aquatic ecosystems downwind. There would be no impacts.		No impacts.
Protected species			
Construction	Both systems: The loggerhead shrike, a federal sensitive species, could be affected by loss of habitat.		No impacts since there would be no construction.
Operations	Both systems: No impacts on endangered, threatened, or candidate species would result from normal operations.		No impacts.
Wetlands			
Construction	Both systems: No wetlands are near the proposed construction areas. There would be no impacts.		No impacts since there would be no construction.
Operations	Both systems: Concentrations of organic compounds and trace metals would not be at levels that would adversely affect downwind wetlands. There would be no impacts.		No impacts.
Cultural resources			
Construction	Both systems: No known cultural resources are located within the construction area. Unexpected discoveries of cultural resources during earth-moving activities would be evaluated in coordination with regulators. Impacts are unlikely.		No impacts since there would be no construction.
Operations	Both systems: There are no known cultural resources. There would be no impacts.		No impacts.
Socioeconomics			
Construction	Both systems: Impacts on the ROI would be relatively small. In-migration would have only a marginal effect on population growth. No significant impact on public finances or public service jobs is expected. On-post employee commuting patterns would have no impact on levels of service in the local transportation network.		No impacts since there would be no construction.

TABLE S.6-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	No Action
Construction (Cont.)	Increases Employment: 600 direct jobs 570 indirect jobs Income: $36 million In-migrating population: 1,140	Increases Employment: 680 direct jobs 540 indirect jobs Income: $37 million In-migrating population: 1,200	
Operations	Both systems: Impact on the ROI would be relatively small.		Negligible impact on the ROI.
	Increases: Employment: 640 direct jobs 530 indirect jobs Income: $44 million In-migrating population: 750	Increases: Employment: 640 direct jobs 580 indirect jobs Income: $45 million In-migrating population: 790	Continued storage produces: Employment: 80 direct jobs 60 indirect jobs Income: $6 million
Environmental justice			
Construction	Both systems: The socioeconomic impacts from construction would primarily increase short-term employment and income. They would also increase demand for housing, schools, and public services. None of these impacts would be high or adverse for local governments, and the existing housing stock would likely meet the demand. Similarly, no high and adverse impacts are anticipated during construction of an ACWA facility. As a result, environmental justice impacts are not anticipated from construction.		No impacts since there would be no construction.
Operations	Both systems: During operations, there would be no high and adverse socioeconomic impacts associated with the facility. In addition, the risk of noncancer health effects and the risk of cancer from hazardous chemicals released during normal operations would be very low for both workers and the public. Neither of these impacts would be considered high and adverse. As a consequence, no environmental justice impacts are anticipated.		No impacts.

TABLE S.6-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	No Action
Agriculture			
Construction	Both systems: No impacts on agriculture would be likely from facility construction.		No impacts since there would be no construction.
Operations	Both systems: Facility emissions would be within applicable air quality standards during routine operations. A screening-level agricultural risk assessment indicated that risks from maximum concentrations would be negligible.		No impacts.

[a] Abbreviations: CDC = Centers for Disease Control and Prevention, CO = carbon monoxide, HAP = hazardous air pollutant, NESHAP = National Emission Standards for Hazardous Air Pollutants, PM_{10} = particulate matter with a mean aerodynamic diameter of 10 micrometers or less, $PM_{2.5}$ = particulate matter with a mean aerodynamic diameter of 2.5 micrometers or less, ROI = region of influence, scf = standard cubic foot (feet).

[b] The numbers used in the analysis were from demonstration testing. Subsequent engineering design studies now indicate 5.7 million gal/yr of process water for Neut/Bio and 1.3 million gal/yr for Neut/SCWO.

S.7 BLUE GRASS ARMY DEPOT

A more detailed discussions of the affected environment and potential consequences from the proposed action and no action at BGAD is provided in Chapter 7 of the EIS.

S.7.1 Affected Environment

Blue Grass Army Depot (BGAD) is located in east central Kentucky, just southeast of the city of Richmond and approximately 30 miles southeast of the city of Lexington. The installation encompasses approximately 14,600 acres, composed mainly of open fields and wooded areas. The installation is used for the storage of conventional explosive munitions as well as ACWs.

It is assumed that the potential locations for an ACWA pilot test facility would be in close proximity to the current ACW storage location. Area A is directly adjacent to the eastern boundary of the Chemical Limited Area (CLA) (Figure S.7-1). Area B is directly adjacent to the western boundary of the current storage area. The following text describes BGAD in terms of the affected environment for each impact area.

Land Use: Land use on BGAD primarily involves industrial and related activities associated with the storage and maintenance of conventional and chemical munitions. There are about 1,150 structures on BGAD, but the facility is dominated by undeveloped woodland and areas leased for hay production and pasture. There is also a contractor-operated helicopter maintenance facility located on the installation. Land use in the vicinity includes agricultural, industrial, and low-density residential uses. A large public recreational facility adjoins the northwestern boundary of BGAD.

Infrastructure: Electricity is provided by the Kentucky Utilities Company via 69-kV transmission lines. Delta Natural Gas Company supplies natural gas to the installation. The main gas line at BGAD does not extend to the CLA. Water is supplied from Lake Vega, a 135-acre impoundment with an estimated capacity of 600 million gallons. The water treatment plant has a capacity of 720,000 gal/d. Two wastewater treatment plants treat on-post sanitary sewage, and there are also several septic systems.

Waste Management: BGAD generates hazardous wastes from maintenance of conventional munitions, demilitarization of obsolete conventional munitions, and storage of obsolete chemical munitions. Hazardous wastes are either shipped off post to a permitted disposal facility or are stored at a number of locations on post. Nonhazardous wastes are disposed of at an off-post landfill.

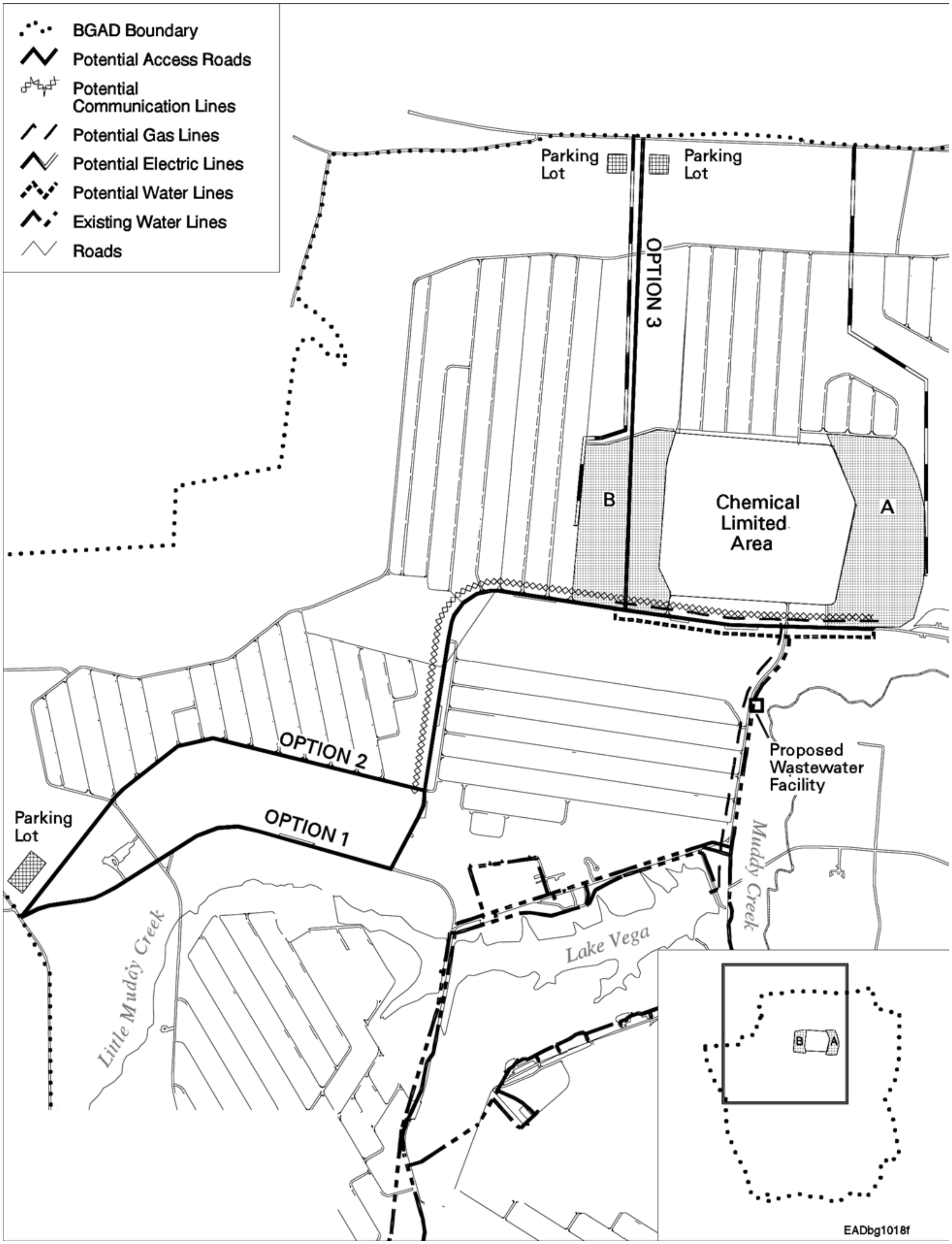

FIGURE S.7-1 Assessment Areas at BGAD

Air Quality: The climate is continental temperate, with a rather large day-to-night temperature range. The existing sources of criteria pollutants include boilers and ovens, solid waste disposal, surface coating and metal cleaning operations, fuel storage and handling, and miscellaneous industrial processes. The combined emissions from BGAD make up a very small percentage of the total emissions for the county, which is in attainment for NAAQS and SAAQS. However, statewide concentrations of ozone and $PM_{2.5}$ exceed the NAAQS and SAAQS. Emissions of toxic air pollutants did not reach the thresholds for required reporting under TRI regulations.

Human Health and Safety: No existing contamination associated with chemical agent has been detected at areas being considered for an ACWA pilot test facility.

Noise: The areas adjacent to BGAD boundaries are suitable for noise-sensitive uses, except for an area along the southern boundary that is subject to potentially objectionable noise levels from open detonation. The nearest residence to the facility is located about 1.6 miles north of the installation. Other noise-sensitive receptors are located at greater distances.

Visual Resources: BGAD is generally characterized by open fields and rolling hills with scattered woodlots. The military and industrial nature of the installation mainly is hidden from view, but where it is visible, it is consistent with other industrial land use in the area.

Geology and Soils: The topography is characterized by gently rolling hills that become steeper near major streams. Bedrock is composed of nearly horizontally bedded dolomite, shale, and limestone units. No mineral deposits of economic value have been mapped. There are no indications of faults that would be capable of creating an earthquake.

Water: BGAD is located within the Kentucky River watershed. There are a large number of lakes and streams of various sizes on the installation and many more in the surrounding area. Groundwater resources are limited and are not used at BGAD. Surface water quality in the area is generally good.

Biological Resources: Most of the BGAD land area is maintained as pasture, interspersed with shrubs and trees. Forests cover roughly 2,900 acres. Vegetation on most of the installation, including forested areas, has been adversely affected by cattle grazing. The diversity of ground-nesting birds, amphibians, and reptiles is relatively low because of the effects that grazing has had on their habitat. Rivers and streams in the area support fisheries that are attractive to recreational anglers. The bald eagle and running buffalo clover are the only protected species known to occur at BGAD. Wetlands occur along streams and other surface water bodies scattered throughout the installation.

Cultural Resources: No cultural resources have been identified in surveyed portions of the two proposed locations for an ACWA pilot facility. However, very little of the area has been surveyed for archaeological sites. Several sites have been recorded in the vicinity of the project area. The potential for containing cultural resources is high in approximately one-half of the unsurveyed portion of the project area. There are no standing structures within the project area, and no traditional cultural properties have been identified.

Socioeconomics: The BGAD region of influence (ROI) is composed of Clark, Estill, Fayette, Jackson, and Madison Counties. Almost 80% of BGAD workers reside in these counties. In 2000, the ROI population was 393,330, and it was increasing at an annual rate of 1.5% over the period 1990–2000. Trade and service industries constitute the dominant areas of employment in the ROI. The manufacturing sector has been growing rapidly, while agricultural employment has been declining.

Environmental Justice: In Madison County, the 2000 census recorded 7.6% of the population as having minority ethnic/racial status, whereas the 1990 census recorded 21.2% as having incomes below the poverty level. When compared with the United States as a whole, the Madison County percentage of minorities is lower and its percentage of low-income population is higher.

Agriculture: The agricultural ROI includes 22 counties around the installation. The ROI contains 3.9 million acres of land, of which 2.4 million acres (61%) were farmland in 1997. There were 16,000 farms, of which more than a third were operated by full-time farmers. Although farming has historically been a significant source of employment in the ROI, its importance declined somewhat during the 1990s.

S.7.2 Consequences of the Proposed Action and No Action

Table S.7-1 summarizes the impacts associated with the location of each of the four technologies at BGAD and those associated with the decision to take no action. For almost all of the impact areas, consequences associated with the construction and normal operations of the technologies would be the same. There would be some differences in the areas of human health and socioeconomics. None of the impacts, however, would be significant.

TABLE S.7-1 BGAD Summary Table[a]

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Land use	All systems: Actions would be consistent with current and planned installation use. Construction could disturb up to 95 acres for the facility and supporting infrastructure. Development of Proposed Area A may interfere with other site activities.				No impacts.
Infrastructure					
Electric power supply	All systems: Temporary lines or generators would be required for construction. A new line and substation would be needed for operation. Supply would be adequate to meet increased demand.				No impacts.
	2 GWh/yr would be required.	60 GWh/yr would be required.	26 GWh/yr would be required.	122 GWh/yr would be required.	
Natural gas	All systems: Extension of gas pipelines and a new metering station would be required. Supply would be adequate to meet increased demand.				No impacts.
	9 million scf/yr would be required.	52 million scf/yr would be required.	138 million scf/yr would be required.	52 million scf/yr would be required.	
Water supply and use	All systems: Extension of water supply pipelines would be required. Supply would be adequate to meet increased demand. A new storage tank would be required for emergency response. A new wastewater treatment plant would be required.				No impacts.
	1.3 million gal/yr of process water would be required; 300,000 gal/yr of potable water would be required.	6.3 million gal/yr of process water would be required; 6.4 million gal/yr of potable water would be required.	18 million gal/yr of process water would be required; 6.4 million gal/yr of potable water would be required.	1 million gal/yr of process water would be required; 6.4 million gal/yr of potable water would be required.	
Waste management and facilities					
Construction	All systems: Construction wastes could be treated by existing systems. No additional impacts from managing these wastes are anticipated.				No impacts since there would be no construction.

TABLE S.7-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Operations	All systems: Hazardous and nonhazardous solid wastes would be generated during the treatment processes. These solid wastes would be collected and disposed of off post at appropriately permitted facilities. Quantities of brine salts produced by all technologies would vary, depending on the agent to be destroyed. Nonprocess solid wastes could be contaminated with agent and would also require treatment. Chemical weapons are RCRA listed wastes in Kentucky; therefore, all treatment residues are also listed wastes and, if not delisted under RCRA, must be managed and disposed of as hazardous waste. Process and nonprocess liquid wastes would be recycled within the treatment process. The only liquid waste associated with ACWA facilities that would be discharged would be domestic sanitary wastewater.				No impacts.
Air quality — criteria pollutants					
Construction	All systems: Total concentrations of criteria air pollutants resulting from fugitive dust emissions would be below applicable NAAQS, except for $PM_{2.5}$. Statewide background levels of $PM_{2.5}$ are above the annual NAAQS without the addition of an ACWA pilot facility; consequently, the total estimated annual average concentrations of $PM_{2.5}$ would be above the applicable NAAQS.				No impacts.
Operations	All systems: Estimated maximum concentration of criteria air pollutants would be within applicable standards, except for $PM_{2.5}$, for routine and fluctuating operations. Total estimated annual average concentrations of $PM_{2.5}$ would be above the applicable NAAQS, primarily because of high background concentration levels.				Background levels of $PM_{2.5}$ exceed NAAQS.
Air quality — toxic air pollutants					
Construction	All systems: Impacts would be negligible. Minor emissions would result from construction equipment.				No impacts since there would be no construction.
Operations	All systems: Routine: Pilot facility emissions would not be a major source of HAP emissions and would not fall under any of the source categories regulated by the EPA under NESHAP. Fluctuating: No agent emissions would be expected. Modeling of worst-case emissions resulted in estimated ambient agent concentrations of less than 1% of the allowable concentrations for general population exposure established by the CDC.				No impacts.

TABLE S.7-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Human health and safety — routine operations					
Construction	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 17	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 22	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 22	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 24	No impacts since there would be no construction.
	All systems: <u>Other on-post workers and residents:</u> Potential for adverse health impacts from inhalation of $PM_{2.5}$ in existing environment already exists. There would be no other impacts. <u>Off-post public:</u> Potential for adverse health impacts from inhalation of $PM_{2.5}$ in existing environment already exists. There would be no other impacts.				
Operations	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 35	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 35	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 35	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 35	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 3
	All systems: <u>On-post workers and residents:</u> Estimated hazard indices and carcinogenic risks from inhalation of toxic air pollutants are well below benchmarks considered representative of negligible risk levels. No agent emissions are expected. Even under hypothetical worst-case emission levels, the maximum estimated on-post concentration would be less than 1% of the allowable concentration for general public exposures. The maximum estimated incremental cancer risk from the inhalation of hypothetical mustard emissions is well below the benchmark risk value. Potential for adverse health impacts from inhalation of $PM_{2.5}$ in the existing environment already exists. <u>Off-post public:</u> Estimated hazard indices and carcinogenic risks from inhalation of toxic air pollutants are well below benchmarks considered representative of negligible risk levels. No agent emissions are expected. Even under hypothetical worst-case emission levels, the maximum estimated on-post concentration would be less than 1% of the allowable concentration for general public exposures. The maximum estimated incremental cancer risk from the inhalation of hypothetical mustard emissions is well below the benchmark risk value. Potential for adverse health impacts from inhalation of $PM_{2.5}$ in existing environment already exists.				Potential for adverse health impacts from inhalation of $PM_{2.5}$ in existing environment already exists.

TABLE S.7-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Noise					
Construction	All systems: Impacts on nearest residents would be negligible. Noise level would be below EPA guidelines for residential zones.				No impacts since there would be no construction
Operations	All systems: Impacts on nearest residents would be negligible. Noise level would be well below EPA guidelines for residential zones.				No impacts.
Visual resources					
Construction	All systems: Temporary impacts would result from increased traffic and construction dust.				No impacts since there would be no construction.
Operations	All systems: There would be no impacts. Industrial character of the facility and possible presence of small steam plume would be consistent with the visual character of the surrounding area and depot.				No impacts.
Geology and soils					
Construction	All systems: Impacts would be negligible. Up to 95 acres would be disturbed by construction of pilot facilities and associated infrastructure. Best management practices for soil erosion would minimize adverse impacts.				No impacts since there would be no construction.
Operations	All systems: There would be no impacts. No contamination of soils would be expected. The facility would be designed to prevent migration of small accidental releases (spills or leaks).				No impacts. Procedures are in place to prevent migration of small accidental releases (spills or leaks) while ACWs are in storage.

TABLE S.7-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Groundwater					
Construction	All systems: There would be no impacts. The use of best management practices for erosion control would restrict surface runoff. Existing procedures dictate that spills or leaks of contaminants be quickly removed so they will not be transported to groundwater resources.				No impacts since there would be no construction.
Operations	All systems: Impacts would be negligible. There would be a slight increase in groundwater flow because of releases from the domestic sewage treatment plant.				No adverse impact from continued storage.
Surface water					
Construction	All systems: Construction impacts on surface flow would be negligible to minor and could be naturally mitigated by standard construction practices. Existing procedures dictate that spills or leaks of contaminants be quickly removed so they will not be transported to surface waters. Impacts on water supply would be negligible.				No impacts since there would be no construction.
Operations	All systems: There would be no impacts. The facility would be designed to prevent migration of small accidental releases (spills or leaks). Impacts on water supply would be negligible.				No impacts.
Terrestrial habitats and vegetation					
Construction	All systems: Impacts would be negligible. Up to 95 acres of vegetation and terrestrial habitat could be disturbed. Much of the disturbance would be temporary and mitigated through revegetation. Best management practices for soil erosion would minimize adverse impacts.				No impacts since there would be no construction.
Operations	All systems: Impacts would be negligible. The facility would be designed to prevent migration of small accidental releases (spills or leaks). Air emissions would be low and would not affect vegetation. Concentrations and deposition of emission constituents would pose no ecological risk.				No impacts.

TABLE S.7-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Wildlife					
Construction	All systems: Impacts would be negligible. Noise, human activity, and habitat loss would have little impact because nearby habitats are similar. Less mobile species could be killed during construction and site preparation. Mitigation measures would be implemented to avoid impacts from erosion, use of construction vehicles, and siting of transmission lines.				No impacts since there would be no construction.
Operations	All systems: Impacts would be negligible. Noise, human activity, and habitat loss would have little impact because nearby habitats are similar. Releases of trace metals and organic compounds would be well below threshold levels for ecosystems. Deposition from atmospheric emissions would result in very low concentrations of trace metals and organic compounds. Deposition was shown to pose no ecological risk to terrestrial habitats.				No impacts.
Aquatic habitats and fish					
Construction	All systems: Impacts would be unlikely. Potential impacts due to soil erosion or sedimentation would be avoided through mitigation.				No impacts since there would be no construction.
Operations	All systems: There would be no impacts. No effluents would be released to streams because all process liquids would be recycled.				No impacts.
Protected species					
Construction	All systems: Construction of a transmission line could affect the running buffalo clover, a federal listed endangered species, through direct disturbance or loss of individual plants. Mitigation measures have been developed to minimize adverse effects.				No impacts since there would be no construction.
Operations	All systems: There would be no impacts.				No impacts.
Wetlands					
Construction	All systems: No wetlands would be directly affected within proposed Area A. Proposed Area B contains three small wetlands that could be adversely affected. Mitigation measures have been developed to minimize adverse effects.				No impacts since there would be no construction.

TABLE S.7-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Operations	All systems: There would be no impacts.				No impacts.
Cultural resources					
Construction	Several archaeological sites are known to occur near the project area. Surveys would be required before ground disturbance could begin. Additional sites could be identified. Mitigation would be required if important archaeological sites were to be adversely affected by construction. No impacts are expected on previously surveyed portion of Proposed Area A.				No impacts since there would be no construction.
Operations	All systems: There would be no impacts.				No impacts.
Socioeconomics					
Construction	All systems: Impacts on the ROI would be relatively small. In-migration would have only a marginal impact on population growth. No significant impact on public finances or public service jobs would be expected. On-post employee commuting patterns would have no impact on levels of service in the local transportation network.				No impacts since there would be no construction.
	Increases: Employment: 570 direct jobs 530 indirect jobs Income: $35 million In-migrating population: 310	Increases: Employment: 670 direct jobs 510 indirect jobs Income: $37 million In-migrating population: 490	Increases: Employment: 710 direct jobs 550 indirect jobs Income: $39 million In-migrating population: 570	Increases: Employment: 800 direct jobs 610 indirect jobs Income: $44 million In-migrating population: 740	

TABLE S.7-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Operations	All systems: Impacts on the ROI would be relatively small.				Negligible impact on the ROI.
	Increases: Employment: 720 direct jobs 570 indirect jobs Income: $49 million In-migrating population: 680	Increases: Employment: 720 direct jobs 610 indirect jobs Income: $51 million In-migrating population: 720	Increases: Employment: 720 direct jobs 560 indirect jobs Income: $49 million In-migrating population: 680	Increases: Employment: 720 direct jobs 600 indirect jobs Income: $50 million In-migrating population: 710	Continued storage produces: Employment: 50 direct jobs 40 indirect jobs Income: $4 million
Environmental justice					
Construction	All systems: The socioeconomic impacts from construction would primarily increase short-term employment and income. They would also increase demand for housing, schools, and public services. None of these impacts would be high or adverse for local governments, and the existing housing stock would likely meet the demand. Similarly, no high and adverse impacts are anticipated during construction of an ACWA facility. As a result, environmental justice impacts are not anticipated from construction.				No impacts since there would be no construction.
Operations	All systems: During operations, there would be no high and adverse socioeconomic impacts associated with the facility. In addition, the risk of noncancer health effects and the risk of cancer from hazardous chemicals released during normal operations would be very low for both workers and the public. Neither of these impacts would be considered high and adverse. As a consequence, no environmental justice impacts are anticipated.				No impacts.

TABLE S.7-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Agriculture					
Construction	All systems: Impacts on agriculture from facility construction would not be likely.				No impact since there would be no construction.
Operations	During normal operations, facility emissions would be within applicable air quality standards. A screening-level agricultural risk assessment was conducted. The analysis indicated that the risks from maximum concentrations would be negligible.				No impact.

[a] Abbreviations: CDC = Centers for Disease Control and Prevention, CO = carbon monoxide, HAP = hazardous air pollutant, NESHAP = National Emission Standards for Hazardous Air Pollutants, PM_{10} = particulate matter with a mean aerodynamic diameter of 10 micrometers or less, $PM_{2.5}$ = particulate matter with a mean aerodynamic diameter of 2.5 micrometers or less, ROI = region of influence, scf = standard cubic foot (feet).

S.8 SUMMARY AND COMPARISON OF ACCIDENTS

The analysis provides an estimate of the upper range of the potential fatalities that might occur as a result of the hypothetical highest-risk accident related to the proposed action (i.e., pilot testing of the proposed technology) or related to no action (i.e., continued storage). The term "highest-risk accident" is used in this analysis to define the accident scenario that has the highest combination of consequences (in terms of human fatalities) and probability of occurrence among all of the scenarios considered. For existing continued storage and for operations, highest risk accidents would involve the release of chemical agent; release of other materials would result in lesser consequences.

The hypothetical accident for the proposed action (pilot testing ACWA technologies) evaluates either an earthquake scenario (BGAD and PCD) or a rocket-handling accident scenario (ANAD and PBA). For the no action alternative (continued storage of the inventory), a lightning strike into a rocket storage igloo was evaluated for all sites except PCD. An aircraft crash into a storage igloo was used in this case. The greatest consequences from the no action alternative scenarios were always greater than or equal to the consequences from the proposed action scenarios.

The accidents evaluated could have consequences of major proportions, including human fatalities, the generation of large quantities of hazardous waste, destruction of wildlife and wildlife habitat, destruction of economic resources, and denial of access to historic or recreational properties. However, the accidents evaluated also have a low estimated probability of occurrence, on the order of 2×10^{-3} per year or less (1 occurrence in 476 years). Thus, the actual risk (consequences multiplied by probability) of such accidents is low.

S.9 SUMMARY AND COMPARISON OF CUMULATIVE IMPACTS

Cumulative impacts would result from adding the incremental impacts of the proposed action to other past, present, and reasonably foreseeable future actions. "Reasonably foreseeable future actions" are considered to be (1) actions that are covered in an environmental impact document that was either published or in preparation, (2) formal actions such as initiating an application for zoning approval or a permit, or (3) actions for which some funding has already been secured. Cumulative impacts could result from actions occurring at the same time or from actions occurring over a period of time.

An ACWA pilot test facility could take up to 34 months to construct and would operate for up to 36 months, depending on the duration of the pilot test program and the quantity of the stockpile. This short operational time frame reduces the potential for cumulative impacts. The two scenarios for cumulative impacts that were considered and that are presented below are (1) the construction and operation of an ACWA pilot test facility in addition to other activities that are occurring or planned on post and off post and (2) the construction and operation of an

ACWA facility in addition to other activities plus the operation of an incinerator. Tables S.9-1 through S.9-4 provide summaries of the cumulative impacts for each of the four installations.

TABLE S.9-1 Cumulative Impacts at ANAD

Impact Area	ACWA Facility + Operating Incinerator + Other Activities
Land use	An incinerator and ACWA pilot test facility together would disturb up to 150 acres (0.8% of the area of ANAD), some of it in previously disturbed areas. Other anticipated on-post activities would disturb additional land but would follow current on-post land use patterns. Cumulative land use impacts from on- and off-post activities should not be significant.
Electric power	A new transmission line and substation have been built to supply the incinerator. Additional power distribution infrastructure would be needed to meet electric power needs of an ACWA pilot and other on-post activities. Depending on the ACWA technology selected, more than 105 GWh/yr of electric power, in addition to the 33 GWh for the incinerator, might be needed. Together, these could represent an increase of about 220% over year 2000 consumption levels. Discussions with local planners indicated no current or foreseeable problems supplying electric power.
Natural gas	Additional gas distribution infrastructure would be needed beyond that built for the incinerator. Depending on the ACWA technology selected, more than 130 million scf/yr of natural gas, in addition to the 1.3 billion scf/yr required by the incinerator, would be needed while still supplying other on-post uses. This would represent an increase of about 460% over year 2000 consumption levels. Other future on-post actions would require additional gas. Discussions with local planners indicated no current or foreseeable problems with supplying natural gas.
Water supply and sewage treatment	Coldwater Spring has the capacity to support an ACWA facility, the incinerator, and other reasonably foreseeable on-post actions. The water supply system is being upgraded to support an incinerator. Additional water distribution pipelines and a supply system to provide for peak demands for emergency response would be needed for an ACWA facility. Other on-post activities would require additional pipelines beyond ACWA requirements to meet emergency demands. The existing sewage treatment plant is being upgraded to meet incinerator demands. Expanded treatment capacity might be required for an ACWA facility and other on-post facilities.
Waste management and facilities	The quantities of wastes generated by construction of an ACWA facility and other on-post facilities would be small and have minimal impacts on waste management systems. The quantities of wastes generated during operation of an ACWA facility and a baseline incinerator would represent a substantial increase for ANAD but would be minimal in the vicinity of the post. Sewage from both facilities together would represent a large increase over the sewage treated in 1999. A new sewage treatment plant will be available for the incinerator. An additional increase in sewage treatment capacity might be needed to handle the additional load from an ACWA facility.
Air quality	Simultaneous construction of an ACWA facility and operation of the incinerator would not cause ambient air concentrations in excess of particulate NAAQS levels. Concentrations during construction of an ACWA facility would exceed 99% of the NAAQS level for annual $PM_{2.5}$, but existing background levels are already near or above this NAAQS level in Alabama. During operation, concentrations of everything except annual $PM_{2.5}$ would be, at most, 83% of NAAQS levels. Concentrations of annual $PM_{2.5}$ during operation would be 97% of the NAAQS level. Other future on- and off-post actions would contribute small or temporary increases to these levels.

TABLE S.9-1 (Cont.)

Impact Area	ACWA Facility + Operating Incinerator + Other Activities
Human health and safety — routine operations	Particulate NAAQS levels would not be exceeded off-post during construction of an ACWA facility. For annual $PM_{2.5}$ levels, however, operation of an incinerator and construction of an ACWA facility would raise the maximum level to over 99% of NAAQS level. During routine operations, annual $PM_{2.5}$ would be about 97% of the NAAQS level. Other actions would contribute small concentrations to these levels and raise the annual $PM_{2.5}$ concentrations. The preexisting high background level almost equal to the NAAQS presents a potential for cumulative adverse health impacts off post. The total carcinogenic risk for operating an ACWA facility and incinerator would be 82% of the level generally considered negligible (a risk level of one in 1 million). The maximum agent concentration from simultaneous operation of both facilities would be 0.68% of the allowable level recommended by the CDC. It is unlikely, however, that this level would be reached during normal operations.
Noise	The cumulative off-post noise level during construction of an ACWA facility and during concurrent operation of both facilities would be less than the EPA's 55-dBA guideline.
Visual resources	Increased traffic and dust during construction of an ACWA facility would be temporary and intermittent. During operations, an ACWA pilot facility would produce a small plume. When present, the plume would add to the visual impact of the large steam plume from the incinerator. Other on-post actions would be in keeping with the industrial nature of the southeastern portion of the post. Overall visual impacts in the vicinity of ANAD would not be significant.
Soils	Construction activities would increase erosion and the potential for accidental spills and releases. These impacts would be temporary and minor if best-management practices were followed. Deposition from operations of an ACWA facility would add to deposition from an incinerator, but, given the low emissions from both units, the cumulative impact should be negligible. There would be no significant cumulative impact on surface soils from routine operation of an ACWA facility, the incinerator, and other on- and off-post actions.
Groundwater	Coldwater Spring supplies water to ANAD. Impacts on groundwater from construction of an ACWA and other on-post facilities would be negligible if standard precautions were taken to prevent leaks and spills. Operation of an ACWA facility and incinerator could use up to 94 million gal/yr of water, about 1.4% of Coldwater Spring's minimum flow. Water use by other on-post facilities would be smaller, and cumulative needs would not exceed the water available from Coldwater Spring. Neither facility would release process water. The discharge of treated sanitary sewage from both facilities and future on-post actions would not affect groundwater flows.
Surface water	Construction impacts on surface flow would be negligible to minor and could be naturally mitigated by standard construction practices. Neither an ACWA facility nor the incinerator would discharge process water during operation. Together, both facilities would discharge about 15 million gal/yr of treated sanitary sewage. This discharge would be small compared to surface water flows and would not significantly change flow conditions in the vicinity of ANAD. Water discharges from other on-post actions would not be expected to affect surface water flows significantly.
Terrestrial habitats and vegetation	Construction of an ACWA facility would disturb up to 77 acres of previously undisturbed land in addition to the 70 acres disturbed by construction of the incinerator. Each new on-post construction action would disturb additional land and increase vegetation and habitat loss. Emissions from an ACWA facility and incinerator along with future on-post and off-post actions would have negligible impacts on terrestrial habitats and vegetation.

TABLE S.9-1 (Cont.)

Impact Area	ACWA Facility + Operating Incinerator + Other Activities
Wildlife	Construction of an ACWA facility would disturb up to 77 acres of land in addition to the 70 acres disturbed by construction of the incinerator. Each new on-post construction action would increase habitat loss, human activity, and construction traffic, causing additional deaths among less mobile species and displacing additional wildlife during the construction period. Increased noise would cumulatively displace additional small mammals and increase the potential for habitat abandonment by songbirds. Additional operations on post would increase roadkills. Emissions from an ACWA facility and the incinerator along with other future on-post and off-post actions would have negligible impacts on wildlife.
Aquatic habitats and fish	Disturbance of streams in Area A could result in loss of aquatic habitat. Construction in any of the three proposed areas could result in impacts on downstream habitats. Avoidance of streams where possible and implementation of erosion and sedimentation controls would minimize the potential for construction impacts. Operational impacts from an ACWA facility and the incinerator would be small. The minor emissions potential of other reasonably foreseeable actions and the distance from the ACWA facility of those actions should mean that during routine operations, cumulative impacts from an ACWA facility, the incinerator, and other on- and off-post actions would be negligible.
Protected species	Construction of an ACWA facility and associated utility corridors and construction of other reasonably foreseeable on-post facilities would not be likely to affect protected species adversely. Implementation of runoff and sedimentation controls during construction of an ACWA facility and other future on-post facilities would reduce the potential for impacts on the aquatic habitats of protected species. Impacts on protected species from routine operations of an ACWA facility, the incinerator, and other future on- and off-post activities would be negligible.
Wetlands	Construction of an ACWA facility in Area A would be likely to require construction in a 100-yr floodplain, an adverse impact. It could also result in the loss of wetlands, which could have an adverse impact. Construction in any of the three areas could affect downstream wetlands. Impacts downstream from the areas would be negligible if standard measures for controlling erosion and runoff are followed. Cumulative impacts from routine operations of an ACWA facility, the incinerator, and other future on- and off-post actions would be negligible.
Socioeconomics	Cumulative impacts from constructing and operating an ACWA facility, the baseline incinerator, and other future on- and off-post actions would be relatively small. Adverse cumulative impacts on housing should not occur. Even if other reasonably foreseeable actions were to occur during operation of the baseline incinerator and construction and operation of the ACWA facility, the potential cumulative impacts on the local economy, local labor markets, and public and community services would be minor. Operation of the baseline incinerator with concurrent construction and operation of an ACWA facility and other future actions might have moderate impacts on the local transportation network.
Environmental justice	During construction and routine operation of an ACWA facility, the incinerator, and other future actions, no high and adverse human health or socioeconomic impacts on populations are anticipated. Consequently, significant environmental justice impacts are not anticipated.

TABLE S.9-2 Cumulative Impacts at PBA

Impact Area	ACWA Facility + Operating Incinerator + Other Activities
Land use	Depending on the location chosen, the PBCDF and construction of an ACWA pilot facility would disturb up to 82 acres of land (0.5% of the area of PBA). Cumulative land use impacts from on- and off-post activities should not be significant.
Water supply and sewage treatment	There would be no off-post impacts on water supply and infrastructure, since these systems are self-contained at PBA. New water distribution pipelines and sewage pipelines, in addition to those supplying the incinerator, would be required for an ACWA facility. Water supply at PBA is sufficient to meet the needs of an ACWA facility, the PBCDF, and other on-post actions. PBA currently has the capacity to treat the sewage from these facilities.
Electric power	Depending on the technology chosen, an ACWA facility would require up to 120 GWh of electric power annually, in addition to the 33 GWh required by the incinerator, an increase of about 450% over current consumption levels. New power lines and service connections would be needed to supply the power needs of the ACWA facility. Discussions with local planners indicated no current or foreseen problems supplying electric power.
Natural gas	The existing infrastructure could not supply the natural gas needs of an ACWA pilot facility. Additional pipelines would be needed for an ACWA facility as well as for any other new on-post activities. An ACWA facility and incinerator would require about 1.4 billion scf of natural gas annually, increasing current natural gas consumption by 340% during operation while still supplying existing on-post use. This would be a significant increase in the consumption of natural gas at PBA. Discussions with local planners indicated no current or foreseen problems supplying natural gas.
Waste management and facilities	The quantities of construction wastes generated by an ACWA facility and other on-post facilities would be small and have minimal impacts on waste management systems. The quantities of wastes generated during the operation of an ACWA facility and the PBCDF would represent a substantial increase for PBA but would be minimal in the vicinity of the post. Both facilities together would discharge less than 21% of the amount of sewage currently discharged. PBA currently has the capacity to treat this and other reasonably foreseeable increases in sewage.
Air quality	Simultaneous construction of an ACWA facility and operation of the PBCDF would not cause ambient concentrations in excess of particulate NAAQS levels. Concentrations during construction of an ACWA facility could exceed 99% of the NAAQS level for annual $PM_{2.5}$, but already existing background levels are near or above this NAAQS level in Arkansas. Except for annual $PM_{2.5}$, ambient concentrations during simultaneous operation of both facilities would be, at most, 84% of NAAQS levels. Annual $PM_{2.5}$ concentrations would exceed 96% of the NAAQS level. Other future on- and off-post actions would raise the cumulative annual $PM_{2.5}$ level during construction and operation of an ACWA facility.

TABLE S.9-2 (Cont.)

Impact Area	ACWA Facility + Operating Incinerator + Other Activities
Human health and safety — routine operations	NAAQS levels would not be exceeded off post during construction or operation of an ACWA facility. For $PM_{2.5}$, however, operation of the PBCDF and construction of an ACWA facility could raise the maximum level to more than 99% of the NAAQS level for annual $PM_{2.5}$, while concurrent operation of both facilities could result in a maximum level of more than 96% of this level. Other future actions would contribute small concentrations to this level and raise the cumulative annual $PM_{2.5}$ concentrations. Because of the preexisting high background level, there is a potential for cumulative adverse health impacts off post. Noncarcinogenic risks from operation of an ACWA facility and the PBCDF along with the Central Incinerator Complex would be less than 20% of the levels considered to present hazards. The maximum increase in carcinogenic risk to on- and off-post populations from concurrent operation of an ACWA facility, the PBCDF, and the Central Incinerator Complex would be in the lower end of the target range used by the EPA to determine whether cleanup of hazardous waste sites is warranted and would generally be considered negligible. The maximum increase in agent concentration from the ACWA facility and PBCDF operations would be, at most, 0.06% of the maximum allowable level recommended by the CDC. It is unlikely, however, that these levels would be reached during routine operations.
Noise	The cumulative off-post noise impact from construction and operation of an ACWA facility, the PBCDF, and other future on- and off-post actions would not exceed the EPA's 55-dBA guideline.
Visual resources	Current actions and reasonably foreseeable future on-post actions are in keeping with the existing visual character of PBA. Traffic and dust during construction of the ACWA facility would be visible but intermittent and temporary. During operation, a small plume would be visible from an ACWA pilot facility. This would add to the visual impact of the large plume from the incinerator. However, the cumulative visual impact would remain in keeping with the visual character of the installation and would not be significant.
Soils	Construction activities would increase erosion and the potential for accidental spills and releases. These impacts would be temporary and minor if best management practices were followed. There would be no significant cumulative impacts on surface soils from the routine operations of an ACWA facility, the PBCDF, and other on- and off-post actions.
Groundwater	All water used at PBA is withdrawn from the Sparta Aquifer. Impacts on groundwater from the construction of an ACWA facility and other on-post facilities would be negligible if standard precautions were taken to prevent leaks and spills. The operation of an ACWA facility, the PBCDF, and other on-post activities would represent an increase of 28% in current water use at PBA and an increase of 0.49% in current withdrawals in the vicinity of PBA. The on-post wells could supply the increased need. Other on- and off-post actions would increase the withdrawals from the aquifer. In view of the large ground water supply, cumulative impacts on groundwater supplies would not be significant. During operation of an ACWA facility and the PBCDF, all liquid process wastes would be recycled, and there would be no discharge of process wastewater. Hence, there would be no groundwater impacts involving discharges from facilities.
Surface water	Construction impacts on surface flow would be negligible to minor and could be naturally mitigated by standard construction practices. Surface water is not used for potable water supply at PBA. Impacts from the operation of an ACWA facility and other on-post facilities should be negligible if standard precautions to prevent leaks and spills are followed. During the routine operation of an ACWA facility and the PBCDF, all liquid process wastes would be recycled. There would be no discharge of process water. Sanitary sewage would be treated in the on-post treatment plant. An ACWA facility and the PBCDF together would discharge about 15 million gal/yr of sewage, less than 21% of the amount currently discharged. The cumulative additional discharge should not affect surface water flows on PBA or in the vicinity.

TABLE S.9-2 (Cont.)

Impact Area	ACWA Facility + Operating Incinerator + Other Activities
Terrestrial habitats and vegetation	Construction of an ACWA facility would disturb 37 acres in addition to the 45 acres already disturbed by construction of the PBCDF. Construction of other on-post facilities would increase loss of vegetation. Emissions from both facilities and reasonably foreseeable future actions would be small and would have negligible impacts on terrestrial biota in the vicinity of PBA.
Wildlife	Construction of an ACWA facility would disturb 37 acres in addition to the 45 acres already disturbed by the construction of the PBCDF. Construction of other on-post facilities would increase habitat loss, human activity, and construction traffic, thereby causing additional deaths among less mobile species and displacing additional wildlife. Increased noise would displace additional small mammals and lead to potential increased habitat abandonment by songbirds. Additional operations on post would increase roadkills. Cumulative impacts on wildlife due to emissions from an ACWA facility, the PBCDF, and other potential on- and off-post actions would be negligible.
Aquatic habitats and fish	Aquatic habitats and fish would not be likely to suffer impacts from construction of an ACWA pilot test facility along with other reasonably foreseeable on-post activities if runoff and siltation control measures were employed. Any impacts would add to impacts already caused by construction of the PBCDF. During routine operations, air emissions and deposition from an ACWA facility, the PBCDF, and other on- and off-post actions would have negligible impacts on aquatic habitats and fish.
Protected species	No federal listed species are known to occur at PBA. Cumulative impacts on protected species from an ACWA pilot test facility, the PBCDF, and other reasonably foreseeable actions would be negligible.
Wetlands	Both Area A and Area B contain wetlands that could be eliminated or affected by construction of an ACWA facility. There are wetlands in Area C where the conventional weapons SCWO will be constructed. Avoidance of wetlands and the use of standard practices for controlling runoff, sedimentation, and erosion would reduce the potential for impacts on wetlands. Cumulative impacts from routine operations of an ACWA facility, the PBCDF, and other potential on-post actions would be negligible. Reasonably foreseeable off-post actions would be too far away to affect wetlands on PBA.
Socioeconomics	The cumulative impacts from constructing and operating an ACWA facility, the PBCDF, and other future on- and off-post actions would be relatively small. Adverse cumulative impacts on housing should not occur. Even if other reasonably foreseeable actions were to occur during the construction and operation of an ACWA facility and operation of the PBCDF, the potential cumulative impacts on the local economy, local labor markets, and public and community services would be minor. Operation of the PBCDF with concurrent construction and operation of an ACWA facility and other future actions might have moderate impacts on the local transportation network.
Environmental justice	Construction and routine operation of an ACWA facility, the PBCDF, and other future operations are not anticipated to contribute to high and adverse human health or socioeconomic impacts to populations. Consequently, significant environmental justice impacts are not anticipated.

TABLE S.9-3 Cumulative Impacts at PCD

Impact Area	ACWA Facility + Other Activities	ACWA Facility + Incinerator + Other Activities
Land use	This scenario would require 85 acres, 0.4% of PCD's land area. Activities would be consistent with current and future land use under the reuse plan. Cumulative land use impacts from on- and off-post activities should not be significant.	This scenario would require 170 acres, 0.8% of PCD's land area. Activities would be consistent with current and future land use under the reuse plan. Cumulative land use impacts from on- and off-post activities should not be significant.
Electric power	Depending on which technology was chosen, more than 60 GWh/yr of additional electric power would be needed for an ACWA facility, an increase of more than 500% over recent consumption levels. Local electric supplies could meet this demand. Current infrastructure would have to be expanded to meet the needs both of an ACWA facility and of future on-post operations. Discussions with local planners indicated no current or foreseen problems with supplying electric power.	Depending on which technology was chosen, more than 89 GWh/yr of additional electric power would be needed for an ACWA facility and an incinerator, an increase of more than 800% over current consumption levels. Local electric supplies could meet this demand. Additional infrastructure would be needed beyond that required for an ACWA facility and other future on-post operations. Discussions with local planners indicated no current or foreseen problems with supplying electric power.
Natural gas	Depending on which technology was chosen, more than 149 million scf of gas would be needed annually for an ACWA facility. Additional gas would be required for other future on-post needs. Local gas supplies could meet this demand. More pipelines and stations would be essential for an ACWA facility as well as other future on-post needs. Discussions with local planners indicated no current or foreseen problems with supplying natural gas.	Depending on which technology was chosen, more than 609 million scf of gas would be needed annually for an ACWA facility and an incinerator. Additional gas would be required for other future on-post needs. Local gas supplies could meet this demand. More pipelines and stations would be essential for an incinerator, beyond those required by an ACWA facility and other future on-post needs. Discussions with local planners indicated no current or foreseen problems with supplying natural gas.
Water supply and sewage treatment	Water use during the construction and operation of an ACWA facility and other reasonably foreseeable on-post actions would be less than historic peak groundwater withdrawals and could be supplied. Additional delivery and storage systems would be needed to support an ACWA facility and other future on-post facilities. Expansion of existing sewage lagoons might be required.	Water use during the construction and operation of an ACWA facility, an incinerator, and other reasonably foreseeable on-post actions would be less than historic peak groundwater withdrawals and could be supplied. Additional delivery and storage systems would be needed beyond those required to support an ACWA facility and other future on-post facilities. Expansion of existing sewage lagoons might be required.
Waste management and facilities	The quantities of wastes generated by construction and operation of an ACWA facility and other on-post future facilities would represent a substantial increase for PCD but would be minimal in the vicinity of the installation. The additional sanitary waste generated by an ACWA facility and other on-post future actions might require expansion of the on-post evaporative lagoons.	The quantities of wastes generated by construction and operation of an ACWA facility, a baseline incinerator, and other on-post future facilities would represent a substantial increase for PCD but would be minimal in the vicinity of the installation. The additional sanitary waste generated by an ACWA facility, an incinerator, and other on-post future actions might require expansion of the on-post evaporative lagoons.

TABLE S.9-3 (Cont.)

Impact Area	ACWA Facility + Other Activities	ACWA Facility + Incinerator + Other Activities
Air quality	Simultaneous construction of an ACWA facility and other on- and off-post facilities would not cause off-post particulate levels to exceed NAAQS levels. Operation of an ACWA facility and other on- and off-post facilities would not cause off-post criteria pollutant levels to exceed NAAQS levels.	Simultaneous construction of a baseline ACWA facility, an incinerator, and other on- and off-post facilities would not cause off-post particulate levels to exceed NAAQS levels. Operation of an ACWA facility, an incinerator, and other on- and off-post facilities would not cause off-post criteria pollutant levels to exceed NAAQS levels.
Human health and safety — routine operations	No adverse cumulative impacts on the health of the off-post public would occur during construction of an ACWA facility and other on- and off-post facilities. Applicable ambient standard levels for criteria pollutants would not be exceeded during construction or operation of an ACWA facility and other on- and off-post actions. The maximum increase in carcinogenic risk to on- and off-post populations from ACWA facility operations would be about 20% of the level generally considered negligible. The maximum concentration of agent from ACWA operations would be 0.2% of the allowable level recommended by the CDC. Other future on-post facilities would contribute negligible health risks.	No adverse cumulative impacts on the health of the off-post public would occur during construction of an ACWA facility, an incinerator, and other on- and off-post facilities. Applicable ambient standard levels for criteria pollutants would not be exceeded during concurrent construction and operation of an ACWA facility and a baseline incinerator with other on- and off-post actions. The maximum increase in carcinogenic risk to on- and off-post populations from an ACWA facility and incinerator operations would be about 82% of the level generally considered negligible. The maximum concentration of agent from ACWA facility operations would be 0.4% of the allowable level recommended by the CDC. Other future on-post facilities would contribute negligible health risks.
Noise	Cumulative noise levels at the nearest residences during construction and operation of an ACWA facility and other on-post facilities would be less than the EPA's 55-dBA guideline.	Simultaneous construction and operation of an incinerator and an ACWA facility would increase cumulative noise levels at the nearest residences by, at most, a barely perceptible 3 dBA. The cumulative level would still be below the EPA's 55-dBA guideline.
Visual resources	Construction and operation of an ACWA facility would be consistent with the largely industrial nature of PCD. Any plumes from an ACWA facility and other on-post actions would be small. No adverse visual impacts would result from construction and operation of an ACWA facility and other on- and off-post facilities.	Construction and operation of an incinerator and an ACWA facility would be consistent with the largely industrial nature of PCD. Any plumes from an ACWA facility and other on-post actions would be small. An operating incinerator would produce a larger, additional plume. No adverse visual impacts would result from construction and operation of an ACWA facility, an incinerator, and other on- and off-post facilities.
Soils	Construction could contribute to soil erosion and to accidental spills and releases. These impacts would be temporary and minor if best-management practices were followed. There should be no significant impacts on soils from routine operations of an ACWA facility and other on-post facilities.	Construction could contribute to soil erosion and to accidental spills and releases. These impacts would be temporary and minor if best-management practices were followed. Impacts from an incinerator would add to the impacts of an ACWA facility alone, but there should be no significant cumulative impacts on soils from routine operations of an ACWA facility, an incinerator, and other on-post facilities.

TABLE S.9-3 (Cont.)

Impact Area	ACWA Facility + Other Activities	ACWA Facility + Incinerator + Other Activities
Groundwater	PCD water use during operation of an ACWA facility and other on-post actions would exceed 24 million gal/yr. This use is less than historic peak withdrawals from the terrace alluvial aquifer. However, PCD would have to purchase additional water rights. After completion of pilot testing, withdrawals would cease, and the aquifer would recharge quickly. PCD is hydrologically isolated from off-post activities, so there would be no cumulative impacts on groundwater quantity or quality. No contamination of groundwater should occur during construction of any facilities if standard precautions are taken to prevent leaks and spills. The ACWA facility and other on-post facilities would not be expected to release substances to the groundwater during routine operations.	PCD water use during operation of an ACWA facility, an incinerator, and other on-post actions would exceed 48 million gal/yr. This use is less than historic peak withdrawals from the terrace alluvial aquifer. However, PCD would have to purchase additional water rights. After completion of chemical demilitarization, withdrawals would cease, and the aquifer would recharge quickly. PCD is hydrologically isolated from off-post activities, so there would be no cumulative impacts on groundwater quantity or quality. No contamination of groundwater should occur during construction of any facilities if standard precautions are taken to prevent leaks and spills. An ACWA facility, an incinerator, and other on-post facilities would not be expected to release substances to the groundwater during routine operations.
Surface water	Cumulative impacts on surface flow from construction of an ACWA facility and other on-site facilities would be negligible to minor and could be naturally mitigated by standard construction practices. Routine operation of an ACWA facility would not result in additional releases to surface waters. Cumulatively, the impacts from an ACWA facility and other reasonably foreseeable actions would be small. Domestic sewage would be treated in lined evaporative lagoons before release.	Cumulative impacts on surface flow from construction of an ACWA facility, an incinerator, and other on-post facilities would be negligible to minor and could be naturally mitigated by standard construction practices. Routine operation of an ACWA facility and an incinerator would not result in additional releases to surface waters. Cumulatively, the impacts from an ACWA facility, an incinerator, and other reasonably foreseeable actions would be small. Domestic sewage would be treated in lined evaporative lagoons before release.
Terrestrial habitats and vegetation	Construction of an ACWA facility and associated infrastructure would disturb about 85 acres of land. Each new construction activity would increase loss of vegetation as sites were cleared. Emissions from an ACWA facility and other future actions would have negligible impacts on terrestrial habitats and vegetation.	Construction of an ACWA facility, an incinerator, and associated infrastructure would disturb about 170 acres of land, causing greater impact on terrestrial habitats and vegetation than would construction of an ACWA facility alone. Each new construction activity would increase loss of vegetation as sites were cleared. Emissions from an ACWA facility, an incinerator, and other on-site future actions would have negligible impacts on terrestrial habitats and vegetation.

TABLE S.9-3 (Cont.)

Impact Area	ACWA Facility + Other Activities	ACWA Facility + Incinerator + Other Activities
Wildlife	Construction of an ACWA facility and associated infrastructure would disturb about 85 acres of land. Each new on-post construction activity would increase habitat loss, increase human activities, cause additional deaths among less mobile species, and displace additional wildlife. Further operations on-post would increase traffic, with a consequent increase in roadkills. Emissions from an ACWA facility and other future on- and off-post actions would have negligible impacts on wildlife.	Construction of an ACWA facility, an incinerator, and associated infrastructure would disturb about 170 acres of land, causing greater impacts on wildlife than would construction of an ACWA facility alone. Each new on-post construction activity would increase habitat loss, increase human activities, cause additional deaths among less mobile species, and displace additional wildlife. Adding an incinerator on post would increase traffic, with a consequent upsurge in roadkills beyond the levels associated with an ACWA facility alone. Emissions from an ACWA facility, an incinerator, and other future on- and off-post actions would have negligible impacts on wildlife.
Aquatic habitats and fish	No aquatic resources occur in the areas proposed for construction of an ACWA facility or other on-post future actions. Operation of these facilities would have negligible impacts on aquatic habitats and fish.	No aquatic resources occur in the areas proposed for construction of an ACWA facility, an incinerator, or other on-post future actions. Impacts from incinerator operations would add to impacts from an ACWA facility. Overall, operation of these facilities would have negligible impacts on aquatic habitats and fish.
Protected species	Construction impacts, if any, would depend on the location selected for the facility. Avoiding the southern portions of Areas B and C and the shrubland habitat in Areas A and B would minimize potential adverse impacts. Cumulative impacts from routine operations of an ACWA facility and other future on- and off-post actions would be negligible.	Construction impacts beyond those associated with an ACWA facility would depend on the location selected for an incinerator. Avoiding the southern portions of Areas B and C and the shrubland habitat in Areas A and B would minimize potential adverse impacts. Cumulative impacts from routine operations of an ACWA facility, an incinerator, and other future on- and off-post actions would be negligible.
Wetlands	There are no wetlands in the areas proposed for an ACWA facility and other future on-post actions. Operations of an ACWA facility and other on- and off-post facilities would have negligible impacts on wetlands.	There are no wetlands in the areas proposed for an ACWA facility, an incinerator, and other future on-post actions. Operations of an ACWA facility, an incinerator, and other on- and off-post facilities would have negligible impacts on wetlands.
Socioeconomics	The cumulative impacts from constructing and operating an ACWA facility and other future on- and off-post actions would be relatively small. Adverse cumulative impacts on housing should not occur. Even if other reasonably foreseeable actions were to occur during the construction and operation of an ACWA facility, the potential cumulative impacts on the local economy, local labor markets, and public and community services would be minor. Concurrent construction and operation of an ACWA facility and other future actions might have minor impacts on the local transportation network.	The cumulative impacts from constructing and operating an ACWA facility, a baseline incinerator, and other future on- and off-post actions would be relatively small. Adverse cumulative impacts on housing should not occur. Even if other reasonably foreseeable actions were to occur during the concurrent construction and operation of an ACWA facility and an incinerator, the potential cumulative impacts on the local economy, local labor markets, and public and community services would be minor. Concurrent construction and operation of an ACWA facility, an incinerator, and other future actions might have moderate impacts on the local transportation network.

TABLE S.9-3 (Cont.)

Impact Area	ACWA Facility + Other Activities	ACWA Facility + Incinerator + Other Activities
Environmental justice	During construction and routine operation of an ACWA facility and other on-post actions, no high and adverse impacts on human health or socioeconomic impacts on populations are anticipated. Consequently, significant environmental justice impacts are not anticipated.	A baseline incinerator would add to the human health and socioeconomic impacts from an ACWA facility alone. The overall impacts of an ACWA facility, an incinerator, and other on-post actions would not be high and adverse. Consequently, significant environmental justice impacts are not anticipated.

TABLE S.9-4 Cumulative Impacts at BGAD

Impact Area	ACWA Facility + Other Activities	ACWA Facility + Incineration + Other Activities
Land use	This scenario would require 95 acres, 0.6% of BGAD's land area. Activities would be consistent with use of BGAD for industrial activities and the continuing trend of urbanization in the BGAD vicinity. Cumulative land use impacts from on- and off-post activities should not be significant.	This scenario would require 180 acres, 1.2% of BGAD's land area. Activities would be consistent with use of BGAD for industrial activities and the continuing trend of urbanization in the BGAD vicinity. Development of two destruction facility sites may interfere with other site activities. Cumulative land use impacts from on- and off-post activities should not be significant.
Electric power	Depending on which technology was chosen, up to 120 GWh/yr of additional electric power would be needed for an ACWA facility, an increase of 1,500% over year 2000 consumption levels. Local electric supplies could meet this demand. Current infrastructure would need to be expanded. Discussions with local planners indicated no current or foreseen problems with supplying electric power.	Depending on which technology was chosen, up to 150 GWh/yr of additional electric power would be needed for an ACWA facility and a baseline incinerator, an increase of about 2,000% over year 2000 consumption. Local electric supplies could meet this demand. Additional infrastructure would be required in addition to that necessary for an ACWA facility and other future on-post needs. Discussions with local planners indicated no current or foreseen problems with supplying electric power.
Natural gas	Existing infrastructure could not supply the needs both of an ACWA facility and other future on-post facilities. Additional gas lines and metering stations would be necessary. Depending on which technology was chosen, an ACWA facility would significantly increase natural gas consumption at BGAD, requiring up to 140 million scf/yr, a large increase over current consumption levels. Discussions with local planners indicated no current or foreseen problems with supplying natural gas.	Existing infrastructure could not supply the needs of an ACWA facility, a baseline incinerator, and other future on-post facilities. Additional gas lines and metering stations would be needed. Depending on which technology was chosen, an ACWA facility and a baseline incinerator would significantly increase natural gas consumption at BGAD, requiring up to 978 million scf/yr, a large increase over current consumption levels. Discussions with local planners indicated no current or foreseen problems with supplying natural gas.
Water supply and sewage treatment	Current water supply capacity would be sufficient to meet demands of an ACWA facility and other reasonably foreseeable on-post actions. Additional delivery, storage, and emergency supply systems would be needed. Additional sewage treatment capacity would be necessary.	Current water supply capacity would be sufficient to meet the demands of an ACWA facility, an incinerator, and other reasonably foreseeable on-post actions. Additional delivery, storage, and emergency supply systems would be needed beyond those necessary to support an ACWA facility and other future on-post facilities. Additional sewage treatment capacity would be required beyond that needed for an ACWA facility and other future on-post facilities.

TABLE S.9-4 (Cont.)

Impact Area	ACWA Facility + Other Activities	ACWA Facility + Incineration + Other Activities
Waste management and facilities	The quantities of wastes generated during construction would be small and would have minimal impacts on waste management systems. The quantities of wastes generated during operations of an ACWA facility and other on-post facilities would represent a substantial increase for BGAD but would be minimal in the vicinity of the post. An ACWA facility would increase the amount of sanitary sewage needing treatment by about 21%. Other future on-post facilities would produce additional sewage. Additional sewage treatment capacity would be necessary.	The quantities of wastes generated during construction would be small and would have minimal impacts on waste management systems. The quantities of wastes generated during operations of a baseline incinerator and an ACWA facility would represent a substantial increase for BGAD but would be minimal in the vicinity of the post. An ACWA facility and a baseline incinerator would increase the amount of sanitary sewage needing treatment by about 54%. Other future on-post facilities would produce additional sewage. Additional sewage treatment capacity would be needed.
Air quality	Simultaneous construction of an ACWA facility and other future on-post actions would not cause concentrations in excess of PM_{10} and 24-hour $PM_{2.5}$ NAAQS levels. The annual $PM_{2.5}$ NAAQS level would be exceeded, but background levels in the vicinity of BGAD and throughout Kentucky already exceed this level, even without an ACWA facility. With the exception of the annual $PM_{2.5}$ concentration, operations of an ACWA facility and other future on-post facilities would not cause off-post concentrations to exceed NAAQS levels. All new activities would add small increments to the current levels of $PM_{2.5}$.	Simultaneous construction of an ACWA facility, a baseline incinerator, and other future on-post actions would not cause concentrations in excess of PM_{10} and 24-hour $PM_{2.5}$ NAAQS levels. The annual $PM_{2.5}$ NAAQS level would be exceeded, but background levels in the vicinity of BGAD and throughout Kentucky already exceed this level, even without an ACWA facility. Simultaneous construction of an ACWA facility and a baseline incinerator would add less than 3% of the annual $PM_{2.5}$ NAAQS level. With the exception of the annual $PM_{2.5}$ concentration, operations of an ACWA and other future on-post facilities would not cause off-post concentrations to exceed NAAQS levels. All new activities would add small increments to the current levels of $PM_{2.5}$. Simultaneous operation of an ACWA facility and a baseline incinerator would add less than 3% to the annual $PM_{2.5}$ NAAQS level.
Human health and safety — routine operations	Except for the potential for adverse cumulative impacts associated with existing annual $PM_{2.5}$ concentrations, which already exceed NAAQS levels, no adverse cumulative impacts on the health of the off-post public would occur. The maximum increase in carcinogenic risk to on- and off-post populations from ACWA facility operations would be about 0.2% of the level generally considered negligible. The maximum agent concentration from ACWA facility operations would be, at most, 0.26% of the maximum allowable level recommended by the CDC. Increases in health risks beyond those associated with an ACWA facility would be negligible.	Except for the potential for adverse cumulative impacts associated with existing annual $PM_{2.5}$ concentrations, which already exceed NAAQS levels, no adverse cumulative impacts on the health of the off-post public would occur from the construction and operation of an ACWA facility, a baseline incinerator, and other future on- and off-post facilities. The maximum increase in carcinogenic risk to on- and off-post populations from simultaneous ACWA facility and baseline incinerator operations would be about 62% of the level generally considered negligible. The maximum agent concentration from routine operations of an ACWA facility and a baseline incinerator would be, at most, 0.52% of the maximum allowable level recommended by the CDC. Increases in health risks beyond those associated with an ACWA facility would be negligible.

TABLE S.9-4 (Cont.)

Impact Area	ACWA Facility + Other Activities	ACWA Facility + Incineration + Other Activities
Noise	Construction and operation of an ACWA facility and other future on-post actions would result in noise levels below the EPA's 55-dBA guideline at the nearest boundary.	Simultaneous construction and operation of an ACWA facility and a baseline incinerator would increase cumulative noise levels at the nearest boundary by, at most, a barely perceptible 3 dBA. The cumulative level would still be below the EPA's 55-dBA guideline.
Visual resources	The cumulative visual impacts from construction and operation of an ACWA facility would remain in keeping with the visual character of BGAD and the surrounding area and would not be significant. Any plumes from an ACWA facility and other on-post actions would be small.	The cumulative visual impacts from construction and operation of an ACWA facility and an incinerator would remain in keeping with the visual character of BGAD and the surrounding area and would not be significant. Any plumes from an ACWA facility and other on-post actions would be small. An operating baseline incinerator would produce an additional, larger plume.
Soils	Construction activities would increase erosion and the potential for accidental spills and releases. These impacts would be temporary and minor if best-management practices were followed. There would be no significant impacts on soils from routine operations of an ACWA facility along with other on- and off-post facilities.	Construction activities would increase erosion and the potential for accidental spills and releases. These impacts would be temporary and minor if best-management practices were followed. Impacts from a baseline incinerator would add to the impacts of an ACWA facility alone, but there should be no significant cumulative impacts on soils from routine operations of an ACWA facility, a baseline incinerator, and other on- and off-post facilities.
Groundwater	Groundwater is not used for water supplies at BGAD. No contamination of groundwater should occur during construction of any facilities if standard precautions are taken to prevent leaks, spills, and erosion. An ACWA facility would not release process water during normal operations. Other on-post facilities would have negligible or no impacts on groundwater. Increased sewage treatment flows from new on-post facilities would not affect groundwater resources.	Groundwater is not used for water supplies at BGAD. No contamination of groundwater should occur during construction of any facilities if standard precautions are taken to prevent leaks, spills, and erosion. Neither an ACWA facility nor a baseline incinerator would release process water during normal operations. Other on-post facilities would have negligible or no impacts on groundwater. Increased flows from sewage treatment from new on-post facilities would not affect groundwater resources.

TABLE S.9-4 (Cont.)

Impact Area	ACWA Facility + Other Activities	ACWA Facility + Incineration + Other Activities
Surface water	On-post Lake Vega supplies water to BGAD. Construction impacts on surface flow would be negligible to minor and could be naturally mitigated by standard construction practices. Depending on which technology was chosen, an ACWA facility could use up to 24 million gal/yr of water. Current water supply capacity would be sufficient to meet this need. Other future on-post actions would use additional, minor quantities of water. None of the ACWA technologies would discharge process water during operation. The discharge of additional sanitary sewage would not affect surface water flows. Other future on-post facilities would produce additional minor quantities of sewage.	On-post Lake Vega supplies water to BGAD. Construction impacts on surface flow would be negligible to minor and could be naturally mitigated by standard construction practices. Depending on which technology was chosen, an ACWA facility and a baseline incinerator could use up to 127 million gal/yr of water. Current water supply capacity would be sufficient to meet this need. Other future on-post actions would use additional minor quantities of water. Neither an ACWA facility nor a baseline incinerator would discharge process water during operation. The discharge of additional sanitary sewage from both facilities would not affect surface water flows. Other future on-post facilities would produce additional minor quantities of sewage.
Terrestrial habitats and vegetation	Construction of an ACWA facility and associated infrastructure could disturb up to 95 acres of land. Each new construction activity would increase loss of vegetation as sites were cleared. Emissions from an ACWA facility would be small and would have negligible impacts on terrestrial habitats and vegetation. Impacts on terrestrial habitats and vegetation from off-post actions could not be quantified but are expected to be minor.	Construction of an ACWA facility, a baseline incinerator, and associated infrastructure could disturb up to 180 acres of land. Each new construction activity would increase loss of vegetation as sites were cleared. Emissions from an AWCA facility, a baseline incinerator, and other future on-post actions would be small and would have negligible impacts on terrestrial habitats and vegetation. Impacts on terrestrial habitats and vegetation from off-post actions could not be quantified but are expected to be minor.
Wildlife	Construction of an ACWA facility and associated infrastructure could disturb up to 95 acres of land. Each new construction activity would affect wildlife by increasing loss of habitat, human activity, and construction traffic. These impacts could cause additional deaths among burrowing and less mobile species. If possible, construction disturbance to tributaries and portions of Proposed Area B should be avoided in order to protect the floodplain riparian community. Additional operations on post would increase roadkills. Emissions from an ACWA facility and other future on-post actions would be small and would have negligible impacts on wildlife. Reasonably foreseeable off-post actions would have localized impacts that could not be quantified but would have temporary or minor impacts at BGAD.	Construction of an ACWA facility, a baseline incinerator, and associated infrastructure could disturb up to 180 acres of land. Each new construction activity would affect wildlife by increasing loss of habitat, human activity, and construction traffic. These impacts could cause additional deaths among burrowing and less mobile species. If possible, construction disturbance to tributaries and portions of Proposed Area B should be avoided in order to protect the floodplain riparian community. Additional operations on post would increase roadkills. Emissions from an ACWA facility, a baseline incinerator, and other future on-post actions would be small and would have negligible impacts on wildlife. Reasonably foreseeable off-post actions would have localized impacts that could not be quantified but would have temporary or minor impacts at BGAD.
Aquatic habitats and fish	Adverse impacts would be unlikely if measures were taken to control runoff and erosion during construction. Cumulative impacts should be negligible during routine operations of an ACWA facility and other reasonably foreseeable actions.	Adverse impacts would be unlikely if measures were taken to control runoff and erosion during construction. Cumulative impacts from the operation of an ACWA facility, a baseline incinerator, and other future on-post facilities should be negligible.

TABLE S.9-4 (Cont.)

Impact Area	ACWA Facility + Other Activities	ACWA Facility + Incineration + Other Activities
Protected species	Construction could have adverse impacts on running buffalo clover. Surveying for clover colonies and marking and avoiding patches during construction would reduce the potential for impacts. The cumulative deposition potential of an ACWA facility and other future on- and off-post actions is small and would have negligible impacts on protected species.	Construction of a baseline incinerator would add to the potential for adverse impacts on running buffalo clover associated with an ACWA facility alone. Surveying for clover colonies and marking and avoiding patches during construction could reduce the potential for impacts. The cumulative deposition potential of an ACWA facility, a baseline incinerator, and other future on- and off-post actions is small and would have negligible impacts on protected species.
Wetlands	If built in Proposed Area B, an ACWA facility could affect wetlands. Other future on-post actions appear to avoid wetlands. Potential construction impacts could be mitigated by avoiding wetlands and using standard practices to control sedimentation and runoff. Because the emissions deposition potential would be small, cumulative impacts from routine operation of an ACWA facility and other future on- and off-post actions would be negligible.	If built in Proposed Area B, an ACWA facility and a baseline incinerator could affect wetlands. Potential construction impacts could be mitigated by avoiding wetlands and using standard practices to control sedimentation and runoff. Other future on-post actions appear to avoid wetlands. Because the emissions deposition potential would be small, cumulative impacts from routine operation of an ACWA facility, a baseline incinerator, and other future on- and off-post actions would be negligible.
Socioeconomics	The cumulative impacts from constructing and operating an ACWA facility and other future on- and off-post actions would be relatively small. Adverse cumulative impacts on housing should not occur. Even if other reasonably foreseeable actions were to occur during the construction and operation of an ACWA facility, the potential cumulative impacts on the local economy, local labor markets, and public and community services would be minor. Concurrent construction and operation of an ACWA facility and other future actions might have moderate impacts on the local transportation network.	The cumulative impacts from constructing and operating an ACWA facility, a baseline incinerator, and other future on- and off-post actions would be relatively small. Adverse cumulative impacts on housing should not occur. Even if other reasonably foreseeable actions were to occur during the concurrent construction and operation of an ACWA facility and an incinerator, the potential cumulative impacts on the local economy, local labor markets, and public and community services would be minor. Concurrent construction and operation of an ACWA facility, an incinerator, and other future actions might have moderate impacts on the local transportation network.
Environmental justice	During construction and routine operation of an ACWA facility and other on-post actions, no high and adverse human health or socioeconomic impacts on populations are anticipated. Consequently, significant environmental justice impacts are not anticipated.	A baseline incinerator would add to the human health and socioeconomic impacts from an ACWA facility alone. During construction and routine operation of an ACWA facility, a baseline incinerator, and other on-post actions, no high and adverse human health or socioeconomic impacts on populations are anticipated. Consequently, significant environmental justice impacts are not anticipated.

S.10 PREFERRED ALTERNATIVE

DOD prefers the proposed action, which is to pilot test one or more technologies at one or more installations. On the basis of the environmental analysis contained in this FEIS, the preferred alternative(s) are discussed below for each installation.

At ANAD, four alternative technology systems were examined: Neut/Bio, Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox. None of the systems evaluated would have a significant effect on the human environment. The preferred alternative at ANAD is No Action.

At PBA, three alternative technology systems were examined: Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox. None of the systems evaluated would have a significant effect on the human environment. The preferred alternative at PBA is No Action.

At PCD, two alternative technology systems were examined, as specified by P.L. 106-398: Neut/Bio and Neut/SCWO. Neither of the systems evaluated would have a significant effect on the human environment. The preferred alternative at PCD is Neut/Bio. Additionally, the Army will look for ways to accelerate the demilitarization process.

At BGAD, four alternative technology systems were examined: Neut/Bio, Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox. None of the systems evaluated would have a significant effect on the human environment. The preferred alternative at BGAD is No Action at this time. The Army will continue analysis in the site-specific EIS by PMCD, which will preserve options for deployment of a full-scale pilot plant. Additionally, the Army will look for ways to accelerate the demilitarization process.

The ROD for this NEPA action will announce the decision on pilot testing ACWA technology systems. This decision will be based on the results of the environmental impact analysis presented in this FEIS, as well as other factors. These other factors will include, but not be limited to, mission needs, budget, other programmatic factors, and installation-specific factors.

S.11 CLOSURE AND DECOMMISSIONING

After the conclusion of testing, an ACWA pilot facility could be (1) closed and decommissioned (i.e., operations ceased and the site secured), (2) converted to an operational chemical weapon destruction facility (this assumes that there would be chemical weapons remaining at the site), or (3) converted to functions other than the demilitarization of weapons in the chemical weapons stockpile (within the constraints imposed by the *National Defense Authorization Act for Fiscal Year 2000*). Assessment of the latter two options is beyond the scope of this EIS and would require additional NEPA analysis. Hence, only closure and decommissioning of the ACWA pilot facility are addressed in the EIS. On the basis of the general requirements for a treatment, storage, and disposal facility (TSDF) under RCRA, U.S. Army and DOD policies and regulations, and concepts for the decommissioning of chemical destruction facilities, the following steps would likely be involved in the closure and decommissioning of an ACWA pilot facility:

- Removal of all hazardous wastes from the installation;
- Decontamination of the structures and equipment (to include piping and tankage) to allow safe handling;
- Removal of all or part of the remaining equipment;
- Demolition of all or part of the facility;
- Removal or abandonment of all or part of the supporting infrastructure; and
- Grading and revegetation, as needed, of the areas after removal of structures and infrastructure.

These actions would generate wastes similar to those wastes created during the operation of the facility: (1) decontamination solutions consisting of water or caustic solutions containing agent and energetic by-products (similar to agent and energetic hydrolysates); (2) contaminated and noncontaminated debris, such as metals, wood, and concrete (similar to dunnage and maintenance wastes); (3) protective clothing; (4) wastes from administrative and maintenance areas; and (5) petroleum products and industrial chemicals. To the degree feasible, these materials would be processed through the ACWA facility in the same manner as like materials during the pilot testing. Once the facility was rendered nonoperational, these materials would be collected, placed in containers, and treated or disposed of in accordance with environmental regulations.

Equipment removed from the facility would be decontaminated and reused or recycled when possible. Structures would be decontaminated to the degree required by the U.S. Army and

DOD regulations to allow either their reuse or their demolition. Demolition debris would be disposed of in accordance with environmental, U.S. Army, and DOD regulations.

A more detailed discussion of closure is in Chapter 8 of the EIS.

S.12 REFERENCES

PMACWA, 1999, *Assembled Chemical Weapons Assessment Program: Supplemental Report to Congress*, U.S. Department of Defense, Program Manager Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md., Sept. 30.

PMACWA, 2001, *Final Technical Evaluation: AEA Technology/CH2MHill SILVER II Electrochemical Oxidation, Foster Wheeler/Eco Logic International/Kvaerner Neutralization/ GPCR/TW-SCWO, Teledyne-Commodore Solvated Electron Systems*, Appendix C in *Assembled Chemical Weapons Assessment Program: Supplemental Report to Congress*, June 2001, U.S. Department of Defense, Program Manager Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md., March.

U.S. Army, 1988, *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Jan.

1 PURPOSE AND NEED

This Assembled Chemical Weapons Assessment (ACWA) environmental impact statement (EIS) analyzes the potential environmental impacts of a proposed action to pilot test[1] one or more alternative systems for the destruction of assembled chemical weapons (ACWs) at one or more alternative Army installations with stored ACWs. This EIS was prepared by the Program Manager Assembled Chemical Weapons Assessment (PMACWA) of the U.S. Department of Defense (DOD). It was prepared to comply with (1) the *National Environmental Policy Act* of 1969 (NEPA), *United States Code* (USC) 4321 et seq.; (2) applicable NEPA implementing regulations promulgated by the President's Council on Environmental Quality (CEQ), 40 *Code of Federal Regulations* (CFR) Part 1502; and (3) the U.S. Department of the Army (DA) NEPA implementing regulation, Army Regulation (AR) 200-2 (32 CFR Part 651). The preparation of this EIS was announced in a Notice of Intent (NOI) in volume 65, pages 20139–20140 of the *Federal Register* (65 FR 20139–20140) on April 14, 2000 (Attachment 1).

1.1 INTRODUCTION

The U.S. Congress established the ACWA program as part of the *Omnibus Consolidated Appropriations Act* of 1997 (Public Law [P.L.] 104-208). This authorizing legislation instructed DOD to "demonstrate not less than two alternatives to the baseline incineration process for the demilitarization of assembled chemical munitions." Congress also directed DOD to designate a program manager for ACWA (the PMACWA) who was independent of baseline incineration management (i.e., independent of the Program Manager for Chemical Demilitarization [PMCD]). Subsequently, P.L. 105-261 (1999) specified the continued management of the development and testing of technologies that are potential or demonstrated alternatives to the baseline incineration process for the destruction of assembled ACWs.

The primary purpose of ACWA is to pilot test alternative systems for destroying ACWs. (The actual destruction of chemical munitions is not the primary function of the ACWA program. The PMCD, as mandated under P.L. 99-145, is charged with the systematic construction and operation of facilities or processes to reduce the chemical weapons stockpile.) DOD has determined that a pilot test would be a major federal action with the potential to significantly affect the human environment, thus requiring preparation of an EIS as defined in NEPA. Because a decision on pilot testing is both a broad agency action, setting the course of a program, and an action that would result in site selection, facility construction, and facility

[1] A pilot test models a full-scale operation. The facility used may be a smaller version of a full-sized facility or constrained to operate at a throughput rate lower than that of a full-sized facility or both. A pilot test facility can range from a small fraction of the size of an actual facility to the full size of an actual facility. The actual size of a pilot plant is designed so that data obtained by pilot operations can be scaleable to full-size operation. For purposes of analysis, this EIS assumes full-scale operation. Using this assumption provides information for the assessment of a reasonable worst-case scenario.

operation, this EIS addresses both programmatic and site-specific issues. This EIS analyzes the potential environmental impacts of the alternative destruction systems that the PMACWA could pilot test at individual installations, and it also analyzes the environmental impacts that would result from a PMACWA decision to take no action. PMCD is also preparing EISs for stockpile destruction at Pueblo Chemical Depot (PCD) and Blue Grass Army Depot (BGAD).

1.2 PURPOSE AND NEED

DOD defines assembled chemical weapons or ACWs as munitions containing both chemical agents and energetic materials (explosives and propellants) that are stored in the U.S. unitary chemical weapons stockpile.[2] This definition includes rockets, projectiles, and mines. Chemical agents include blister agents (e.g., H, HD, and HT) and nerve agents (e.g., GB [Sarin] and VX) (Chemical and Biological Defense Command [CBDCOM] 1997).[3] Also included are the associated materials such as shipping and firing tubes and packaging materials (PMACWA 1999).

The purpose of the proposed action is to pilot test alternative systems that do not involve incineration for destroying the ACWs stockpiled in the United States. Such testing is necessary to adequately respond to the *National Defense Appropriations Act for Fiscal Year 1999*. In this legislation, Congress directed the PMACWA to plan for the pilot-scale testing of alternative technologies.

The United States must destroy its stockpile of chemical weapons also to comply with the *Convention on the Prohibition of the Development, Stockpiling and Use of Chemical Weapons and Their Destruction* (January 13, 1993; 32 *International Legal Materials* 800 [ILM]). This convention, commonly known as the Chemical Weapons Convention or CWC, is an international treaty that entered into force[4] on April 29, 1997, the same day that the U.S. Senate gave its advice and consent to ratification. The CWC (Article IV, Paragraph 6) established the date for the destruction of chemical weapon stockpiles as 10 years from entry into force of the convention; in other words, destruction of the U.S. stockpile must be completed before April 29, 2007. The CWC also contains a provision for submitting a request to the Organization for the Prohibition of Chemical Weapons to extend the destruction completion date for five years, until April 29, 2012.

---

[2] The term “unitary” refers to the use of a single hazardous compound (i.e., chemical agent) in the munitions. In contrast, “binary” chemical weapons use two relatively nonhazardous components that are mixed together to form a hazardous or lethal compound after the weapon is fired or released.

[3] For more information on chemical agents, see http://www.sbccom.apgea.army.mil/RDA/msds/index.htm and http://www.mitretek.org/mission/envene/chemica/chem_back.html.

[4] CWC Article XXI establishes entry into force as 180 days after the sixtieth country ratifies the treaty; it has now been ratified by 65 countries.

1.3 SCOPE OF THIS ENVIRONMENTAL IMPACT STATEMENT

Scope refers to the range of actions, alternatives, and impacts to be considered in an EIS. An agency usually determines the scope in a two-part process: internal scoping and public scoping. Internal scoping refers to the efforts within the agency to identify potential alternatives, identify important issues, and determine the analyses to be included in the EIS. As described in detail later in this chapter, public scoping refers to the request for public involvement in the decision making on the proposed action. Public scoping includes consultation with federal, state, and local agencies as well as requests for comments from stakeholder organizations and members of the general public.

DOD proposes to design, construct, and operate one or more facilities for pilot testing ACW destruction systems at one or more chemical weapons stockpile installations. The systems analyzed in this EIS are those four that have completed successfully the demonstration phase of development: neutralization/biological treatment (Neut/Bio), neutralization/supercritical water oxidation (Neut/SCWO), neutralization/gas-phase chemical reduction/transpiring wall supercritical water oxidation (Neut/GPCR/TW-SCWO), and electrochemical oxidation (Elchem Ox). Potential locations for pilot testing include Anniston Army Depot (ANAD) in Alabama, Pine Bluff Arsenal (PBA) in Arkansas, PCD in Colorado, and BGAD in Kentucky. At PCD, however, the technologies considered in this EIS are limited by P.L. 106-398 to those demonstrated by ACWA on or before May 1, 2000. These are Neut/Bio and Neut/SCWO. For PBA, Neut/Bio was not considered as it is not appropriate for the inventory at this installation. This EIS also addresses a no action alternative: continued storage at the stockpile installations until a destruction system can be constructed and implemented (PCD and BGAD) or until the ACW stockpile can be destroyed at the baseline incineration facility already being used for other demilitarization activities (ANAD and PBA). The process used to arrive at the proposed action and alternative systems and installations is described in more detail in Chapter 2.

The scope of this EIS addresses the impacts from constructing and operating each of the destruction systems successfully demonstrated by ACWA as a pilot at each of the four installations under consideration. These activities would occur simultaneously with any existing chemical demilitarization programs and schedules at these installations. Appropriate ACWA destruction systems could be piloted at more than one installation. However, whether a particular system is appropriate for initial consideration at an installation is determined by the system's applicability to the components of the installation's ACW stockpile. Table 1.3-1 links the alternative destruction systems proposed for pilot testing to the types of agent at each installation. The substantive impact areas that are considered in this EIS include the following broad categories: land use, infrastructure, waste management, air quality, noise, human health and safety, visual resources, water use and quality, soils, biological resources, cultural resources, socioeconomics, environmental justice, accidents, agriculture, and cumulative effects.

TABLE 1.3-1 Appropriate Destruction Systems at the Four Installations[a]

Installation and Agent	Neut/Bio	Neut/SCWO	Neut/GPCR/ TW-SCWO	Elchem Ox
ANAD				
Blister	Yes	Yes	Yes	Yes
Nerve	NA	Yes	Yes	Yes
PBA[b]				
Blister	No	No	No	No
Nerve	NA	Yes	Yes	Yes
PCD				
Blister (mustard)	Yes	Yes	NC	NC
Nerve	No	No	No	No
BGAD				
Blister	Yes	Yes	Yes	Yes
Nerve	NA	Yes	Yes	Yes

[a] Yes = this site has ACWs with this agent. No = this site does not have ACWs with this agent. NA = technology is not applicable. NC = technology is not considered on the basis of P.L. 106-398.

[b] PBA has bulk quantities of blister agents but no ACWs containing blister agents.

Because the size of the pilot facility has not been determined, for purposes of the analysis in this EIS, a full-sized facility is assumed. A full-sized facility is considered to be comparable in size to the baseline incineration facilities being constructed by PMCD at ANAD and PBA. This size facility was specified in the request for proposals (CBDCOM 1997) for ACWA systems. This EIS also assumes that the pilot tests will be operated at design throughput (which is the maximum capacity of the overall destruction process); these parameters allow for the assessment of a reasonable worst-case scenario.

For the analysis in this EIS, it would be premature to assume that a proposed technology would be used to destroy the entire inventory at an installation. Any use of a proposed technology beyond pilot testing is beyond the scope of this EIS. For this reason, decontamination/decommissioning and closure of pilot test facilities are also addressed in this EIS.

1.4 PUBLIC INVOLVEMENT

1.4.1 General Public Involvement

DOD has invited full public participation and has promoted open communication with the public in order to facilitate better decision-making. All persons and organizations that have a potential interest in the proposed action, including minority, low-income, disadvantaged, and Native American groups, have been urged to participate. The scoping process and public comment process helped DOD focus the EIS on issues of importance to the public and other interested agencies and organizations.

The public participation process for this EIS is guided by (1) the President's CEQ implementing regulations; (2) DOD Directive 6050.1, *Environmental Effects in the United States of DOD Actions*; and (3) AR 200-2, *Environmental Effects of Army Actions*. These three regulations provide for public participation and notification through (1) the NOI, (2) public scoping, (3) public review of the draft EIS (DEIS), (4) public meetings on the DEIS, (5) public release of the final EIS (FEIS) and a 30-day waiting period, and (6) publication of the Record of Decision (ROD). These steps are discussed in Sections 1.4.3 through 1.4.7.

1.4.2 ACWA Dialogue

In addition to receiving guidance from the general public participation process established by NEPA implementing regulations, DOD received perspectives on the ACWA program, development of ACWA technologies, and the NEPA process from the ACWA Dialogue. The goal of the Dialogue is to draw on a wide range of experience, perspectives, and expertise to help identify and demonstrate effective and broadly acceptable methods for destroying chemical munitions and for disposing of the resulting materials or waste streams (see Section 2.4). Participants in the Dialogue include representatives from affected communities, state regulators and tribal representatives, U.S. Environmental Protection Agency (EPA) staff, DOD staff from affected sites and headquarters, representatives from national citizens groups that regularly work on the chemical demilitarization issue, and other concerned entities.

1.4.3 Notice of Intent

The NOI is the first formal step in the NEPA public involvement process. The public was initially notified of DOD's intent to prepare this EIS in the NOI published in the April 14, 2000, issue of the *Federal Register* (Attachment 1).

1.4.4 Scoping Process

The scoping process is designed to solicit public comment on issues or concerns that should be addressed early in the EIS process. For this EIS, comments from persons thought to be potentially interested or affected by the planned action were solicited through mailings, media advertisements, and public scoping meetings. These venues were used to ensure that the public was informed and given the opportunity to participate in the decision-making process. While informal comments were welcome throughout the preparation of the DEIS, the scoping period and scoping meetings provided formal opportunities for the public to participate in and comment on the environmental impact analysis process.

1.4.4.1 Public Scoping Process

A 45-day scoping period followed the issuance of the NOI. During this time, written comments on the scope of the EIS were obtained. Scoping meetings were held in May 2000 in Pueblo, Colorado; Pine Bluff, Arkansas; Anniston, Alabama; Richmond, Kentucky; and Washington, D.C. Legal notices of these public scoping meetings were published in newspapers serving the regions surrounding the installations being considered in the proposed action. Press releases inviting the public to express their views at the referenced scoping meetings were distributed to local and regional television stations, radio stations, and newspapers. Announcements or "scoping fliers" were mailed to the agencies, organizations, and individuals on the project mailing list. The fliers contained a description of the purpose of the meeting and an invitation to attend the meeting and to submit written comments identifying key items for consideration in the EIS. A separate comment sheet, with return mailing address, was included with the flier.

1.4.4.2 Scoping Results and Key Areas of Concern

The written comments received during the scoping process covered the areas summarized below. Comments in these areas were taken into consideration in developing the scope of this EIS.

- *Range of technologies considered as alternatives:* These comments suggested including in this EIS technologies currently undergoing demonstration testing, baseline incineration, combinations of demonstrated technologies, technologies for retrofitting incineration facilities, and other technologies that exist in the private sector. There were also comments on the definition of the no action alternative for each of the installations.

- *Installations considered in the EIS:* These comments contained suggestions to include some installations that were not included and to exclude some installations that were included.

- *Need for two EISs:* These comments included statements on integrating this ACWA EIS with another EIS that is being prepared on the destruction of the stockpile at PCD (the PCD EIS).

- *Releases and by-products associated with technologies and their health impacts on workers and the public:* These comments included suggestions that the affected public should include fetuses, infants, children, adults, the elderly, and those with infirmities and chronic diseases. Some comments suggested that the impacts of chronic low-level exposures (below standards) as well as any exceedances of standards should be addressed. It was also stated that the analysis must include dioxins, polychlorinated biphenyls (PCBs), and other persistent organics.

- *Risks associated with each alternative system and with continued storage:* Comments stated that these risks should be analyzed.

- *Impacts on plants, animals, and ecosystems:* Comments stated that these impacts should be considered. Both cumulative and direct impacts were mentioned, as was the uptake of contaminants by plants.

- *Impacts on agriculture and agricultural markets:* Comments mentioned that these impacts should be considered.

- *Demands of alternative technologies on installation resources:* The comments said that the analysis should cover water use and water rights, natural gas, and electricity.

- *Post-pilot-test activities of the pilot plant:* Comments stated that these activities must be considered and that a discussion of the fate of the facility after pilot testing should be included in the analysis.

- *Environmental justice:* Comments stated that this issue must be included in the analysis.

- *Adequacy of installation emergency planning capabilities:* Comments indicated that this topic should be addressed in the discussion.

1.4.5 Draft Environmental Impact Statement (DEIS)

Copies of the DEIS were made available for public review and comment. A Notice of Availability (NOA) was published in the *Federal Register* on 9 May 2001 to inform the public that the DEIS was released. A similar notice was also placed in the legal sections of local and regional newspapers. These notices identified a point of contact for obtaining more information on the EIS process; listed several public libraries where the DEIS could be reviewed; provided an address to which to submit requests for copies of the DEIS; provided the address of the ACWA web site where the EIS can be found; listed the locations, dates, and times for public meetings; and provided an address to which to send written comments on the DEIS. In addition, copies of the DEIS were mailed to everyone on the ACWA program's mailing list. A 45-calendar-day comment period (starting with the publication of the NOA in the *Federal Register*) was established to give all agencies, organizations, and individuals the opportunity to comment on the DEIS. The comment period was extended for 45 days in response to a public request, and it ended on 9 August 2001. During this comment period, DOD collected written comments and held public comment meetings at the four installations. The documents received during the public comment period are continued in Section 3 of Volume 2 of this FEIS.

1.4.6 Final Environmental Impact Statement (FEIS)

DOD assessed and considered the comments on the DEIS provided by agencies, organizations, and individuals. This FEIS incorporates changes suggested in these comments, as appropriate, and contains responses to the written comments received during the DEIS review period. The comment/response document is Volume 2 of this FEIS. The FEIS contains a line in the right margin where changes have occurred between the draft and final. The NOA for the FEIS was published in the *Federal Register* and in local and regional newspapers to inform the public that the FEIS had been released. The notices identified locations where the FEIS would be available and informed people how they could obtain copies.

1.4.7 Record of Decision (ROD)

At least 30 days from the publication of the FEIS NOA, a ROD will be signed and published in the *Federal Register* by the Army. The ROD will describe DOD's decision regarding the proposed action, identify potential problems, explain any uncertainties, and identify the type and extent of impacts that might occur. The ROD will also describe actions to be taken by DOD to reduce or mitigate any significant adverse impacts associated with its decision.

1.5 RELATED NEPA REVIEWS AND SUPPORTING STUDIES

DOD has prepared, or is in the process of preparing, other NEPA reviews that are related either to ACWA technologies or to stockpile destruction at the installations considered in this ACWA EIS. These reviews are described briefly below.

1.5.1 PMCD Programmatic EIS

In 1988, the DA issued the *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement* (U.S. Army 1988). This PEIS evaluated the environmental impacts of alternative approaches to disposing of lethal chemical weapon stockpiles throughout the continental United States. Eight installations and two types of chemical agent — nerve and blister — were included. The PEIS was programmatic rather than site-specific because the proposed action was national in scope and involved a number of complex, interrelated actions. Critical site-specific issues were analyzed in sufficient detail to allow for comparisons of each alternative in the national program, the selection of a preferred alternative, and completion of a ROD. This EIS was a tiering document, and subsequent site-specific NEPA documents focused on the individual installations. The alternatives considered were: (1) continued storage of the stockpile at each existing location, (2) on-site destruction at existing storage installations, (3) regional destruction at centers located at ANAD and Tooele Army Depot (TEAD), (4) national destruction at a center located at TEAD, and (5) partial relocation. On the basis of the analysis, the on-site destruction option was preferred, and this decision was documented in the ROD.

1.5.2 Anniston Army Depot

The DA is proceeding with the construction and operation of a chemical agent destruction facility at ANAD. In 1991, the DA issued the *Final Environmental Impact Statement for Disposal of Chemical Agents and Munitions at Anniston Army Depot, Anniston, Alabama* (U.S. Army 1991). This EIS assessed the potential environmental impacts of on-site destruction using incineration.

1.5.3 Pine Bluff Arsenal

The DA is proceeding with the construction and operation of a chemical agent destruction facility at PBA. In 1997, the DA issued the *Revised Final Environmental Impact Statement for Disposal of Chemical Agents and Munitions Stored at Pine Bluff Arsenal, Arkansas* (U.S. Army 1997). This EIS assessed the potential environmental impacts of on-site destruction using incineration.

1.5.4 Pueblo Chemical Depot

PCD was designated for realignment by the 1988 Base Realignment and Closure Commission (BRAC). In 1991, the DA issued the *Final Environmental Impact Statement for Realignment of Pueblo Depot Activity Colorado with Transfers to Tooele Army Depot, Utah and Red River Army Depot, Texas* (U.S. Army Corps of Engineers [COE] 1991). This EIS evaluated the environmental consequences of alternatives for future use of this installation. Such uses include chemical demilitarization and site restoration.

On April 14, 2000, the DA issued an NOI to prepare an *Environmental Impact Statement for the Design, Construction, and Operation of a Facility for the Destruction of Chemical Agent at Pueblo Chemical Depot*. This EIS, referred to in this document as the PCD EIS, was published as a draft in May 2001 (U.S. Army 2001) and as a final at about the same time that this Final ACWA EIS was published. It covers the design, construction, operation, and closure of a facility for the destruction of chemical agent at PCD, Colorado. The focus of the PCD EIS is on what technology should be used to destroy the chemical weapons stockpile at PCD. The PCD EIS covers incineration technologies as well as two of the ACWA technologies (Neut/Bio and Neut/SCWO) that are evaluated in this ACWA EIS.

1.5.5 Blue Grass Army Depot

On December 4, 2000, the DA issued an NOI to prepare an *Environmental Impact Statement for the Design, Construction, and Operation of a Facility for the Destruction of Chemical Agents and Munitions at Blue Grass Army Depot, Kentucky*. This EIS, referred to in this document as the BGAD EIS, is in process. It will cover the design, construction, operation, and closure of a facility to destroy all of the chemical agents and munitions currently stored at BGAD. The BGAD EIS will examine the environmental impacts of a baseline incineration facility, full-scale facility to pilot test an alternative technology successfully demonstrated by the ACWA Program, and no action alternative of continued storage of the chemical agents and munitions at BGAD. The BGAD EIS will include the four ACWA technologies evaluated in this ACWA EIS: Neut/Bio, Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox.

1.5.6 Technology Testing

The DA is planning to conduct pilot tests of certain technologies for the destruction of bulk agents. In 1998, the DA issued the *Final Environmental Impact Statement for Pilot Testing of Neutralization/Biotreatment of Mustard Agent at Aberdeen Proving Ground, Maryland* (U.S. Army 1998a). In 1998, the DA also issued the *Final Environmental Impact Statement for Pilot Testing of Neutralization/Supercritical Water Oxidation of VX Agent at Newport Chemical Depot, Indiana* (U.S. Army 1998b). The technologies covered in those two EISs are similar to the technologies to be used in the ACWA pilot test facilities addressed in this ACWA EIS.

1.6 ORGANIZATION OF THIS ENVIRONMENTAL IMPACT STATEMENT

This EIS addresses four installations and the ACWA destruction systems under consideration for pilot testing at each installation. It is organized to reflect the distinctions among the installations. Chapter 1 focuses on the purpose and need for the proposed action and the purpose and scope of the EIS. Chapter 2 describes the proposed action and alternatives, including why certain alternatives were selected for consideration. Chapter 2 also provides a comparative summary of the impacts of alternative destruction systems and the no action alternative at each installation. Chapter 3 describes the alternative ACW destruction systems.

Location-specific considerations for each installation, including infrastructure requirements, resource requirements, employment needs, and alternative siting locations, are described in Chapters 4, 5, 6, and 7 for ANAD, PBA, PCD, and BGAD, respectively. Chapters 4, 5, 6, and 7 also describe the affected environments for each of the four installations. Each installation is described in terms of the same environmental categories. In addition, Chapters 4, 5, 6, and 7 describe the consequences of the siting, construction, and operation of the alternative ACW destruction systems at each of the four installations. These four chapters conclude with a summary of certain issues that are multidisciplinary: impacts of accidents, cumulative impacts, and mitigation and monitoring. Decommissioning and closure are discussed in Chapter 8. Chapter 9 describes the federal and state permits, regulations, and executive orders that govern the construction and operation of the facilities. To assist the reader, an index is provided at the end of the main text of the EIS. Finally, a series of appendixes are attached that address specific impact areas in greater detail. The responses to the comments received on the DEIS during the public comment period are provided in Volume 2 of this FEIS.

1.7 REFERENCES FOR CHAPTER 1

CBDCOM, 1997, *Solicitation No. DAAM01-97-R-0031*, U.S. Army Chemical and Biological Defense Command, Aberdeen Proving Ground, Md., Aug.

COE: see U.S. Army Corps of Engineers.

PMACWA, 1999, *Assembled Chemical Weapons Assessment Program: Supplemental Report to Congress*, U.S. Department of Defense, Program Manager Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md., Sept. 30.

U.S. Army, 1988, *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Jan.

U.S. Army, 1991, *Final Environmental Impact Statement for Disposal of Chemical Agents and Munitions Stored at Anniston Army Depot, Anniston, Alabama*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., May.

U.S. Army, 1997, *Revised Final Environmental Impact Statement for Disposal of Chemical Agents and Munitions Stored at Pine Bluff Arsenal, Arkansas*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Apr.

U.S. Army, 1998a, *Final Environmental Impact Statement for Pilot Testing of Neutralization/ Biotreatment of Mustard Agent at Aberdeen Proving Ground, Maryland*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Feb.

U.S. Army, 1998b, *Final Environmental Impact Statement for Pilot Testing of Neutralization/ Supercritical Water Oxidation of VX Agent at Newport Chemical Depot, Indiana*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Dec.

U.S. Army, 2001, *Draft Environmental Impact Statement for Destruction of Chemical Munitions at Pueblo Chemical Depot, Colorado*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., May.

U.S. Army Corps of Engineers, 1991, *Final Environmental Impact Statement, Realignment of Pueblo Chemical Depot Activity, Colorado, with Transfers to Tooele Army Depot, Utah, and Red River Army Depot, Texas*, prepared by COE, Omaha, Neb., Aug.

2 PROPOSED ACTION AND ALTERNATIVES

2.1 INTRODUCTION

This chapter identifies and describes the alternatives for implementing the proposed action. The no action alternative is also described, and the preferred alternative is identified. The alternatives are also compared in summary form in a table at the end of this chapter. The ACW destruction systems chosen for analysis, including siting requirements at each installation, are described in Chapter 3.

2.2 PROPOSED ACTION

The authorizing legislation for PMACWA instructed DOD to "demonstrate not less than two alternatives to the baseline incineration process for the demilitarization of assembled chemical munitions." In the *National Defense Appropriations Act for Fiscal Year 1999*, Congress directed DOD to continue managing the development and testing of technologies that are potential or demonstrated alternatives to the baseline incineration program for the destruction of ACWs. Management was to include planning for the pilot testing of alternative technology systems.

To comply with these directions, DOD proposes to design, construct, and operate one or more pilot test facilities for ACW destruction systems at one or more chemical weapons stockpile installations. This action would occur simultaneously with any existing chemical weapons destruction or demilitarization programs and schedules at these installations. The design, construction, and operation of ACW pilot test facilities are further described in Chapter 3.

The following describes the schedule assumed in this EIS for the construction and testing of an ACWA pilot facility. Final design and permitting of a facility would take from one to two years. Facility construction would require up to 34 months. The EIS assumes that a pilot test would take up to 36 months, although the amount of time could be shorter. Finally, it is assumed that facility closure would take up to 24 months. This general schedule, however, may vary, depending on installation.

A stakeholder group designated "The Dialogue" (described in Chapter 1) was instrumental in the development of alternative systems for destroying ACWs. In concert with The Dialogue, the PMACWA developed criteria to evaluate alternative technologies for possible implementation in overall destruction systems. The criteria were organized into four categories (PMACWA 1999):

- *Process efficiency/process performance:* This category includes performance, maturity, operability, process monitoring and control, and applicability criteria.

- *Safety/worker health and safety:* This category includes criteria for worker safety, normal operations and facility accidents, and public safety during facility accidents as well as off-site accidents.

- *Human health and environment:* This category includes criteria for effluent characterization, completeness of effluent characterization, effluent management, permitting and compliance, and resource requirements.

- *Potential for implementation:* This category includes life-cycle cost, schedule, and public acceptance criteria.

Twelve firms responded to a PMACWA request for proposals (RFPs) for alternative destruction systems. From these twelve, PMACWA selected six for demonstration testing on the basis of evaluations based on the first three categories of evaluation criteria. Initially, funding was available to demonstrate only three of the six technologies. Subsequent Congressional legislation provided funding to demonstrate the remaining three technologies. PMACWA performed a series of technology demonstrations to investigate and evaluate the potential for implementing the alternative technologies as full-scale integrated processes. On the basis of all four criteria categories, PMACWA determined that four technology systems were viable for further development and pilot testing. These four technology systems are assessed in this EIS. These alternative ACWA systems (identified by the process used to destroy energetics and agents) are capable of disassembling the munitions and treating the dunnage and metal parts, destroying the agent and energetics, and disposing of resulting residues and effluents.

After the issuance of this Final ACWA EIS and the ROD, the Defense Acquisition Executive (DAE) will decide whether an ACWA technology will be implemented and where (i.e., at which installation) it will be implemented. The major criteria for the technology selections will be

- Cost,

- Schedule,

- Safety, and

- Environment.

The process that culminates in the DAE technology selection is called a Defense Acquisition Board (DAB) review. The DAB review will consist of Integrated Product Team (IPTs) who will analyze, exchange, and manage information. Three Working IPTs (WIPTs) will be formed to address the major criteria listed above. Output from these WIPTs will be provided to an Integrating Integrated Product Team (IIPT) and Overarching Integrated Product Team (OIPT), who will report to the DAE. The DAE will consider all information from these IPTs before making the technology decision. Also, as required by Public Law 104-208, each ACWA technology will have to be "certified" with regard to cost, safety, environment, and schedule before being considered in the DAE technology selection.

This particular review will be unlike most standard DAB/DAE reviews, which evaluate only one program. This review will take into account a Major Defense Acquisition Program (i.e., PMCD) and a research and development (R&D) program (i.e., PMACWA). PMCD and PMACWA have separate reporting chains; PMCD reports to the Department of the Army, while PMACWA reports to the Office of the Secretary of Defense. Because of these complexities, the process has been tailored to accommodate a multi-program-manager environment.

2.3 INSTALLATIONS

Potential installations that could be used for pilot testing ACW destruction systems must have stockpiles with sufficient ACWs available for testing. An evaluation of the 1999 stockpiles and destruction schedules identified four reasonable alternative installations: ANAD, PBA, PCD, and BGAD (Table 2.1-1). Other installations were judged not to be reasonable alternatives for the following reasons.

- Chemical stockpiles at Aberdeen Proving Ground in Maryland and Newport Chemical Depot in Indiana were eliminated from further consideration in this EIS because there are no ACWs at these locations.

- Johnston Atoll in the Pacific Ocean was eliminated from further consideration in this EIS because all chemical weapons at the installation were destroyed in early 2001.

- Deseret Chemical Depot in Utah and Umatilla Chemical Depot in Oregon were eliminated from further consideration in this EIS because it is unlikely that an ACWA pilot facility could begin testing before the stockpiles at these installations have been destroyed by ongoing operations. The earliest date for ACWA pilot tests to begin startup and system checks is January 2006 (PMACWA 1999).

TABLE 2.1-1 Completion Dates for Assembled Chemical Weapons Destruction by PMCD

Installation	Completion Date[a]
Anniston Army Depot	First quarter, 2009
Bluegrass Army Depot	NS[b]
Deseret Chemical Depot	Third quarter, 2005
Pine Bluff Arsenal	Second quarter, 2008
Pueblo Chemical Depot	NS
Umatilla Chemical Depot	Fourth quarter, 2008

[a] First quarter: January, February, March; second quarter: April, May, June; third quarter: July, August, September; and fourth quarter: October, November, December.

[b] NS = chemical destruction system not yet selected.

Source: U.S. Army (2001).

- On September 26, 2001, new stockpile destruction schedules were published that indicated later completion dates for Umatilla Chemical Depot. DOD is evaluating Umatilla to determine if sufficient ACWs would remain by 2006 to support pilot testing. If so, then the ACWA EIS would be supplemented.

2.4 ALTERNATIVE ACW DESTRUCTION SYSTEMS

The ACW destruction systems evaluated in this ACWA EIS are alternatives to baseline or other incineration technologies. According to DOD's definition, baseline incineration incorporates the technology and process design in place at the Johnston Atoll Chemical Agent Disposal System (JACADS). Baseline incineration systems are also in use at the Tooele Chemical Agent Disposal Facility (TOCDF) located at the Deseret Chemical Depot in Utah, and they have been or are under construction at three other chemical weapon stockpile storage locations, including ANAD and PBA. PMACWA is not considering any type of incineration technology for pilot testing. However, ACW destruction systems evaluated in this ACWA EIS may incorporate the reverse assembly process, which is the method used to open ACWs and access energetic materials and agents before they are destroyed. Reverse assembly is also used in baseline incineration (CBDCOM 1997).

2.4.1 Neutralization Followed by Biological Treatment (Neut/Bio)

This alternative would first disassemble the munitions to access the agents and energetics, and then it would destroy the blister agents and energetics with water and caustic chemicals (neutralization). The products of the neutralization would then be treated in a biological process operated at temperatures and pressures near ambient conditions. Air emissions would be passed through an air pollution control process. Recovered metal parts and dunnage would be treated at high temperatures. Effluents could be held and tested before being released to pollution control processes. Process water would be reused, and remaining solid residues would be disposed of in an appropriate landfill. The PMACWA considers this technology a viable solution for demilitarization of ACWs containing mustard agent but not for ACWs containing nerve agents (PMACWA 1999). The ACW destruction system based on this technology is described further in Chapter 3.

2.4.2 Neutralization Followed by Supercritical Water Oxidation (Neut/SCWO)

This alternative would first disassemble the munitions to access the agents and energetics, and then it would destroy the agents and energetics with water and caustic chemicals (neutralization). The products of the neutralization and shredded dunnage would then be destroyed by the SCWO process. SCWO would mineralize the resulting chemicals at temperatures and pressures above the critical point of water (705.2°F [340°C] and 3,204.6 pounds per square inch absolute [psia]). Recovered metal parts would be washed with caustic chemicals and treated at high temperatures. Effluents could be held and tested before being released to pollution control processes. Process water would be reused, and remaining solid residues would be disposed of in an appropriate landfill. The PMACWA considers this technology a viable solution for the demilitarization of all ACWs (PMACWA 1999). The ACW destruction system based on this technology is further described in Chapter 3.

2.4.3 Neutralization Followed by Gas-Phase Chemical Reduction and Transpiring Wall Supercritical Water Oxidation (Neut/GPCR/TW-SCWO)

This alternative would first disassemble the munitions to access the agents and energetics, and then it would destroy the agents and energetics with water and caustic chemicals (neutralization). The products of the neutralization would then be destroyed by the SCWO process. SCWO would mineralize the resulting chemicals at temperatures and pressures above the critical point of water. In this alternative, the TW-SCWO reactor vessel would be protected from corrosion and mineral buildup by a perforated liner through which water would be continuously forced to form a protective layer. Metal parts and dunnage would be washed with caustic chemicals and subjected to a gas-phase chemical reduction process in a high-temperature hydrogen and steam atmosphere. Air emissions could be held and tested before being released to pollution control processes. Process water would be reused, and remaining solid residues would be disposed of in an appropriate landfill. The PMACWA considers this technology a viable solution for the demilitarization of all ACWs (PMACWA 2001). The ACW destruction system based on this technology is further described in Chapter 3.

2.4.4 Electrochemical Oxidation

This alternative would first disassemble the munitions to access the agents and energetics, and then it would destroy the agents and energetics and shredded dunnage in a separate electrochemical oxidation process. The slurry of agent or energetics would be fed into a cell where an electric current would flow through a semipermeable membrane between an anode and cathodes in a silver nitrate and nitric acid bath, oxidizing the organic materials. Nitrogen oxides (NO_x) produced by the process would be reformed to nitric acid and reused. Silver would also be recovered and reused. Recovered metal parts and dunnage would be treated at high temperatures in a steam environment. Air emissions would be passed through an air pollution control process. Effluents could be held and tested before being released to pollution control processes. Solid residues would be disposed of in an appropriate landfill. The PMACWA considers this technology a viable solution for the demilitarization of all ACWs (PMACWA 2001). The ACW destruction system based on this technology is further described in Chapter 3.

2.5 NO ACTION ALTERNATIVE

If the PMACWA decides not to proceed with the design, construction, and operation of a pilot facility, no ACWA pilot plant facilities would be constructed and operated at any of the four installations. The portion of the ACW stockpile that would be used for pilot testing would remain in storage, as would the rest of the ACW stockpile. Under either the proposed action or no action alternative, ACWs would continue to be stored until their destruction by DOD. The means of destruction available for the ACW stockpile would depend on the ongoing or planned construction of facilities at ANAD and PBA and on the results from the evaluation of alternatives being included in the PMCD EISs for PCD and BGAD. Munitions being stored until their destruction by DOD would remain in their existing storage location and be maintained in their existing condition. It is assumed that the current munitions management procedures would continue to be followed and that the munitions would be safeguarded against any release to the environment.

2.5.1 Destruction of ACWs at Pine Bluff Arsenal and Anniston Army Depot

An incinerator for the destruction of ACWs has been constructed at ANAD and is under construction at PBA. If ACWA pilot testing is not conducted at those installations, the ACWs that might otherwise have been used for ACWA pilot testing would be destroyed by the incineration facility.

2.5.2 Pueblo Chemical Depot and Blue Grass Army Depot

If a pilot test facility is not sited, constructed, or operated at PCD or BGAD, the ACWs that would be destroyed during pilot testing at these installations would remain in storage with the rest of the stockpile. DOD is currently preparing the PCD EIS and the BGAD EIS to select a destruction system for the stockpiles at these installations. The weapons in storage at these installations would be destroyed after the systems announced in the RODs for those EISs were constructed. If one or more of the RODs did not announce the selection of a destruction technology, the ACWs at the affected installation would remain in storage until a destruction technology was developed.

2.6 ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL

2.6.1 Other Technologies

P.L. 105-261 authorized the PMACWA to proceed with activities for the design, construction, and operation of a pilot facility after the “technology has been demonstrated to be successful.” Congress did not authorize the PMACWA to advance technologies that have not been successfully demonstrated to the pilot stage. Therefore, systems based on processes or technologies not successfully demonstrated are not reasonable alternatives for this EIS. Two systems are in this category: (1) a system based on plasma arc technology and (2) a system that uses fluid-abrasive cutting and fluid mining with ammonia to access agent and energetics. The agent and energetics are then destroyed by solvated electron technology (SET), which uses sodium metal and ammonia in the initial destruction process and then oxidizes reaction products.

In the PMACWA demonstration testing, the particular plasma arc process that was evaluated was not validated for agent destruction because of its lack of maturity. Although the plasma arc process incorporates technology that is in industrial and commercial use, the marginal performance of the equipment, the continued modifications to the equipment, and the redesign of the equipment throughout the demonstration phase indicated that it might be difficult to develop plasma arc technology into a full-scale, integrated system. The PMACWA therefore does not consider such a system to be a viable solution for the demilitarization of ACWs (PMACWA 1999).

The SET process, like the plasma arc process, has the potential to demilitarize ACWs. However, the SET process was not validated for the destruction of products that result from processing agents and energetics, since the required demonstration tests were not completed. Consequently, the PMACWA does not consider the SET process to be a viable total solution for the demilitarization of ACWs at this time (PMACWA 2001).

2.6.2 Transportation of ACWs to Another Site for Pilot Tests

Transportation of the ACWs from one stockpile installation to another is not an alternative because such an action would be prohibited per 50 USC 1512a (a): "The Department of Defense may not transport any chemical munition that constitutes part of the chemical weapons stockpile out of the state in which that munition is located on October 5, 1994. . . ." Consequently, transportation to another installation would not be possible as part of the ACWA program.

2.7 SUMMARY COMPARISON OF ALTERNATIVES

Four tables (Tables 2.7-1 through 2.7-4, placed at the end of this chapter) summarize the results of the assessments of the impacts from construction and normal operations of the appropriate alternative technologies at each of the four installations and the impacts from construction and operations under the no action alternative at each installation. The impacts associated with accidents at each installation are discussed separately in each installation chapter (Chapters 4, 5, 6, and 7). Cumulative impacts also are discussed separately in each installation chapter.

For the majority of impact areas considered at each installation, the technology alternatives had similar impacts. In most cases, the no action alternative had no impacts. Distinctions among the technologies did, however, occur in the areas of utility requirements, human health and safety, and socioeconomics. In all cases, the impacts associated with construction and normal operations were not significant. The impacts that might occur would be short-term.

2.8 PREFERRED ALTERNATIVE

DOD prefers the proposed action, which is to pilot test one or more technologies at one or more installations. On the basis of the environmental analysis contained in this FEIS, the preferred alternative(s) are discussed below for each installation.

At ANAD, four alternative technology systems were examined: Neut/Bio, Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox. None of the systems evaluated would have a significant effect on the human environment. The preferred alternative at ANAD is No Action.

At PBA, three alternative technology systems were examined: Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox. None of the systems evaluated would have a significant effect on the human environment. The preferred alternative at PBA is No Action.

AT PCD, two alternative technology systems were examined, as specified by P.L. 106-398: Neut/Bio and Neut/SCWO. Neither of the systems evaluated would have a significant effect on the human environment. The preferred alternative at PCD is Neut/Bio. Additionally, the Army will look for ways to accelerate the demilitarization process.

At BGAD, four alternative technology systems were examined: Neut/Bio, Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox. None of the systems evaluated would have a significant effect on the human environment. The preferred alternative at BGAD is No Action at this time. The Army will continue analysis in the site-specific EIS by PMCD, which will preserve options for deployment of a full-scale pilot plant. Additionally, the Army will look for ways to accelerate the demilitarization process.

The ROD for this NEPA action will announce the decision on pilot testing ACWA technology systems. This decision will be based on the results of the environmental impact analysis presented in this FEIS, as well as other factors. These other factors will include, but are not limited to, mission needs, budget, other programmatic factors, and installation-specific factors.

2.9 REFERENCES FOR CHAPTER 2

CBDCOM, 1997, *Solicitation No. DAAM01-97-R-0031*, U.S. Army Chemical and Biological Defense Command, Aberdeen Proving Ground, Md., Aug.

PMACWA, 1999, *Assembled Chemical Weapons Assessment Program: Supplemental Report to Congress*, U.S. Department of Defense, Program Manager Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md., Sept. 30.

PMACWA, 2001, *Final Technical Evaluation: AEA Technology/CH2MHill SILVER II Electrochemical Oxidation, Foster Wheeler/Eco Logic International/Kvaerner Neutralization/ GPCR/TW-SCWO, Teledyne-Commodore Solvated Electron Systems*, Appendix C in *Assembled Chemical Weapons Assessment Program: Supplemental Report to Congress*, June 2001, U.S. Department of Defense, Program Manager Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md., March.

U.S. Army, 2001, *U.S. Army Chemical Demilitarization Program Releases Updated Official Schedule and Cost Estimates*, press release, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Oct. 4.

TABLE 2.7-1 ANAD Summary Table[a]

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/ Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Land use	All systems: Land requirements for the facility and additional infrastructure could total 30 to 77 acres. Impacts on and off the installation would be negligible because proposed activities would take place in the Chemical Limited Area. Normal operations would be consistent with installation use and would not significantly adversely affect other continuing installation operations.				No impacts
Infrastructure					
Electric power supply	All systems: Current infrastructure would not be able to meet the needs for the pilot facility. New service connections would have to be added, and a new substation would need to be constructed. The new power supply infrastructure would be independent of the other ANAD power supply.				No impacts.
	36 GWh/yr would be required.	60 GWh/yr would be required.	26 GWh/yr would be required.	105 GWh/yr would be required.	
Natural gas and fuel oil supply	All systems: The current infrastructure would be likely to meet the needs, although new pipelines might be needed to extend the system The fuel oil requirement is 48,000 gal/yr.				No impacts.
	50 million scf/yr of natural gas would be required.	69 million scf/yr of natural gas would be required.	130 million scf/yr of natural gas would be required.	48 million scf/yr of natural gas would be required.	
Water supply and use					
Construction	All systems: Construction would require water for a variety of uses. These needs have not been quantified; however, estimated use would be small compared with existing capacity. The existing system could meet these needs.				No impacts since there would be no construction.
Operations	All systems: The existing water supply system would be sufficient if pipeline extensions were built. The existing system would not be adequate to meet peak water demands for emergencies. About 7.5 million gal/yr of sanitary sewage would be produced. Current sewage treatment capacity would need to be expanded.				No impacts.
	7 million gal/yr of process water required; 6.4 million gal/yr of potable water required.	8.3 million gal/yr of process water required; 6.4 million gal/yr of potable water required.	18 million gal/yr of process water required; 6.4 million gal/yr of potable water required.	1 million gal/yr of process water required; 6.4 million gal/yr of potable water required.	

TABLE 2.7-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/ Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Waste management and facilities					
Construction	All systems: No changes in ANAD waste management systems would be needed for management and disposal of these construction wastes. Construction would generate solid and liquid nonhazardous waste.				No impacts since there would be no construction.
	It would also generate 80 yd^3 of solid hazardous waste and 32,000 gal of liquid hazardous waste.	It would also generate 80 yd^3 of solid hazardous waste and 34,000 gal of liquid hazardous waste.	It would also generate 90 yd^3 of hazardous solid waste and 36,000 gal of liquid hazardous waste.	It would also generate 100 yd^3 of hazardous solid waste and 39,000 gal of liquid hazardous waste.	
Operations	All systems: Hazardous and nonhazardous solid wastes would be generated during the treatment processes. These solid wastes would be collected and disposed of off post at appropriately permitted facilities. Quantities of brine salts produced by all technologies would vary, depending on the agent to be destroyed. Nonprocess solid wastes could be contaminated with agent and would also require treatment. If these treatment residual wastes are defined as RCRA hazardous waste, the estimated volume of hazardous waste would be larger, and additional treatment might be necessary before disposal. Process and nonprocess liquid wastes would be recycled within the treatment process. The only liquid waste associated with ACWA facilities that would be discharged would be domestic sanitary wastewater.				No impacts.

TABLE 2.7-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/ Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Operations (Cont.)	Treatment of ACWs would produce 970 tons of residual brine, which is a hazardous waste, and 550 tons of hazardous biomass. No significant impacts are expected.	Treatment of ACWs would produce brine salts ranging from 1,000 to 1,900 tons. No significant impacts are expected.	The TW-SCWO system and GPCR unit would produce hazardous salts as waste. The total salts produced would range from 1,000 to 2,200 tons. No significant impacts are expected.	Silver chloride salt cake would be produced and sent for silver recovery. The remaining salts, solids, and other impurities would be disposed of as hazardous waste. The amount would vary from 250 to 1,200 tons). Small amounts of dilute nitric acid would be neutralized and disposed of as a hazardous liquid. Treatment of ACWs would result in additional residual brine waste of 110 to 170 tons.	
Air quality — criteria pollutants					
Construction	All systems: Emissions of criteria pollutants would include fugitive dust from earth-moving activities and exhaust emissions from equipment and vehicles. Exhaust emissions would be relatively small when compared with fugitive dust. PM_{10} and $PM_{2.5}$ concentration increments would be relatively small fractions of applicable NAAQS. The total 24-hour and annual concentrations of $PM_{2.5}$ (background and increment) would be below but close to applicable NAAQS as a result of high background concentrations.				No impacts since there would be no construction.
Operations	All systems: Estimated maximum concentration increments would contribute less than 9% of applicable NAAQS for all pollutants. Except for 8-hour CO and $PM_{2.5}$, total concentrations of criteria pollutants (background plus increment) would be less than or equal to 53% of NAAQS. CO and $PM_{2.5}$ would be close to, but still below, standards because of high background levels.				Impacts on air quality expected to be minimal.

TABLE 2.7-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/ Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Air quality — toxic air pollutants					
Construction	All systems: Impacts would be negligible. Minor emissions would result from construction equipment.				No impacts since there would be no construction.
Operations	All systems: Routine operations: Pilot facility would not be a major source of HAP emissions and would not fall under any of the source categories regulated by the EPA under NESHAP. Fluctuating operations: No agent emissions would be expected. Modeling of worst-case emissions resulted in estimated ambient agent concentrations of less than 1% of the allowable concentrations for general population exposure established by the CDC.				No impacts.
Human health and safety — routine operations					
Construction	Facility workers: Estimated annual fatalities: <1 Estimated annual injuries: 18	Facility workers: Estimated annual fatalities: <1 Estimated annual injuries: 23	Facility workers: Estimated annual fatalities: <1 Estimated annual injuries: 23	Facility workers: Estimated annual fatalities: <1 Estimated annual injuries: 24	No impacts since there would be no construction.
	All systems: Other on-post workers: There would be no adverse health impacts. Off-post public: There would be no adverse health impacts.				
Operations	Facility workers: Estimated annual fatalities: <1 Estimated annual injuries: 31	Facility workers: Estimated annual fatalities: <1 Estimated annual injuries: 31	Facility workers: Estimated annual fatalities: <1 Estimated annual injuries: 31	Facility workers: Estimated annual fatalities: <1 Estimated Annual injuries: 31	Facility workers: Estimated annual fatalities: <1 Estimated annual injuries: 4

TABLE 2.7-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/ Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Operations (cont.)	All systems: Other on-post workers: Estimated hazard indices and carcinogenic risks from inhalation of toxic air pollutants are well below benchmarks considered representative of negligible risk levels. No agent emissions are expected. Even under hypothetical worst-case emission levels, the maximum estimated on-post concentration would be less than 1% of the allowable concentration for general public exposures. The maximum estimated incremental cancer risk from the inhalation of hypothetical mustard emissions is well below the benchmark risk value. Off-post public: Estimated hazard indices and carcinogenic risks from inhalation of toxic air pollutants are well below benchmarks considered representative of negligible risk levels. No agent emissions are expected, but even under hypothetical worst-case emission levels, the maximum estimated off-post concentration would be less than 1% of the allowable concentration for general public exposures. The maximum estimated incremental cancer risk from the inhalation of hypothetical mustard emissions is well below the benchmark risk value.				No impacts.
Noise					
Construction	All systems: Construction activities would result in maximum estimated noise levels of approximately 48 dBA at the installation boundary closest to a proposed construction site. This level is below the EPA guideline of 55 dBA for residential zones. Potential noise impacts are expected to be minor to negligible at the nearest residence.				No impacts since there would be no construction.
Operations	All systems: Noise levels generated by operation should have negligible impacts on the residence located nearest to the proposed facility and would be well within EPA guideline limits for residential areas.				Levels of noise generated by current stockpile maintenance activities would be part of the background noise levels.
Visual resources					
Construction	All systems: No effect on visual character.				No impacts since there would be no construction.
Operations	All systems: ACWA facility would be consistent with surrounding land uses and would not adversely affect visual character. Operation would not create significant visible emissions.				No impacts.

TABLE 2.7-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/ Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Geology and soils					
Construction	All systems: Approximately 25 acres of ground could be disturbed to some degree from construction of the pilot facility. Development of utilities could also cause additional soil disturbance. This could result in increased potential for erosion, which, in turn, could affect surface water bodies and biological resources. Best management practices would be used to minimize potential for erosion.				No impacts since there would be no construction.
Operations	All systems: Concentrations of contaminants from operations would be so low that they would have no impact on surface soils.				No impacts.
Groundwater					
Construction	All systems: Impacts would be none to negligible, and if impacts did occur, they would be temporary and short-lived. Water use during construction is estimated to be 7 million gal over three years. This is about 0.02% of the minimum yield of Coldwater Spring and would have a negligible impact on the water supply from the spring. Impacts on the groundwater aquifer would also be negligible. Construction would generate 4.5 million gal of sanitary waste over the same period of time.				No impacts since there would be no construction.
Operations	Use of 14 million gal/yr is about 0.04% of the minimum flow of Coldwater Spring.	Use of 15 million gal/yr is slightly more than 0.04% of the minimum flow of Coldwater Spring.	Use of 24 million gal/yr is slightly more than 0.2% of the minimum flow of Coldwater Spring.	Use of slightly more than 7 million gal/yr is about 0.02% of the minimum flow of Coldwater Spring.	No impacts.
Surface water					
Construction	All systems: Construction impacts on surface flow would be negligible to minor and could be naturally mitigated by standard construction practices. There would be no impacts on off-post surface water.				No impacts since there would be no construction.
Operations	All systems: Impacts on both on-post and off-post surface water would be negligible to low. Estimated sewage discharge of 7.5 million gal/yr would be small compared with surface water flows and would not significantly change flow conditions in the vicinity of the treatment plant. The additional withdrawals at Coldwater Spring would not be significant and would have negligible impacts on the surface water environment downstream of the spring.				No impacts.

TABLE 2.7-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/ Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Terrestrial habitats and vegetation					
Construction	All systems: The pilot facility would require approximately 25 acres; however, up to 11 acres might be disturbed as a result of infrastructure additions for Area A, up to 6 acres for Area B, and up to 52 acres for Area C. Biotic communities occurring in undeveloped land in all three areas are relatively common and well represented. Disturbance of communities within existing corridors would be temporary.				No impacts since there would be no construction.
Operations	All systems: During routine operations, biota in the vicinity of the facility would be exposed to emissions from the boiler and the process stack. Emissions would be within applicable standards. Maximum annual average air concentrations of organic compounds due to facility emissions would be considerably lower than levels known to be harmful to biota.				No impacts.
Wildlife					
Construction	All systems: The loss of habitat would not be expected to threaten local populations of any wildlife species since similar habitat would be available nearby.				No impacts since there would be no construction.
Operations	All systems: Deposition from atmospheric emissions would result in very low concentrations of trace metals and organic compounds, well below levels known to be harmful to biota. Consequently, routine operations would result in negligible impacts on wildlife.				No impacts.
Aquatic habitats and fish					
Construction	All systems: Rerouting or culverting the streams in Area A could result in loss of stream habitat. Because of the limited diversity of aquatic habitat and lack of undisturbed habitat in Area A, disturbances could constitute a minor adverse impact. Aquatic habitats do not occur in Areas B or C.				No impacts since there would be no construction.
Operations	All systems: Water withdrawal from surface waters, as well as wastewater discharge, would result in negligible changes to surface water levels. These changes would result in only negligible impacts on aquatic ecosystems. Depositions from atmospheric emissions would result in very low concentrations of trace metals and organic compounds, well below levels known to be harmful to biota.				No impacts.

TABLE 2.7-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/ Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Protected species					
Construction	All systems: None of the sites assessed for the pilot facility or the routes for infrastructure corridors are located in the immediate vicinity of populations of Tennessee yellow-eyed grass. Therefore, the direct impact on this species from construction would be negligible. Implementation of storm-water control measures would greatly reduce the potential for indirect impacts.				No impacts since there would be no construction.
Operations	All systems: During routine operations, biota in the vicinity of the pilot facility would be exposed to atmospheric emissions from the boiler stack and the process stack. Facility emissions would be within applicable air quality standards. The maximum annual average concentration of trace metals would be well below levels known to result in adverse impacts on biota through biouptake and biomagnification. Routine operations would not affect Tennessee yellow-eyed grass.				No impacts.
Wetlands					
Construction	All systems: The loss of up to 1.2 acres of palustrine wetland, up to 1,912 ft of riverine wetland, and up to 12 acres of floodplain as a result of construction in Area A would constitute a moderate to large adverse impact. Wetlands do not occur in Areas B or C.				No impacts since there would be no construction.
Operations	All systems: Water withdrawals from surface waters for the pilot plant as well as wastewater discharge would result in negligible changes in surface water levels. These changes would result in only negligible impacts on aquatic ecosystems, including wetlands located on the periphery of the surface water bodies.				No impacts.
Cultural resources					
Construction	All systems: The probability of adverse effects on cultural resources as a result of construction is very small. The potential for archaeological sites is low in most areas of ANAD. Each of the construction areas is a considerable distance from known archeological sites. No traditional cultural properties are known to exist within the proposed construction areas. Only Area A includes an existing structure, which is scheduled for demolition.				No impacts since there would be no construction.
Operations	All systems: Routine operations should have no impact on archaeological resources, traditional cultural properties, or historic structures.				No impacts.

TABLE 2.7-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/ Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Socioeconomics					
Construction	All systems: The impact on the ROI would be relatively small. In-migration would have only a marginal effect on population growth. No significant impact on public finances or public service jobs would be expected. On-post employee commuting patterns would have no impact on levels of service in the local transportation network.				No impacts since there would be no construction.
	Increases: Employment: 640 direct jobs 540 indirect jobs Income: $35 million In-migrating population: 640	Increases: Employment: 730 direct jobs 520 indirect jobs Income: $37 million In-migrating population: 890	Increases: Employment: 740 direct jobs 580 indirect jobs Income: $39 million In-migrating population: 970	Increases: Employment: 790 direct jobs 620 indirect jobs Income: $42 million In-migrating population: 1,100	
Operations	All systems: The impact on the ROI would be relatively small.				Negligible impact on the ROI.
	Increases: Employment: 660 direct jobs 580 indirect jobs Income: $46 million In-migrating population: 740	Increases: Employment: 660 direct jobs 580 indirect jobs Income: $46 million In-migrating population: 740	Increases: Employment: 660 direct jobs 590 indirect jobs Income: $46 million In-migrating population: 740	Increases: Employment: 660 direct jobs 820 indirect jobs Income: $53 million In-migrating population: 930	Continued storage produces: Employment: 90 direct jobs 60 indirect jobs Income: $7 million
Environmental justice					
Construction	All systems: The socioeconomic impacts from construction would primarily increase short-term employment and income. They would also increase demand for housing, schools, and public services. None of these impacts would be high or adverse for local governments, and the existing housing stock should be able to meet the demand. Similarly, no high and adverse impacts are anticipated during construction of an ACWA facility. As a result, environmental justice impacts are not anticipated from construction.				No impacts since there would be no construction.

TABLE 2.7-1 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/ Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Operations	All systems: During operations, there would be no high and adverse socioeconomic impacts associated with the facility. In addition, the risk of noncancer health effects and the risk of cancer from hazardous chemicals released during normal operations would be very low for both workers and the public. Neither of these impacts would be considered high and adverse. As a consequence, no environmental justice impacts are anticipated.				No impacts.
Agriculture					
Construction	No impacts are likely as a result of construction.				No impacts since there would be no construction.
Operations	During routine operations, facility emissions would be within applicable air quality standards. A screening-level agricultural risk assessment was conducted. The results indicated negligible risk from maximum concentrations on post and even lower risk off post. There is no evidence of bioaccumulation.				No impacts.

[a] Abbreviations: CDC = Centers for Disease Control and Prevention, CO = carbon monoxide, HAP = hazardous air pollutant, NESHAP = National Emission Standards for Hazardous Air Pollutants, PM_{10} = particulate matter with a mean aerodynamic diameter of 10 micrometers or less, $PM_{2.5}$ = particulate matter with a mean aerodynamic diameter of 2.5 micrometers or less, ROI = region of influence, scf = standard cubic foot (feet).

TABLE 2.7-2 PBA Summary Table[a]

Environmental Consequence	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Land use	All systems: Actions would be consistent with current and planned installation use. Up to 37 acres would be disturbed.			No impacts.
Infrastructure				
Electric power supply	All systems: Additional electric power lines would be required.			No impacts.
	60 GWh/yr would be required.	26 GWh/yr would be required.	120 GWh/yr would be required.	
Natural gas	All systems: Construction of additional gas pipelines required. Natural gas supplier has sufficient capacity to meet current and future demand.			No impacts.
	52 million scf/yr would be required.	140 million scf/yr would be required.	48 million scf/yr would be required.	
Water supply and use				No impacts.
Construction	All systems: Impacts on water supply and sewage treatment systems would be negligible.			
Operations	The ACWA facility would have a negligible impact on water supply systems. Sewage systems have sufficient capacity to meet the additional requirements of an ACWA facility.			
	6 million gal/yr of process water would be required; 5.5 million gal/yr of potable water would be required.	18 million gal/yr of process water would be required; 6.4 million gal of potable water would be required.	900,000 gal/yr of process water would be required; 6.4 million gal/yr of potable water would be required.	
Waste management and facilities				
Construction	All systems: Hazardous and nonhazardous wastes would be generated during construction. All wastes would be collected and disposed of off post in accordance with all applicable regulations. Nonhazardous wastes would be collected and disposed of in a local landfill. Sanitary wastes would be treated in an on-post sewage treatment plant. No significant impacts are expected.			No impacts since there would be no construction.

TABLE 2.7-2 (Cont.)

Environmental Consequence	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Operations	All systems: Hazardous and nonhazardous solid wastes would be generated during the treatment processes. These solid wastes would be collected and disposed of off post at appropriately permitted facilities. Quantities of brine salts produced by all technologies would vary, depending on the agent to be destroyed. Nonprocess solid wastes could be contaminated with agent and would also require treatment. If these treatment residual wastes are defined as RCRA hazardous waste, the estimated volume of hazardous waste would be larger, and additional treatment might be necessary before disposal. Process and nonprocess liquid wastes would be recycled within the treatment process. The only liquid waste associated with ACWA facilities that would be discharged would be domestic sanitary wastewater.			No impacts.
Air quality — criteria pollutants				
Construction	All systems: Concentration increments of criteria air pollutants and fugitive dust emissions would be relatively small fractions of applicable NAAQS. Total estimated annual concentration of $PM_{2.5}$ would be below but close to applicable NAAQS primarily because of high background concentration levels.			No impacts since there would be no construction.
Operations	All systems: Estimated maximum concentration increments due to operation would contribute less than 2% of applicable NAAQS for all pollutants. Except for $PM_{2.5}$, maximum estimated concentrations of criteria pollutants would be less than or equal to 54% of NAAQS. $PM_{2.5}$ would be close to standards but still below them.			No impacts.
Air quality — toxic air pollutants				
Construction	All systems: Impacts would be negligible. Minor emissions would result from construction equipment.			No impacts since there would be no construction.
Operations	All systems: <u>Routine operations:</u> Pilot facility emissions would not be a major source of HAP emissions and would not fall under any of the source categories regulated by the EPA under NESHAP. <u>Fluctuating operations:</u> No agent emissions would be expected. Modeling of worst-case emissions resulted in estimated ambient agent concentrations of less than 1% of the allowable concentrations for general population exposure established by the CDC.			No impacts.

TABLE 2.7-2 (Cont.)

Environmental Consequence	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Human health and safety — routine operations				
Construction	Facility workers: Estimated annual fatalities: <1 Estimated annual injuries: 22	Facility workers: Estimated annual fatalities: <1 Estimated annual injuries: 23	Facility workers: Estimated annual fatalities: <1 Estimated annual injuries: 24	No impacts since there would be no construction.
	All systems: Other on-post workers and residents: There would be no adverse health impacts. Off-post public: There would be no adverse health impacts.			
Operations	Facility workers: Estimated annual fatalities: <1 Estimated annual injuries: 35	Facility workers: Estimated annual fatalities: <1 Estimated annual injuries: 35	Facility workers: Estimated annual fatalities: <1 Estimated annual injuries: 35	Facility workers: Estimated annual fatalities: <1 Estimated annual injuries: 5
	All systems: Other on-post workers and residents: Estimated hazard indices and carcinogenic risks from inhalation of toxic air pollutants are well below benchmarks considered representative of negligible risk levels. No agent emissions are expected. Even under hypothetical worst-case emission levels, the maximum estimated on-post concentration would be less than 1% of the allowable concentration for general public exposures. Off-post public: Estimated hazard indices and carcinogenic risks from inhalation of toxic air pollutants are well below benchmarks considered representative of negligible risk levels. No agent emissions are expected. Even under hypothetical worst-case emission levels, the maximum estimated off-post concentration would be less than 1% of the allowable concentration for general public exposures.			No impacts.

TABLE 2.7-2 (Cont.)

Environmental Consequence	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Noise				
Construction	All systems: Impacts on nearest residents would be negligible. Noise level would be below EPA guidelines for residential zones.			No impacts since there would be no construction.
Operations	All systems: Impacts on nearest residents would be negligible. Noise level would be below EPA guidelines for residential zones.			No impacts.
Visual resources				
Construction	All systems: Temporary impacts would result from increased traffic and construction dust. Impacts would be negligible.			No impacts since there would be no construction.
Operations	All systems: Impacts would be negligible. Facility would not be visible from off post. Steam from the facility might be visible on and off post during cold weather, which would be consistent with the industrial character of the area.			No impacts.
Geology and soils				
Construction	All systems: Approximately 25 acres could be affected to some degree during construction. Additional ground would be disturbed for development of site infrastructure. Best management practices would minimize adverse impacts of potential soil erosion.			No impacts since there would be no construction.
Operations	All systems: Potential impact could occur in the event of an accidental spill or release. Containment actions would be taken to limit migration and contaminated soils would be removed. No significant impact on soils would result from air emissions.			No impacts.
Groundwater				
Construction	All systems: Impacts would be none to negligible and would be short-lived. No contamination of groundwater is expected. Existing water supply wells have the capacity to meet construction demand.			No impacts since there would be no construction.
Operations	All systems: Increase in potable water use would not be significant, and existing wells have capacity to meet additional demand. Increased drawdown would not be permanent. Procedures exist to preclude spills and to address them should they occur.			No impacts.

TABLE 2.7-2 (Cont.)

Environmental Consequence	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Surface water				
Construction	All systems: Construction impacts on surface flow would be negligible to minor and could be naturally mitigated by standard construction practices. During incident-free construction, no contamination of surface water would be expected. Berms should be placed to restrict surface runoff. If spills or leaks would occur, procedures would exist to quickly remove contaminants before they could be transported to existing surface or groundwater resources. There would be no impacts on off-post surface water.			No impacts since there would be no construction.
Operations	All systems: Impacts would be negligible. Estimated sewage discharge would be small compared with surface water flows and would not significantly change flow conditions. There would be no impacts on off-post surface water.			No impacts.
Terrestrial habitats and vegetation				
Construction	All systems: Construction would disturb about 25 acres for the pilot facility plus another 4–12 acres for infrastructure.			No impacts since there would be no construction.
Operations	All systems: Impacts on vegetation would be negligible because levels of air pollutant release would be low. Deposition levels on soil and vegetation downwind of the ACWA facility would be negligible.			No impacts.
Wildlife				
Construction	All systems: The presence of construction crews and traffic would cause some species to avoid areas near construction sites during construction period. Less mobile species would be killed during vegetation clearing. Loss of habitat is not expected to eliminate any wildlife species since similar habitat is relatively common elsewhere on the installation.			No impacts since there would be no construction.
Operations	All systems: Increase in human activity and associated traffic would increase number of roadkills. Wildlife species would not be affected by releases of trace metals and organic compounds because food chain transfer via plants would be minimal. The potential for bioaccumulation is low.			No impacts.
Aquatic habitats and fish				
Construction	All systems: No impacts would be likely because erosion control measures would be used to control runoff during construction of the ACWA facility and infrastructure.			No impacts since there would be no construction.

TABLE 2.7-2 (Cont.)

Environmental Consequence	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Operations	All systems: No impacts would be likely because emission rates of all trace constituents and particulates are expected to be at levels well below those that would affect ecosystems through biouptake or biomagnification in the food chain.			No impacts.
Protected species				
Construction	All systems: No impacts on protected species are anticipated. No federal endangered or threatened species are known to exist at PBA.			No impacts since there would be no construction.
Operations	All systems: There would be no impacts because no federal endangered or threatened species are known to exist at PBA.			No impacts.
Wetlands				
Construction	All systems: Construction at Area A could potentially eliminate the small palustrine wetlands on the southwest margin of the installation. Grading for preparation of Area B could disturb wetlands and alter drainage patterns within the installation. Construction on Area B could eliminate two wetlands located on the installation.			No impacts since there would be no construction.
Operations	All systems: Deposition from atmospheric emissions would result in very low concentrations of trace metals and organic compounds, well below levels known to be harmful to biota. The impact on wetlands would be negligible.			No impacts.
Cultural resources				
Construction	All systems: There would be small probability for adverse effects. Area A has not been surveyed, but there is considerable disturbance and waste disposal within the area. The potential for finding intact cultural deposits is low. Areas B and C were surveyed, and no cultural sites were recorded. No traditional cultural properties and no standing structures are located in any of the areas.			No impacts since there would be no construction.
Operations	All systems: There are no cultural resources in the area, so there should be no impacts.			No impacts.
Socioeconomics				
Construction	All systems: Impact on ROI would be relatively small. In-migration would have only a marginal effect on population growth. No significant impact on public finances or public service jobs would be expected. On-post employee commuting patterns would have no impact on levels of service in the local transportation network.			No impacts since there would be no construction.

TABLE 2.7-2 (Cont.)

Environmental Consequence	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Construction (Cont.)	Increases: Employment: 730 direct jobs 570 indirect jobs Income: $40 million In-migrating population: 210	Increases: Employment: 740 direct jobs 610 indirect jobs Income: $42 million In-migrating population: 220	Increases: Employment: 780 direct jobs 660 indirect jobs Income: $45 million In-migrating population: 250	
Operations	All systems: Impacts on the ROI would be relatively small. Increases: Employment: 720 direct jobs 760 indirect jobs Income: $53 million In-migrating population: 580	Increases: Employment: 720 direct jobs 760 indirect jobs Income: $53 million In-migrating population: 580	Increases: Employment: 720 direct jobs 850 indirect jobs Income: $56 million In-migrating population: 640	Negligible impacts on the ROI. Continued storage produces: Employment: 100 direct jobs 80 indirect jobs Income: $8 million
Environmental justice				
Construction	All systems: The socioeconomic impacts from construction would primarily increase short-term employment and income. They would also increase demand for housing, schools, and public services. None of these impacts would be high or adverse for local governments, and the existing housing stock would likely meet the demand. Similarly, no high and adverse impacts are anticipated during construction of an ACWA facility. As a result, environmental justice impacts are not anticipated from construction.			No impacts since there would be no construction.
Operations	All systems: During operations, there would be no high and adverse socioeconomic impacts associated with the facility. In addition, the risk of noncancer health effects and the risk of cancer from hazardous chemicals released during normal operations would be very low for both workers and the public. Neither of these impacts would be considered high and adverse. As a consequence, no environmental justice impacts are anticipated.			No impacts.

TABLE 2.7-2 (Cont.)

Environmental Consequence	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Agriculture				
Construction	No impacts would be likely from construction.			No impacts since there would be no construction.
Operations	Facility emissions would be within applicable air quality standards. A screening-level agricultural risk assessment indicated that the risks from maximum concentrations of emissions from operations would be negligible.			No impacts.

[a] Abbreviations: CDC = Centers for Disease Control and Prevention, CO = carbon monoxide, HAP = hazardous air pollutant, NESHAP = National Emission Standards for Hazardous Air Pollutants, PM_{10} = particulate matter with a mean aerodynamic diameter of 10 micrometers or less, $PM_{2.5}$ = particulate matter with a mean aerodynamic diameter of 2.5 micrometers or less, ROI = region of influence, scf = standard cubic foot (feet).

TABLE 2.7-3 PCD Summary Table[a]

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	No Action
Land use	Both systems: There would be no impacts. Construction would be within the industrial area. The maximum area disturbed for the facility and associated infrastructure would be 85 acres. Land use would be consistent with the reuse plan.		No impacts.
Infrastructure			
Electric power supply			
Construction	Both systems: Power lines and substations would be required. Supply would be adequate to meet increased demand. There would be no impacts.		No impacts.
Operations	36 GWh/yr would be required.	60 GWh/yr would be required.	No impacts.
Natural gas supply	New gas pipeline would be required. Supply would be adequate to meet increased demand. 94 million scf/yr would be required.	149 million scf/yr would be required.	No impacts.
Water supply and use			
Construction	Both systems: New water pipelines required. Supply would be adequate to meet increased demand of 8.6 acre-ft/yr. Additional water rights would need to be purchased. There would be no impact.		No impacts since there would be no construction.
Operations	Both systems: Additional water rights would need to be purchased. Supply is adequate to meet demand. Existing sewage lagoons might need to be expanded.		No impacts.
	Supply would be adequate to meet increased demand of 13 million gal/yr of process water[b] and 6.4 million gal/yr of potable water.	Supply would be adequate to meet increased demand of 18 million gal/yr of process water[b] and 6.4 million gal/yr potable water.	
Waste management and facilities			
Construction	Both systems: Existing waste management facilities would be adequate to handle hazardous solid wastes. No significant impacts would result from the generation of hazardous and nonhazardous wastes during construction.		No impacts since there would be no construction.

TABLE 2.7-3 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	No Action
Operations	Both systems: Hazardous and nonhazardous solid wastes would be generated during the treatment processes. These solid wastes would be collected and disposed of off post at appropriately permitted facilities. Quantities of brine salts produced by all technologies would vary, depending on the agent to be destroyed. Nonprocess solid wastes could be contaminated with agent and would also require treatment. Chemical weapons are RCRA listed wastes in Colorado; therefore, all treatment residues are also listed wastes and, if not delisted under RCRA, must be managed and disposed of as hazardous waste. Process and nonprocess liquid wastes would be recycled within the treatment process. The only liquid waste associated with ACWA facilities that would be discharged would be domestic sanitary wastewater.		Waste would be generated from occasional leaks. Facilities and procedures would be adequate to handle leaks.
Air quality — criteria pollutants			
Construction	Both systems: Emissions would include fugitive dust from earth-moving activities and exhaust from equipment and vehicles. Concentration increments would be relatively small fractions of applicable NAAQS. Overall ambient air quality would be good. Impacts would be minor.		No impacts since there would be no construction.
Operations	Both systems: Concentration increases due to operation would contribute approximately 2% of NAAQS/SAAQS. Overall ambient air quality would be good. Impacts would be negligible.		Stockpile maintenance activities would generate very small emissions from boilers and vehicular traffic in the area of Munitions Storage Area A. Impact would be negligible.
Air quality — toxic air pollutants			
Construction	Both systems: Impacts would be negligible. Minor emissions would result from construction equipment.		No impacts since there would be no construction.
Operations	Both systems: Normal: Pilot facility would not be a major source of HAP emissions and would not fall under any of the source categories regulated by the EPA under NESHAP. Fluctuating: No agent emissions would be expected. Modeling of worst-case emissions resulted in estimated ambient agent concentrations of less than 1% of the allowable concentrations for general population exposure.		No impacts.

TABLE 2.7-3 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	No Action
Human health and safety — routine operations			
Construction	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 17	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 21	No impacts since there would be no construction.
	Both systems: <u>Other on-post workers and residents:</u> There would be no adverse health impacts. <u>Off-post public:</u> There would be no adverse health impacts.		
Operations	Both systems: <u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 30		<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 4
	<u>On-post workers and residents:</u> Estimated hazard indices and carcinogenic risks from inhalation of toxic air pollutants are well below benchmarks considered representative of negligible risk levels. No agent emissions are expected. Even under hypothetical worst-case emission levels, the maximum estimated on-post concentration would be less than 1% of the allowable concentration for general public exposures. The maximum estimated incremental cancer risk from the inhalation of hypothetical mustard emissions is well below the benchmark risk value.		No impacts.
	<u>Off-post public:</u> Estimated hazard indices and carcinogenic risks from inhalation of toxic air pollutants are well below benchmarks considered representative of negligible risk levels. No agent emissions are expected. Even under hypothetical worst-case emission levels, the maximum estimated off-post concentration would be less than 1% of the allowable concentration for general public exposures. The maximum estimated incremental cancer risk from the inhalation of hypothetical mustard emissions is well below the benchmark risk value.		No impacts.
Noise			
Construction	Both systems: Noise levels would be within local/state limits. Potential noise impacts are expected to be comparable to background levels at the nearest residence. Impacts would be negligible.		No impacts since there would be no construction.

TABLE 2.7-3 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	No Action
Operations	Both systems: Estimated noise level at the nearest residence from the proposed facility (less than 35 dBA) would be within residential noise standards (55 dBA). Impacts would be negligible.		Noise generated by stockpile maintenance would be part of background and within legal limits.
Visual resources			
Construction	Both systems: Some decrease in visibility would result from dust emissions. Impacts would be small, intermittent, and temporary.		No impacts since there would be no construction.
Operations	Both systems: ACWA facility would be consistent with surrounding landscape. Operations would not create significant, visible emissions. There would be no impacts.		No impacts.
Geology and soils			
Construction	Both systems: As many as 85 acres of soil could be affected from construction of pilot facilities and associated infrastructure. Best management practices for soil erosion would mitigate potential adverse impacts.		No impacts since there would be no construction.
Operations	Both systems: No contamination of soils would be expected. Facilities are designed to contain small accidental releases. There would be no impacts.		Potential impacts would be limited primarily to leaks of petroleum-based products from vehicles. Impacts would be negligible.
Groundwater			
Construction	Both systems: Water use would be relatively small compared with historical use. Impacts would be negligible.		No impacts since there would be no construction.
Operations	Both systems: Water use would be relatively small compared with historical use. Facilities are designed to contain small accidental releases. Impacts from water withdrawals would be negligible.		No impacts.

TABLE 2.7-3 (Cont.)

<table>
<tr><th>Environmental Consequence</th><th>Neutralization/
Biotreatment</th><th>Neutralization/
Supercritical Water Oxidation</th><th>No Action</th></tr>
<tr><td>Surface water</td><td></td><td></td><td></td></tr>
<tr><td>Construction</td><td colspan="2">Both systems: Construction impacts on surface flow would be negligible to minor and could be naturally mitigated by standard construction practices. No contamination of surface water would be expected. Facilities are designed to contain small accidental releases.</td><td>No impacts since there would be no construction.</td></tr>
<tr><td>Operations</td><td colspan="2">Both systems: No contamination of surface water would be expected. Facilities are designed to contain small accidental releases. There would be no impacts.</td><td>No impacts.</td></tr>
<tr><td>Terrestrial habitats and vegetation</td><td></td><td></td><td></td></tr>
<tr><td>Construction</td><td colspan="2">Both systems: As much as 85 acres of vegetative and terrestrial habitats could be disturbed. Most disturbances would be short-term and would be mitigated through revegetation. Small amount of permanent loss would occur. Negligible impacts.</td><td>No impacts since there would be no construction.</td></tr>
<tr><td>Operations</td><td colspan="2">Both systems: Metals and organic compounds in emissions would be deposited on the ground in very low concentrations and would not adversely affect terrestrial biota. No impacts.</td><td>No impacts.</td></tr>
<tr><td>Wildlife</td><td></td><td></td><td></td></tr>
<tr><td>Construction</td><td colspan="2">Both systems: Less mobile burrowing species could be killed during construction and site preparation. Some losses would occur because of roadkills. Noise, human activity, and habitat loss would have no impact on the continued survival of the species because of the abundance of similar habitat next to proposed construction areas.</td><td>No impacts since there would be no construction.</td></tr>
<tr><td>Operations</td><td colspan="2">Both systems: Noise, human activity, and habitat loss would have little impact because of the abundance of similar habitat next to proposed facility sites. Annual emission rates of all trace constituents and particulates would be well below levels affecting ecosystems through biomagnification or biouptake. There would be no impacts.</td><td>No impacts.</td></tr>
<tr><td>Aquatic habitats and fish</td><td></td><td></td><td></td></tr>
<tr><td>Construction</td><td colspan="2">Both systems: No aquatic resources in the areas be would affected by construction. There would be no impacts.</td><td>No impacts since there would be no construction.</td></tr>
</table>

TABLE 2.7-3 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	No Action
Operations	Both systems: Concentrations of organic compounds and trace metals would not be at levels that would adversely affect aquatic ecosystems downwind. There would be no impacts.		No impacts.
Protected species			
Construction	Both systems: The loggerhead shrike, a federal sensitive species, could be affected by loss of habitat.		No impacts since there would be no construction.
Operations	Both systems: No impacts on endangered, threatened, or candidate species would result from normal operations.		No impacts.
Wetlands			
Construction	Both systems: No wetlands are near the proposed construction areas. There would be no impacts.		No impacts since there would be no construction.
Operations	Both systems: Concentrations of organic compounds and trace metals would not be at levels that would adversely affect downwind wetlands. There would be no impacts.		No impacts.
Cultural resources			
Construction	Both systems: No known cultural resources are located within the construction area. Unexpected discoveries of cultural resources during earth-moving activities would be evaluated in coordination with regulators. Impacts are unlikely.		No impacts since there would be no construction.
Operations	Both systems: There are no known cultural resources. There would be no impacts.		No impacts.
Socioeconomics			
Construction	Both systems: Impacts on the ROI would be relatively small. In-migration would have only a marginal effect on population growth. No significant impact on public finances or public service jobs is expected. On-post employee commuting patterns would have no impact on levels of service in the local transportation network.		No impacts since there would be no construction.

TABLE 2.7-3 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	No Action
Construction (Cont.)	Increases <u>Employment:</u> 600 direct jobs 570 indirect jobs <u>Income:</u> $36 million <u>In-migrating population:</u> 1,140	Increases <u>Employment:</u> 680 direct jobs 540 indirect jobs <u>Income:</u> $37 million <u>In-migrating population:</u> 1,200	
Operations	Both systems: Impact on the ROI would be relatively small.		Negligible impact on the ROI.
	Increases: <u>Employment:</u> 640 direct jobs 530 indirect jobs <u>Income:</u> $44 million <u>In-migrating population:</u> 750	Increases: <u>Employment:</u> 640 direct jobs 580 indirect jobs <u>Income:</u> $45 million <u>In-migrating population:</u> 790	Continued storage produces: <u>Employment:</u> 80 direct jobs 60 indirect jobs <u>Income:</u> $6 million
Environmental justice			
Construction	Both systems: The socioeconomic impacts from construction would primarily increase short-term employment and income. They would also increase demand for housing, schools, and public services. None of these impacts would be high or adverse for local governments, and the existing housing stock would likely meet the demand. Similarly, no high and adverse impacts are anticipated during construction of an ACWA facility. As a result, environmental justice impacts are not anticipated from construction.		No impacts since there would be no construction.
Operations	Both systems: During operations, there would be no high and adverse socioeconomic impacts associated with the facility. In addition, the risk of noncancer health effects and the risk of cancer from hazardous chemicals released during normal operations would be very low for both workers and the public. Neither of these impacts would be considered high and adverse. As a consequence, no environmental justice impacts are anticipated.		No impacts.

TABLE 2.7-3 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	No Action
Agriculture			
Construction	Both systems: No impacts on agriculture would be likely from facility construction.		No impacts since there would be no construction.
Operations	Both systems: Facility emissions would be within applicable air quality standards during routine operations. A screening- level agricultural risk assessment indicated that risks from maximum concentrations would be negligible.		No impacts.

[a] Abbreviations: CDC = Centers for Disease Control and Prevention, CO = carbon monoxide, HAP = hazardous air pollutant, NESHAP = National Emission Standards for Hazardous Air Pollutants, PM_{10} = particulate matter with a mean aerodynamic diameter of 10 micrometers or less, $PM_{2.5}$ = particulate matter with a mean aerodynamic diameter of 2.5 micrometers or less, ROI = region of influence, scf = standard cubic foot (feet).

[b] The numbers used in the analysis were from demonstration testing. Subsequent engineering design studies now indicate 5.7 million gal/yr of process water for Neut/Bio and 1.3 million gal/yr for Neut/SCWO.

TABLE 2.7-4 BGAD Summary Table[a]

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Land use	All systems: Actions would be consistent with current and planned installation use. Construction could disturb up to 95 acres for the facility and supporting infrastructure. Development of Proposed Area A may interfere with other site activities.				No impacts.
Infrastructure					
Electric power supply	All systems: Temporary lines or generators would be required for construction. A new line and substation would be needed for operation. Supply would be adequate to meet increased demand.				No impacts.
	2 GWh/yr would be required.	60 GWh/yr would be required.	26 GWh/yr would be required.	122 GWh/yr would be required.	
Natural gas	All systems: Extension of gas pipelines and a new metering station would be required. Supply would be adequate to meet increased demand.				No impacts.
	9 million scf/yr would be required.	52 million scf/yr would be required.	138 million scf/yr would be required.	52 million scf/yr would be required.	
Water supply and use	All systems: Extension of water supply pipelines would be required. Supply would be adequate to meet increased demand. A new storage tank would be required for emergency response. A new wastewater treatment plant would be required.				No impacts.
	1.3 million gal/yr of process water would be required; 300,000 gal/yr of potable water would be required.	6.3 million gal/yr of process water would be required; 6.4 million gal/yr of potable water would be required.	18 million gal/yr of process water would be required; 6.4 million gal/yr of potable water would be required.	1 million gal/yr of process water would be required; 6.4 million gal/yr of potable water would be required.	
Waste management and facilities					
Construction	All systems: Construction wastes could be treated by existing systems. No additional impacts from managing these wastes are anticipated.				No impacts since there would be no construction.

TABLE 2.7-4 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Operations	All systems: Hazardous and nonhazardous solid wastes would be generated during the treatment processes. These solid wastes would be collected and disposed of off post at appropriately permitted facilities. Quantities of brine salts produced by all technologies would vary, depending on the agent to be destroyed. Nonprocess solid wastes could be contaminated with agent and would also require treatment. Chemical weapons are RCRA listed wastes in Kentucky; therefore, all treatment residues are also listed wastes and, if not delisted under RCRA, must be managed and disposed of as hazardous waste. Process and nonprocess liquid wastes would be recycled within the treatment process. The only liquid waste associated with ACWA facilities that would be discharged would be domestic sanitary wastewater.				No impacts.
Air quality — criteria pollutants					
Construction	All systems: Total concentrations of criteria air pollutants resulting from fugitive dust emissions would be below applicable NAAQS, except for $PM_{2.5}$. Statewide background levels of $PM_{2.5}$ are above the annual NAAQS without the addition of an ACWA pilot facility; consequently, the total estimated annual average concentrations of $PM_{2.5}$ would be above the applicable NAAQS.				No impacts.
Operations	All systems: Estimated maximum concentration of criteria air pollutants would be within applicable standards, except for $PM_{2.5}$, for routine and fluctuating operations. Total estimated annual average concentrations of $PM_{2.5}$ would be above the applicable NAAQS, primarily because of high background concentration levels.				Background levels of $PM_{2.5}$ exceed NAAQS.
Air quality — toxic air pollutants					
Construction	All systems: Impacts would be negligible. Minor emissions would result from construction equipment.				No impacts since there would be no construction.
Operations	All systems: <u>Routine:</u> Pilot facility emissions would not be a major source of HAP emissions and would not fall under any of the source categories regulated by the EPA under NESHAP. <u>Fluctuating:</u> No agent emissions would be expected. Modeling of worst-case emissions resulted in estimated ambient agent concentrations of less than 1% of the allowable concentrations for general population exposure established by the CDC.				No impacts.

TABLE 2.7-4 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Human health and safety — routine operations					
Construction	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 17	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 22	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 22	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 24	No impacts since there would be no construction.
	All systems: <u>Other on-post workers and residents:</u> Potential for adverse health impacts from inhalation of $PM_{2.5}$ in existing environment already exists. There would be no other impacts. <u>Off-post public:</u> Potential for adverse health impacts from inhalation of $PM_{2.5}$ in existing environment already exists. There would be no other impacts.				
Operations	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 35	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 35	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 35	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 35	<u>Facility workers:</u> Estimated annual fatalities: <1 Estimated annual injuries: 3
	All systems: <u>On-post workers and residents:</u> Estimated hazard indices and carcinogenic risks from inhalation of toxic air pollutants are well below benchmarks considered representative of negligible risk levels. No agent emissions are expected. Even under hypothetical worst-case emission levels, the maximum estimated on-post concentration would be less than 1% of the allowable concentration for general public exposures. The maximum estimated incremental cancer risk from the inhalation of hypothetical mustard emissions is well below the benchmark risk value. Potential for adverse health impacts from inhalation of $PM_{2.5}$ in existing environment already exists. <u>Off-post public:</u> Estimated hazard indices and carcinogenic risks from inhalation of toxic air pollutants are well below benchmarks considered representative of negligible risk levels. No agent emissions are expected. Even under hypothetical worst-case emission levels, the maximum estimated on-post concentration would be less than 1% of the allowable concentration for general public exposures. The maximum estimated incremental cancer risk from the inhalation of hypothetical mustard emissions is well below the benchmark risk value. Potential for adverse health impacts from inhalation of $PM_{2.5}$ in existing environment already exists.				Potential for adverse health impacts from inhalation of $PM_{2.5}$ in existing environment already exists.

TABLE 2.7-4 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Noise					
Construction	All systems: Impacts on nearest residents would be negligible. Noise level would be below EPA guidelines for residential zone.				No impacts since there would be no construction
Operations	All systems: Impacts on nearest residents would be negligible. Noise level would be well below EPA guidelines for residential zone.				No impacts.
Visual resources					
Construction	All systems: Temporary impacts would result from increased traffic and construction dust.				No impacts since there would be no construction.
Operations	All systems: There would be no impacts. Industrial character of the facility and possible presence of small steam plume would be consistent with the visual character of the surrounding area and depot.				No impacts.
Geology and soils					
Construction	All systems: Impacts would be negligible. Up to 95 acres would be disturbed by construction of pilot facilities and associated infrastructure. Best management practices for soil erosion would minimize adverse impacts.				No impacts since there would be no construction.
Operations	All systems: There would be no impacts. No contamination of soils would be expected. The facility would be designed to prevent migration of small accidental releases (spills or leaks).				No impacts. Procedures are in place to prevent migration of small accidental releases (spills or leaks) while ACWs are in storage.

TABLE 2.7-4 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Groundwater					
Construction	All systems: There would be no impacts. The use of best management practices for erosion control would restrict surface runoff. Existing procedures dictate that spills or leaks of contaminants be quickly removed so they will not be transported to groundwater resources.				No impacts since there would be no construction.
Operations	All systems: Impacts would be negligible. There would be a slight increase in groundwater flow because of releases from the domestic sewage treatment plant.				No adverse impact from continued storage.
Surface water					
Construction	All systems: Construction impacts on surface flow would be negligible to minor and could be naturally mitigated by standard construction practices. Existing procedures dictate that spills or leaks of contaminants be quickly removed so they will not be transported to surface waters. Impacts on water supply would be negligible.				No impacts since there would be no construction.
Operations	All systems: There would be no impacts. The facility would be designed to prevent migration of small accidental releases (spills or leaks). Impacts on water supply would be negligible.				No impacts.
Terrestrial habitats and vegetation					
Construction	All systems: Impacts would be negligible. Up to 95 acres of vegetation and terrestrial habitat could be disturbed. Much of the disturbance would be temporary and mitigated through revegetation. Best management practices for soil erosion would minimize adverse impacts.				No impacts since there would be no construction.
Operations	All systems: Impacts would be negligible. The facility would be designed to prevent migration of small accidental releases (spills or leaks). Air emissions would be low and would not affect vegetation. Concentrations and deposition of emission constituents would pose no ecological risk.				No impacts.

TABLE 2.7-4 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Wildlife					
Construction	All systems: Impacts would be negligible. Noise, human activity, and habitat loss would have little impact because nearby habitats are similar. Less mobile species could be killed during construction and site preparation. Mitigation measures would be implemented to avoid impacts from erosion, use of construction vehicles, and siting of transmission lines.				No impacts since there would be no construction.
Operations	All systems: Impacts would be negligible. Noise, human activity, and habitat loss would have little impact because nearby habitats are similar. Releases of trace metals and organic compounds would be well below threshold levels for ecosystems. Deposition from atmospheric emissions would result in very low concentrations of trace metals and organic compounds. Deposition was shown to pose no ecological risk to terrestrial habitats.				No impacts.
Aquatic habitats and fish					
Construction	All systems: Impacts would be unlikely. Potential impacts due to soil erosion or sedimentation would be avoided through mitigation.				No impacts since there would be no construction.
Operations	All systems: There would be no impacts. No effluents would be released to streams because all process liquids would be recycled.				No impacts.
Protected species					
Construction	All systems: Construction of a transmission line could affect the running buffalo clover, a federal listed endangered species, through direct disturbance or loss of individual plants. Mitigation measures have been developed to minimize adverse effects.				No impacts since there would be no construction.
Operations	All systems: There would be no impacts.				No impacts.
Wetlands					
Construction	All systems: No wetlands would be directly affected within proposed Area A. Proposed Area B contains three small wetlands that could be adversely affected. Mitigation measures have been developed to minimize adverse effects.				No impacts since there would be no construction.

TABLE 2.7-4 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Operations	All systems: There would be no impacts.				No impacts.
Cultural resources					
Construction	Several archaeological sites are known to occur near the project area. Surveys would be required before ground disturbance could begin. Additional sites could be identified. Mitigation would be required if important archaeological sites were to be adversely affected by construction. No impacts are expected on previously surveyed portion of Proposed Area A.				No impacts since there would be no construction.
Operations	All systems: There would be no impacts.				No impacts.
Socioeconomics					
Construction	All systems: Impacts on the ROI would be relatively small. In-migration would have only a marginal impact on population growth. No significant impact on public finances or public service jobs would be expected. On-post employee commuting patterns would have no impact on levels of service in the local transportation network.				No impacts since there would be no construction.
	Increases: Employment: 570 direct jobs 530 indirect jobs Income: $35 million In-migrating population: 310	Increases: Employment: 670 direct jobs 510 indirect jobs Income: $37 million In-migrating population: 490	Increases: Employment: 710 direct jobs 550 indirect jobs Income: $39 million In-migrating population: 570	Increases: Employment: 800 direct jobs 610 indirect jobs Income: $44 In-migrating population: 740	

TABLE 2.7-4 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Operations	All systems: Impacts on the ROI would be relatively small.				Negligible impact on the ROI.
	Increases: Employment: 720 direct jobs 570 indirect jobs Income: $49 million In-migrating population: 680	Increases: Employment: 720 direct jobs 610 indirect jobs Income: $51 million In-migrating population: 720	Increases: Employment: 720 direct jobs 560 indirect jobs Income: $49 million In-migrating population: 680	Increases: Employment: 720 direct jobs 600 indirect jobs Income: $50 million In-migrating population: 710	Continued storage produces: Employment: 50 direct jobs 40 indirect jobs Income: $4 million
Environmental justice					
Construction	All systems: The socioeconomic impacts from construction would primarily increase short-term employment and income. They would also increase demand for housing, schools, and public services. None of these impacts would be high or adverse for local governments, and the existing housing stock would likely meet the demand. Similarly, no high and adverse impacts are anticipated during construction of an ACWA facility. As a result, environmental justice impacts are not anticipated from construction.				No impacts since there would be no construction.
Operations	All systems: During operations, there would be no high and adverse socioeconomic impacts associated with the facility. In addition, the risk of noncancer health effects and the risk of cancer from hazardous chemicals released during normal operations would be very low for both workers and the public. Neither of these impacts would be considered high and adverse. As a consequence, no environmental justice impacts are anticipated.				No impacts.

TABLE 2.7-4 (Cont.)

Environmental Consequence	Neutralization/ Biotreatment	Neutralization/ Supercritical Water Oxidation	Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation	Electrochemical Oxidation	No Action
Agriculture					
Construction	All systems: Impacts on agriculture from facility construction would not be likely.				No impact since there would be no construction.
Operations	During normal operations, facility emissions would be within applicable air quality standards. A screening-level agricultural risk assessment was conducted. The analysis indicated that the risks from maximum concentrations would be negligible.				No impact.

[a] Abbreviations: CDC = Centers for Disease Control and Prevention, CO = carbon monoxide, HAP = hazardous air pollutant, NESHAP = National Emission Standards for Hazardous Air Pollutants, PM_{10} = particulate matter with a mean aerodynamic diameter of 10 micrometers or less, $PM_{2.5}$ = particulate matter with a mean aerodynamic diameter of 2.5 micrometers or less, ROI = region of influence, scf = standard cubic foot (feet).

3 DESCRIPTION OF ALTERNATIVE SYSTEMS

3.1 INTRODUCTION

This chapter describes characteristics of ACWs and the alternative ACWA destruction systems proposed for pilot testing at one or more of the ACW stockpile installations. The alternative technologies included in these destruction systems were demonstrated as part of the ACWA selection process (see Section 2.4) (PMACWA 1999). Pilot testing of these systems is being considered because, even though the component technologies have been demonstrated, the full integration of the processes has not. As a result, significant issues of system reliability and effectiveness remain to be addressed. Systems designs continue to evolve.

This chapter first discusses the elements that are common to the proposed systems. It then describes the technologies that are proposed for each process and discusses their state of development at the stage of demonstration testing. Finally, installation-specific elements of the destruction systems, including infrastructure, work force, and resource requirements, are described in Chapters 4, 5, 6, and 7.

The ACWA program must provide a system that is a total solution for ACW destruction. It needs to cover the following interrelated processes: opening the weapons; treating agents, energetics, metal parts, and dunnage; and controlling pollution. The terms identified below are employed in discussing the alternatives. Figure 3.1-1 presents the relationships among these terms graphically.

- *Installation (i.e., Post):* The Army activity or depot at which ACWs are being stored and at which emplacement of an ACWA system is being evaluated. It includes both the chemical and nonchemical weapons areas. It is the entire parcel of land owned by the Army.

- *Site:* The location on the installation at which ACWs are currently being stored; also, the location at which the structure for ACW destruction would be built.

- *Facility:* The structure that would be built on the site to implement the ACW destruction activity.

- *System:* A complete approach to weapons destruction that includes disassembling a munition, destroying agents and energetics, treating component parts (e.g., metal and dunnage), and managing and disposing of effluents. Each system is considered an alternative action in this ACWA EIS.

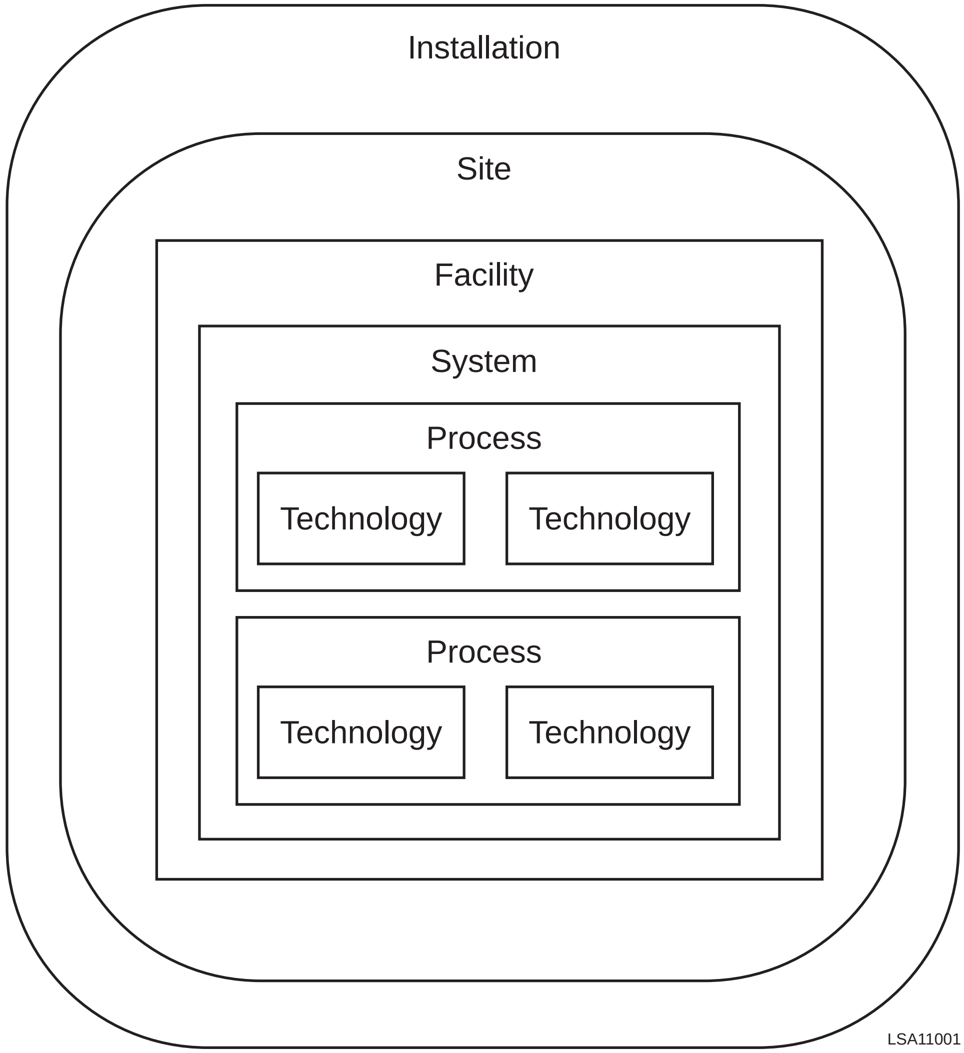

FIGURE 3.1-1 Relationship of Terms Used to Identify Elements of the Proposed Action

- *Process:* A category of activity that contributes to a total system. The processes are munitions access, agent treatment, energetics treatment, dunnage treatment, metal parts treatment, and effluent management/pollution control.

- *Technology:* The technique or techniques used to accomplish a process. More than one technology may be involved in a process. In addition, the same (or a similar) technology (e.g., heat treatment) may be used in multiple processes.

3.1.1 Characteristics of Assembled Chemical Weapons

The ACWs that are to be destroyed exist in a variety of forms, each with different combinations of components. All consist of a metal casing, within which there is some type of chemical agent (Figure 3.1-2). By definition, ACWs also contain some type of explosive (known as a burster, which may be accompanied by a supplemental explosive charge) for chemical agent dispersal. This burster may be accompanied by a fuze (an initiating mechanism) and an additional supplemental charge.

The types of explosives used to disperse the agent contained in ACWs include tetryl, tetrytol, Composition A5, Composition B4, and trinitrotoluene (TNT). Tetrytol is a mixture of tetryl and TNT. Composition A5 is the explosive RDX mixed with stearic acid. Composition B4 is a mixture of TNT and RDX (CBDCOM 1997). All of these explosives also are used in nonchemical munitions. While these explosives are powerful, they are relatively insensitive to heat or shock. A fuze assembly containing a more sensitive explosive compound, such as lead azide, must be used to detonate the explosives listed above. Fuzes are mechanical devices that include a variety of safety mechanisms to protect the explosives from accidental detonation.

Some weapons are also assembled with a propellant designed to fire or launch the weapon. The propellants are designed to generate large quantities of gaseous products through rapid burning rather than through detonation of the materials. The propellants used in the ACWs being considered by ACWA are primarily composed of nitrocellulose and nitroglycerin in varying proportions. Other chemicals are added to this mix to control the rate of burning and other attributes of the propellants. The propellants are relatively insensitive to shock and heat and must be ignited by a small charge of black powder or pyrotechnic material. Together, explosives and propellants make up a category of materials referred to as “energetics.”

Artillery projectiles, mortar projectiles, rockets, and land mines are the major forms of ACWs. The chemical agents contained in these forms fall into two main categories, nerve agents and chemical blister agents.[1] GB (Sarin) and VX are the two types of nerve agents in ACWs. Both are highly toxic and can cause death to a receptor within minutes of exposure to liquid or aerosol forms. GB also creates vapors that are extremely toxic. Both GB and VX interfere with the nervous system and can cause failure of the respiratory system and other bodily functions. Three closely related types of blister agents are used in ACWs: the mustard agents H, HD, and HT. Exposure to liquid, aerosol, or vapor forms of these agents causes severe disruption of skin and membrane functions. Major symptoms of mustard exposure commonly do not appear until

[1] For more information on chemical agents, see http://www.sbccom.apgea.army.mil/RDA/msds/index.htm and http://www.mitretek.org/mission/envene/chemica/chem_back.html.

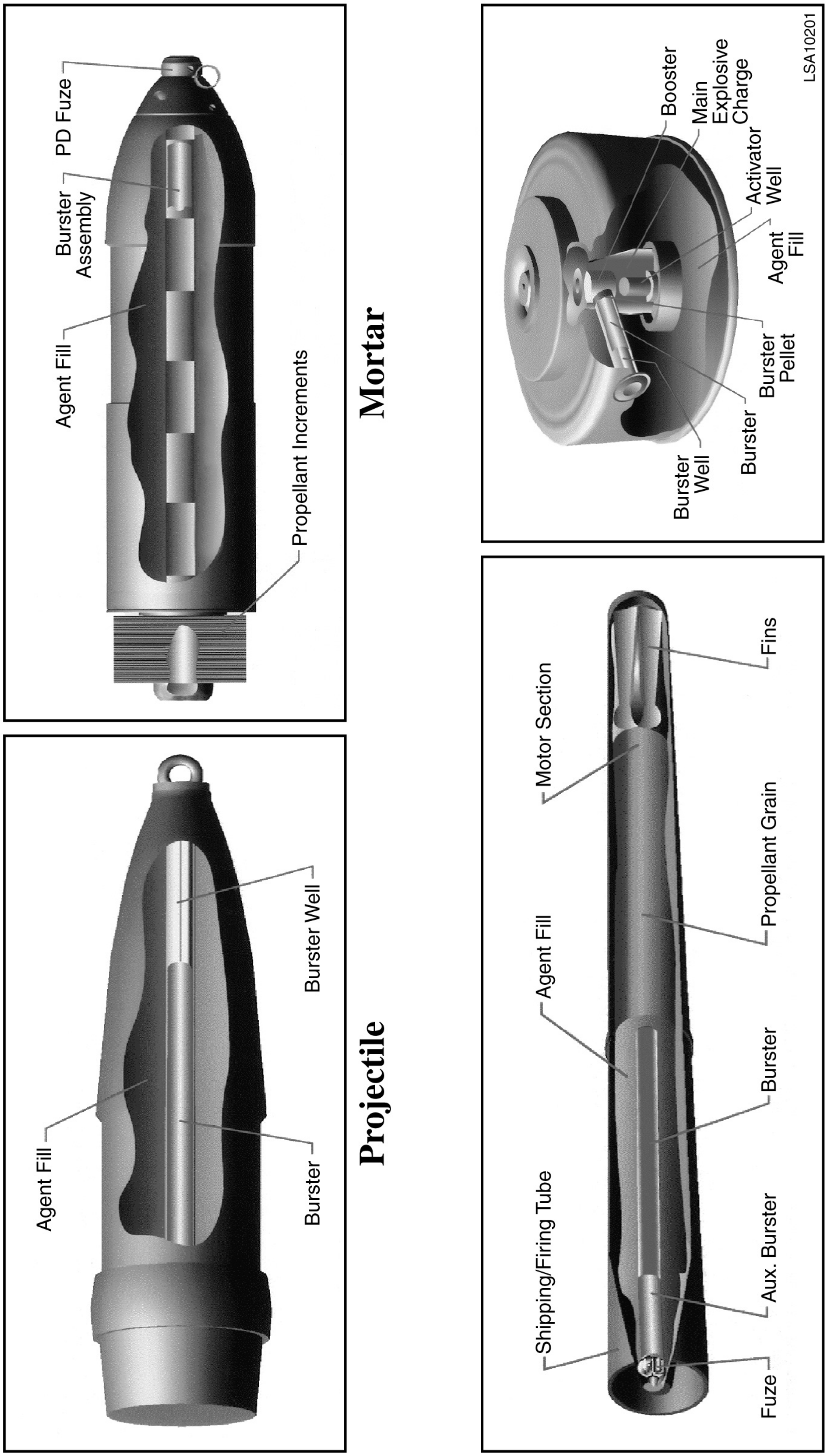

FIGURE 3.1-2 General Diagrams of a Projectile, Mortar, Rocket, and Mine

several hours after exposure. Death may occur if the skin and membrane disruption is sufficiently widespread over the body.

Table 3.1-1 lists the types and locations of ACWs presently in the U.S. chemical weapons stockpile that are included in this EIS. The table also identifies the types of components that may be associated with each type of munition. Any single ACW contains one type of agent and one or more types of energetic. (Some munitions may have one or more of their component energetics removed and stored separately.) Each stockpile location has a different combination of ACW types. Explanations of the ACW configurations are as follows:

- *Projectile*: A weapon designed to be fired from a cannon. ACW projectiles contain dispersing explosives. Except for mortars and rockets, stockpiled projectiles are designed to be breech-loaded.

- *Mortar*: A projectile designed to be fired from a muzzle-loaded cannon. ACW mortar projectiles are assembled with fuzes and propellants, in addition to the agent and dispersing explosives.

- *Cartridge*: A projectile assembled with a fuze and packaged with propellants, in addition to the agent and dispersing explosives.

- *Rocket Warhead*: A projectile with agent, fuzes, and dispersing explosives.

- *Rocket*: A rocket warhead with an attached rocket motor containing propellant.

- *Mine*: A weapon designed to be fixed in place. ACW mines contain fuzes, agent, and dispersing explosives.

3.1.2 Processes Required for ACW Destruction

Each of the alternatives for destruction and disposal of ACWs being considered is designed to treat four categories of material: agent, energetics, metal parts, and dunnage (materials such as protective suits, pallets, and packaging are collectively called “dunnage”). The major processes being considered to accomplish this goal are illustrated conceptually in Figure 3.1-3. The first step, munitions disassembly (i.e., opening the munition), is common to each of the technologies for treating the ACW components being considered, although some modifications of the baseline process have been proposed (see Kimmell et al. 2001). Once the

TABLE 3.1-1 Agent, Burster, and Propellant Types That May Be Associated with Each Munition Type

ACW Form and Munition Type	Agent Type	Burster and Supplemental Charge Type	Fuze[a]	Propellant[b]	Applicable Location[c]
155-mm projectiles M121, M121A1, M104, M110, M122	GB, VX, H, HD	Composition B4, tetrytol, TNT	No	No	ANAD, PCD,[d] BGAD
105-mm projectiles M60, M360	HD, GB	Tetrytol, Composition B4	Yes	No	ANAD, PCD[d]
105-mm cartridges M60, M360	HD, GB	Tetrytol, Composition B4	Yes	Yes	ANAD, PCD[d]
8-in. projectiles M426	GB, VX	Composition B4, TNT	No	No	ANAD, BGAD
4.2-in. mortars M2, M2A1	HD, HT	Tetryl, tetrytol	Yes	Yes	ANAD, PCD[d]
Rockets M55, M56[e]	GB, VX	Composition B4, tetrytol	Yes	Yes[e]	ANAD, PBA, BGAD
Land mines M23	VX	Composition A5, Composition B4, tetryl	Yes	No	ANAD, PBA

[a] Fuzes are mechanical devices that trigger the detonation of a small explosive charge (commonly lead azide) that in turn detonates the larger supplemental and burster charges.

[b] Propelling charges are predominately nitrocelluose compounds with nitroglycerin added.

[c] Only for those locations included in this EIS.

[d] Only the mustard agents HD and HT are contained in munitions at PCD.

[e] The M56 is a rocket warhead without a rocket motor (i.e., propellant) attached.

Source: U.S. Army (1988).

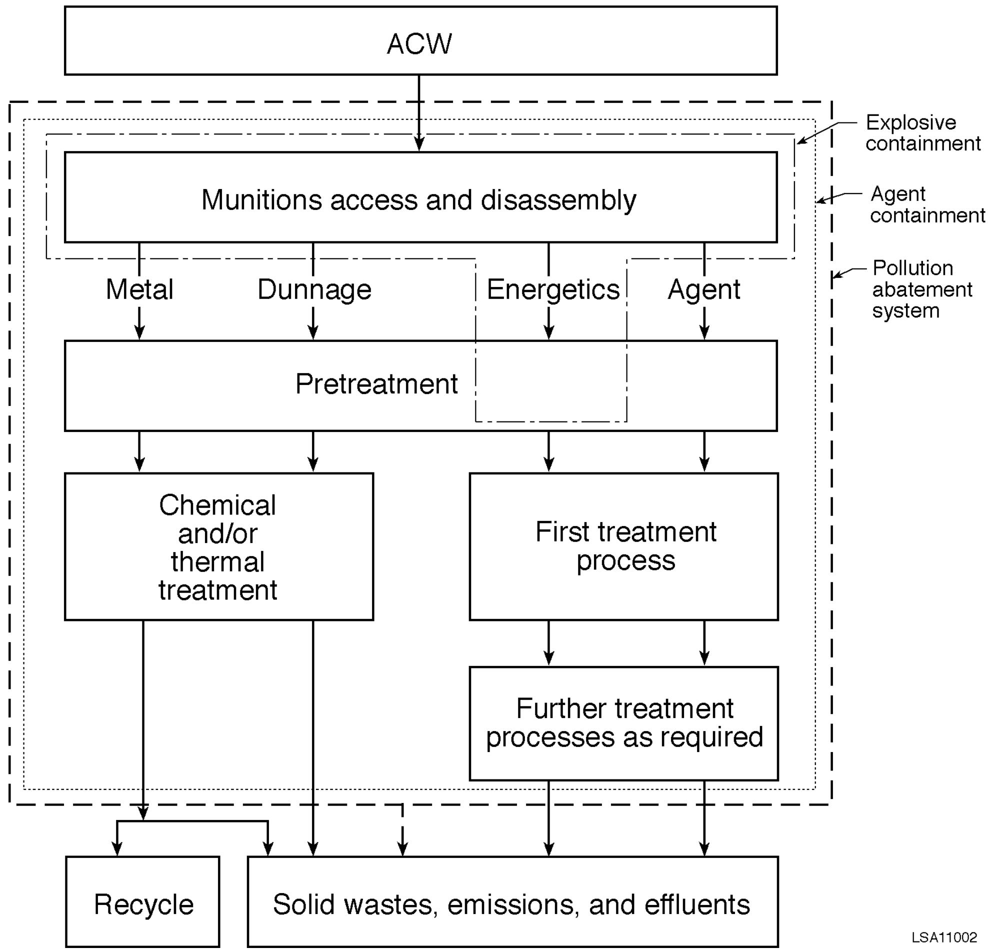

FIGURE 3.1-3 Conceptual Overview of Proposed Alternatives for ACWA Systems

munitions are disassembled, the components can be separated into the four material streams for subsequent processing. The proposed technology systems vary in their approach to ACW destruction.

3.1.3 Containment Structure and Facility Size

Pilot tests of ACW destruction would take place in structures designed to prevent the release of agents to the environment. Disassembly of ACWs and preparation of energetics for treatment would be carried out in an explosion containment area. The overall structure would use features such as air locks and negative internal air pressure to contain agent. Ventilation systems and process gases would pass through the pollution abatement system (see Section 3.3.7) before being released from the structure.

The current facility designs are based on structures used in the baseline incineration process. The main structure would be a two-story building built of noncombustible materials, with a concrete structural frame and a low-slope, concrete roof. This building would contain equipment and systems for munitions disassembly, processing of contents and components, and pollution abatement. It would also contain a chemical analysis laboratory and areas for support of personnel and maintenance.

The facility footprint for each of the proposed technologies would require approximately 25 acres (10 ha). Additional area might be required for support facilities and construction operations (U.S. Army 1997a) and for storm water management, access roads, and utilities, depending on conditions at each installation.

3.2 ACWA SYSTEMS

Four systems for ACW destruction are being considered for pilot testing: neutralization/biotreatment, neutralization/supercritical water oxidation, neutralization/gas-phase chemical reduction/transpiring wall supercritical water oxidation, and electrochemical oxidation.

3.2.1 Neutralization/Biotreatment System

A detailed system description of the Neut/Bio alternative is provided in Kimmell et al. (2001). The PMCD selected a variation of this process for pilot testing as a method for destroying mustard agent at Aberdeen Proving Ground, Maryland. Also, Parsons/Allied Signal (now Parsons/Honeywell) successfully demonstrated similar Neut/Bio processes for destroying blister agent for the PMACWA, but the system has not been successfully demonstrated for destroying nerve agent (PMACWA 1999).

The general process flow of the Neut/Bio system is shown in Figure 3.2-1. As envisioned, the system would use the baseline reverse assembly process or a modification of this process for ACW disassembly. The system would employ hydrolysis (i.e., neutralization) using water and then a caustic solution (such as sodium hydroxide) to treat blister agent, and it would also employ hydrolysis using a caustic solution to treat energetics.

To completely eliminate other hazards and chemical compounds of concern, the hydrolysates (i.e., products resulting from the neutralization process) would be subjected to biological treatment. The treatment would result in a sludge, which would be prepared for disposal by using wastewater treatment equipment to flocculate and solidify the biotreatment effluent. The treatment of metal parts and dunnage would involve caustic hydrolysis and/or thermal treatment.

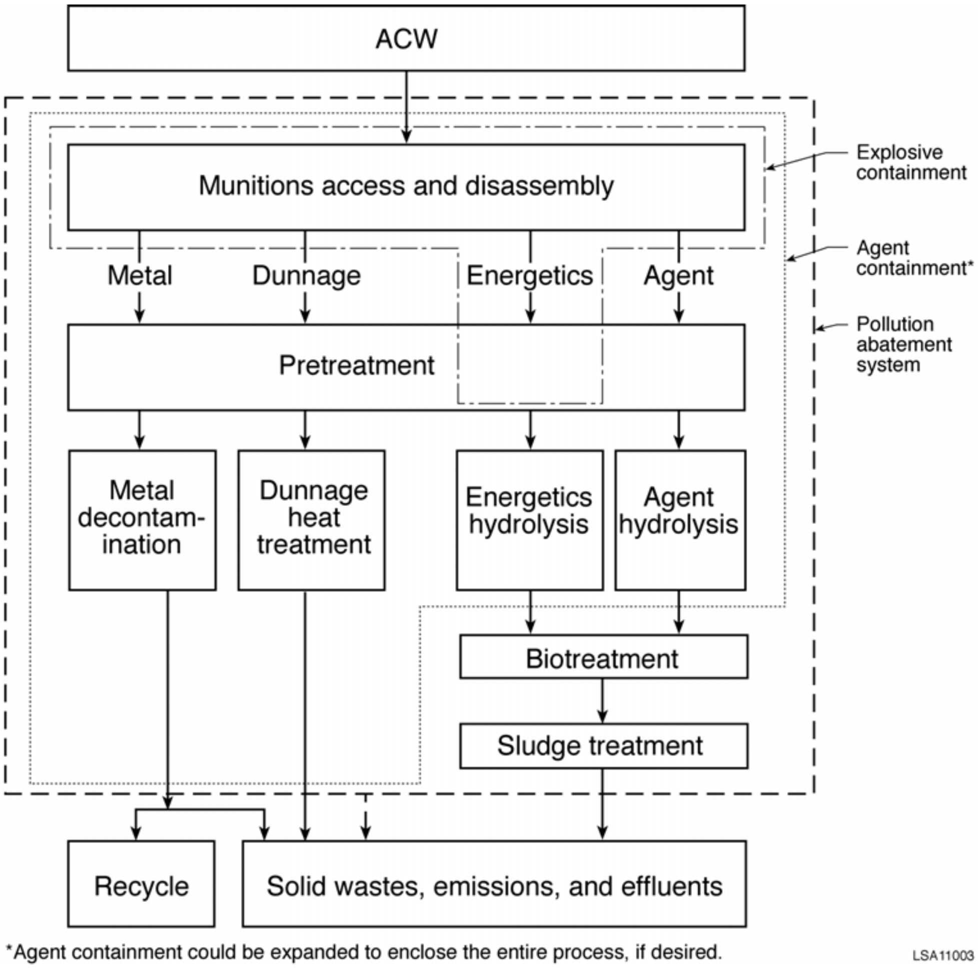

FIGURE 3.2-1 Neutralization/Biotreatment System

3.2.2 Neutralization/Supercritical Water Oxidation System

The Neut/SCWO system is characterized in Kimmell et al. (2001). General Atomics demonstrated Neut/SCWO processes for the PMACWA. The PMCD also selected this type of process for pilot testing as a method for destroying bulk quantities of VX agent at a pilot test facility at Newport Chemical Depot, Indiana.

Figure 3.2-2 illustrates the major processes that make up the Neut/SCWO system. As currently envisioned, the system would employ parts of the baseline reverse assembly process for ACW disassembly. After disassembly, materials would be prepared for neutralization. For example, dunnage would be reduced in size. Agents and energetics would be separated and neutralized in separate systems.

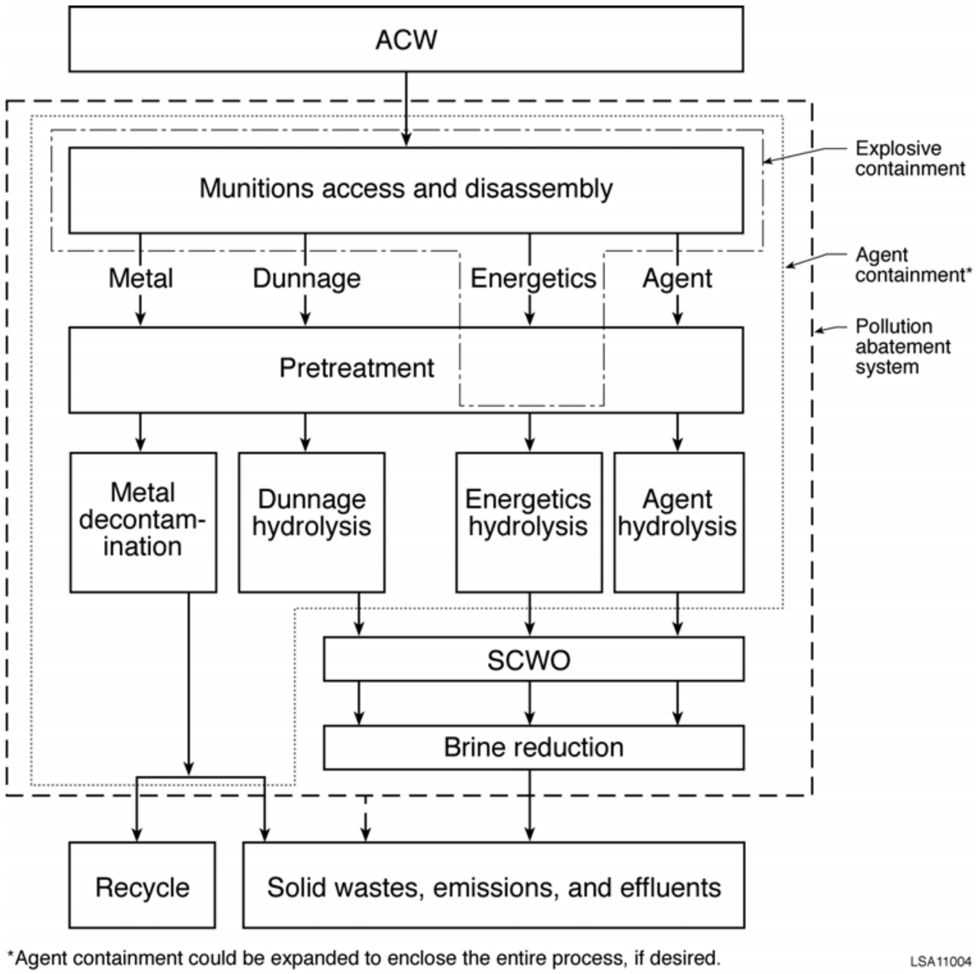

FIGURE 3.2-2 Neutralization/SCWO System

To completely eliminate other hazards and chemical compounds of concern that might remain after neutralization, the agent and energetic hydrolysates would be placed in separate SCWO units. The proposed design includes reactor vessels constructed of a corrosion-resistant metal such as platinum. Slurry prepared from the hydrolyzed dunnage and from used filter carbon would be treated with the energetics hydrolysate in the SCWO unit. Metal parts would be washed in caustic; the caustic would then be treated in the SCWO unit, and the washed metal parts would be thermally treated to ensure that all agents and energetics were removed.

3.2.3 Neutralization/Gas-Phase Chemical Reduction/Transpiring Wall Supercritical Water Oxidation System

The Neut/GPCR/TW-SCWO process would incorporate neutralization of agents and energetics, gas-phase chemical reduction (GPCR) of solids and gases, and treatment of hydrolysate by transpiring wall (TW) supercritical water oxidation (SCWO). Kimmell et al.

(2001) provides a detailed description of the GPCR/TW-SCWO system. Foster Wheeler, Eco Logic, and Kvaerner demonstrated GPCR/TW-SCWO processes for the PMACWA. The general process flow of the system is shown in Figure 3.2-3. As envisioned, the system would use the baseline reverse assembly process or a modification of this process for ACW disassembly. After disassembly, materials would be prepared for neutralization. Agents and energetics would be neutralized in separate hydrolysis systems.

To completely eliminate other hazards and chemical compounds of concern that might remain after neutralization, the agent and energetic hydrolysates would be combined and treated by SCWO. This process would take place in a vessel lined with a transpiring wall through which water would be pumped continuously to prevent corrosion and buildup of solids. Metal parts would be treated by caustic hydrolysis and washed. Then metal parts and dunnage would be thermally treated in a hydrogen and steam atmosphere to ensure that all agents and energetics were removed.

3.2.4 Electrochemical Oxidation System

The electrochemical oxidation system (Elchem Ox) would employ silver nitrate in a concentrated nitric acid bath to oxidize organic substances. Thermal decontamination would be used for metal parts and dunnage. A detailed description of the system is provided in Kimmell et al. (2001). AEA Technology and CH2M HILL demonstrated SILVER II™ for the PMACWA.

The general process flow of the system is shown in Figure 3.2-4. As currently envisioned, the system would use the baseline reverse assembly process or a modification of this process for ACW disassembly. After disassembly, materials would be prepared for treatment. To completely eliminate other hazards and chemical compounds of concern, agents and energetics would be treated in separate oxidation systems. NO_X formed as a result of the oxidation process would be reformed to nitric acid.

Dunnage would be size-reduced and then would be thermally treated. Metal parts also would be thermally treated to ensure that all agents and energetics were removed.

3.3 ACWA PROCESSES

3.3.1 Removal and Movement from Storage

A pilot test of the destruction system would begin by removing pallets that hold ACWs from the storage igloo and moving them to the chemical handling area of the pilot facility for

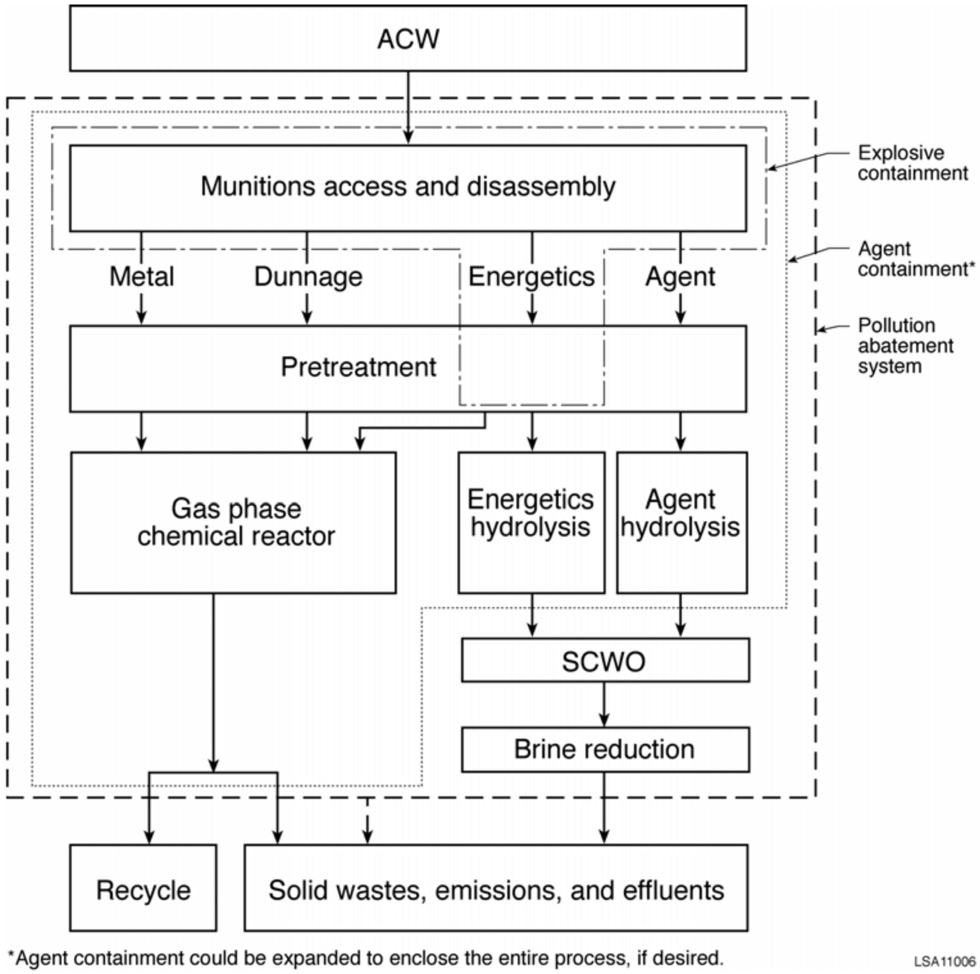

FIGURE 3.2-3 Neutralization/GPCR/TW-SCWO System

disassembly. Before igloos would be opened, the munitions would be monitored to determine if they were safe for transport. If unsafe munitions were identified, they would be overpacked and made safe for transport. All movement of munitions from the storage site to the pilot facility would be within the installation. Monitoring and movement would conform to all applicable safety guidelines and regulations.

3.3.2 Disassembly Process

With regard to ACWs, the term "disassembly" refers to the steps employed to separate the agent and energetics from the metal casing and other metal parts. The basic process used to disassemble ACWs is called baseline reverse assembly. Baseline reverse assembly is employed at JACADS and TOCDF and, with some modifications, would be employed by each of the ACWA alternatives considered.

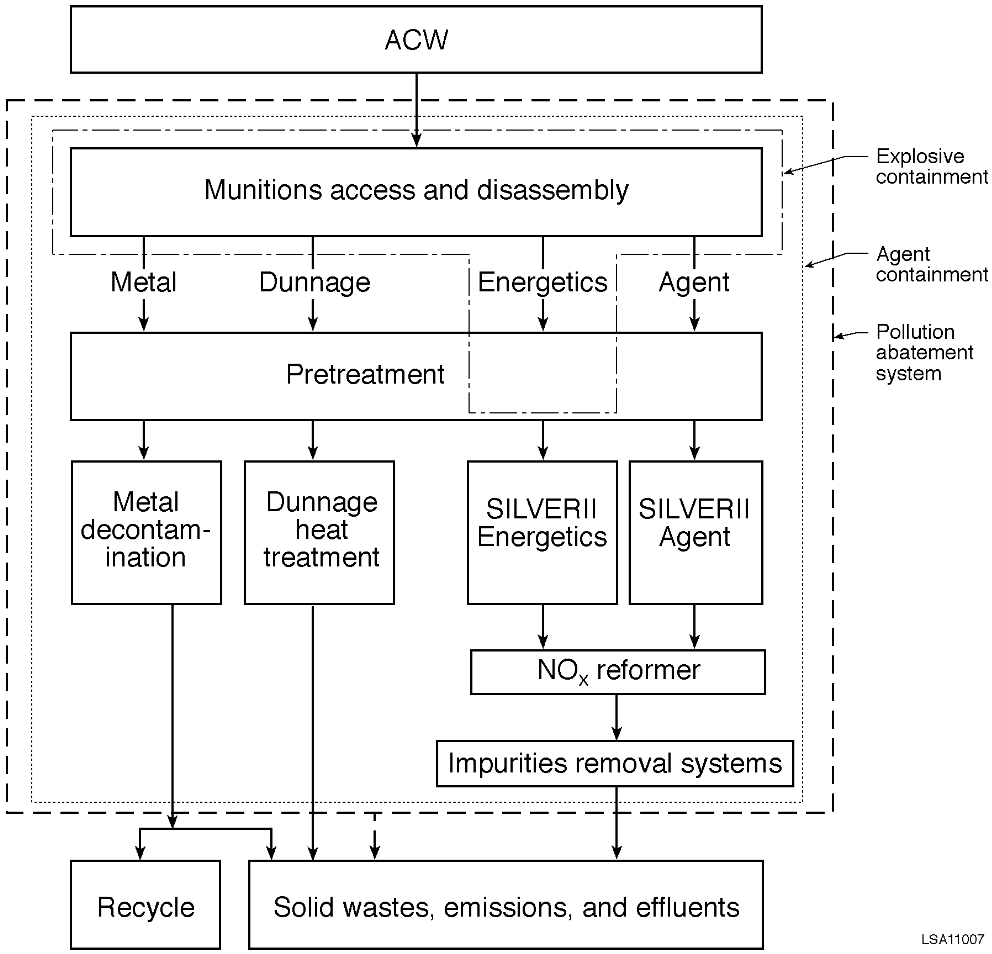

FIGURE 3.2-4 Electrochemical Oxidation System

In conjunction with baseline reverse assembly of the munitions, various technologies could be used to open the metal casing and remove the agents. Details are provided in Kimmell et al. (2001). Demonstrated modifications to reverse assembly could include these:

1. High-pressure fluid jet to cut the munitions,

2. High-pressure wash to remove the agent and energetics, and

3. Cryofracture (a process in which munitions are embrittled by cooling in liquid nitrogen and then fractured) to access the agent after the energetics were removed.

Disassembly would be followed by preparing these streams of materials and the dunnage for further treatment.

3.3.3 Pretreatment Process

Pretreatment is the linking step between disassembly of an ACW and the treatment of its component parts. Most pretreatment activities are specific to the treatment process and are described as part of that process, such as reducing the size of dunnage before its treatment within a SCWO process. However, during the design and construction of integrated systems, it might be determined that material handling equipment, mixing tanks, heating components, and similar items not described in the disassembly and treatment processes (such as SCWO) would be needed.

3.3.4 Neutralization Process

Neutralization (or hydrolysis) is a process that is common to the Neut/Bio, Neut/SCWO, and Neut/GPCR/TW-SCWO alternatives. However, variations in the technology and equipment that would be used to implement the process have been proposed. Hydrolysis is a chemical process that uses a caustic solution (such as sodium hydroxide in water) or water followed by a caustic solution. It can be applied to energetics as well as to nerve and blister agents. This process breaks up the chemical compounds that form the agents and reduces the flammability and explosive reactivity of energetics, but it does not eliminate all hazards. Neutralization of agents produces residual compounds that are controlled under Schedule 2 of the CWC.[2] Secondary processes, such as biotreatment or SCWO, are required to destroy these compounds.

In the process envisioned, after the munitions would be disassembled to access the agents and energetics (explosives and propellants), the agents and energetics would be neutralized with water and a caustic solution or with a caustic solution alone. (Neutralization is discussed in Kimmell et al. [2001]). The temperature of the solution might be increased above ambient temperatures to speed up the reaction, decrease the time needed to treat the agent and energetics, and reduce the quantity of wastes produced. The product that results from the neutralization process is called hydrolysate.

3.3.5 Biotreatment Process

Biotreatment uses microbiological organisms to convert complex organic compounds to simpler materials. The organisms convert organic matter to stable forms (e.g., carbon dioxide, water, nitrates, and phosphates) as well as other organic material. The production of new organic matter is an indirect result of biotreatment. As envisioned, biotreatment would take place at temperatures and pressures near ambient conditions in tanks or similar structures designed to control retention time and hydrolysate contact with the biological organisms. The treatment

[2] The agents themselves are designated as Schedule 1 compounds. Schedule 2 compounds are mainly agent precursors and are restricted from commercial distribution because they can be used to create toxic agents. Schedule 1 and 2 compounds are identified in Appendix B of Kimmell et al. (2001).

would result in a sludge that would be prepared for disposal by using wastewater treatment equipment to flocculate and solidify the biotreatment effluent. Additional details on the biotreatment process are available in Kimmell et al. (2001).

Biotreatment is a relatively mature technology that has been demonstrated for many types of wastes and is commonly used for municipal sewage and industrial wastes. However, the toxicity of the feed materials (e.g., due to metals content) can be a limiting factor that requires monitoring and control.

3.3.6 Supercritical Water Oxidation Process

SCWO is a thermal oxidation process that takes place at temperatures and pressures above the critical point of water (i.e., at supercritical conditions; for water, this means pressures more than 220 times the atmospheric pressure and temperatures greater than about 705°F [340°C]). In the supercritical phase, water exists in a form that is more like a dense gas than a liquid and has enhanced solvent properties. Organic compounds (such as products of neutralized chemical agents and energetics) tend to break apart and dissolve under these conditions. Two different SCWO reactor technologies are being considered for pilot testing. In the processes envisioned, after chemical reactions would be complete, the effluent would be cooled, depressurized, and separated into gaseous and liquid waste streams. Salts and other materials would be removed from solution by evaporation. See Kimmell et al. (2001) for more detailed descriptions.

SCWO has been used on a pilot scale to treat various types of wastes and is in commercial operation. However, its potential for long-term operability in treating energetics has not yet been fully demonstrated. In addition, the issues associated with salt plugging and corrosion associated with the SCWO reactor and feed line design have not yet been addressed fully (PMACWA 1999). These issues and reactor technology issues associated with thermal stress on the reactor lines are being studied by the PMACWA (2001).

3.3.7 Electrochemical Oxidation Process

Electrochemical oxidation occurs when an electric current is applied across an anode and cathodes in a cell containing acids in compartments separated by a membrane. The organic feed containing the agents or energetics is metered into the cell, which also contains silver nitrate. When the current is applied, the silver ions that are generated oxidize the organic materials, while the nitric acid is reduced to NO_X and water.

3.3.8 Thermal Treatment Processes

Demonstrated methods of thermal treatment for contaminated dunnage and metal parts include the use of steam, hot gas (such as hydrogen), or radiant heat. Temperatures are raised in excess of 1,000°F (538°C) for 15 minutes as prescribed in Army standards (U.S. Army 1997b). Under these conditions, the chemical bonds of the nerve and blister compounds are broken and the chemical hazards are eliminated.

3.3.9 Pollution Abatement and Waste Handling Processes

Gases and solids would constitute the major types of wastes from the alternative technologies. Process water streams would be treated and recycled. There would be a nitric acid liquid waste stream from Elchem Ox. Plant ventilation systems would be designed to cascade air flow from the areas least likely to be contaminated to those where there would be a greater possibility of contamination. Catalytic purifiers (similar to automotive catalytic converters), high-efficiency particulate air (HEPA) filters and carbon filters, liquid scrubbers, and combinations of these technologies have been demonstrated and could be used to control air pollution. Ventilation air could be held and tested before its release to pollution control processes.

Solid residues, such as salts, would be considered hazardous waste if they leached heavy metals at levels above those allowed by the *Resource Conservation and Recovery Act* (RCRA) Toxic Characteristic Leaching Procedure (TCLP). Stabilization of these wastes would be required to reduce the leachability of heavy metals to levels below TCLP levels. After stabilization, these wastes could be disposed of in a landfill permitted to receive them. Metal parts would be cleaned sufficiently for release and then recycled. Environmental regulations might create additional requirements at some installations.

3.4 INPUTS AND OUTPUTS

3.4.1 Resource Requirements

The estimates of resource requirements that follow are not exact but do provide an “envelope” for possible levels of annual throughput. Since the alternatives under consideration would involve pilot testing, their operation is unlikely to be continuous, and resource use might differ from the estimates presented here. As presented in this chapter, the inputs for the technologies are installation-specific, but the outputs are general in nature. The differences in inputs for each installation stem from differences in the munition types and inventories and in the types of agent present in the ACW inventory at each installation. Installation-specific information for outputs is provided in Chapters 4, 5, 6, and 7.

3.4.1.1 Neutralization/Biotreatment

Table 3.4-1 lists estimated annual utility and process input requirements for pilot testing the Neut/Bio system for mustard agent. The estimates are based on assumed operations of 12 h/d, 6 d/wk, and 46 wk/yr.[3]

3.4.1.2 Neutralization/SCWO

Estimates of annual utility and process input requirements for pilot testing the Neut/SCWO system are provided in Table 3.4-2. These estimates are also based on assumed operations of 12 h/d, 6 d/wk, and 46 wk/yr.[3] Resource requirements are listed for nerve agent, rather than for GB and VX separately, because the demonstration testing did not provide a basis for developing separate estimates.

3.4.1.3 Neutralization/GPCR/TW-SCWO

Table 3.4-3 lists estimated annual utility and process input requirements for pilot testing the Neut/GPCR/TW-SCWO system. The estimates are based on assumed operations of 12 h/d, 6 d/wk, and 46 wk/yr.[3]

3.4.1.4 Electrochemical Oxidation

Estimated annual utility and process input requirements for pilot testing the Elchem Ox system are provided in Table 3.4-4. The estimates are based on assumed operations of 12 h/d, 6 d/wk, and 46 wk/yr.[3]

3.4.2 Routine Emissions and Wastes

Detailed information on the emissions and wastes for each technology at each installation is provided in Sections 4.4, 5.4, 6.4, and 7.4.

---

[3] The ACWA pilot plants will be available 24 h/d and 365 d/yr, but the four destruction processes (Neut/Bio, Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox) will operate about 38% of the available time (12 h/d, 6 d/wk, 46 wk/yr). The other 62% of the time, they will be devoted to maintenance, review of operational data, and other activities not expected to generate significant waste, emissions, or effluents.

TABLE 3.4-1 Estimates of Annual Operational Input for Neutralization/Biotreatment by Site[a]

Input	Input per Site		
	ANAD	PCD	BGAD[b]
Electric power[c]	36 GWh	36 GWh	2 GWh
Natural gas[c]	50×10^6 scf	94×10^6 scf	9×10^6 scf
Fuel oil[d]	48,000 gal	48,000 gal	2,800 gal
Potable water[e]	6,400,000 gal	6,400,000 gal	300,000 gal
Process water[c]	7,000,000 gal	13,000,000 gal[f]	1,300,000 gal
Air for biotreater[g]	150,100 tons	280,000 tons	25,600 tons
Water in caustic[g]	510 tons	970 tons	90 tons
Sodium hydroxide (in 50% solution)[g]	510 tons	970 tons	90 tons
Sulfuric acid[g]	10 tons	30 tons	2 tons
Dipotassium phosphate[g]	30 tons	50 tons	4 tons
Magnesium chloride[g]	10 tons	20 tons	2 tons
Calcium chloride[g]	10 tons	20 tons	2 tons
Ammonium phosphate[g]	50 tons	90 tons	8 tons
Ammonia[g]	190 tons	350 tons	30 tons
Ferrous sulfate[g]	3 tons	6 tons	1 ton
Hydrogen peroxide[g]	70 tons	140 tons	10 tons

[a] Unit conversions: 1 ft^3 = 0.028 m^3. 1 gal = 3.8 L. 1 ton = 0.91 tonne. 1 scf (standard cubic foot) = 0.028 Nm^3 (normal cubic meter).

[b] At BGAD, values for all commodities other than fuel oil are based on 16 days of operation per year. The value for fuel oil is based on 35 hours of operation per year.

[c] At ANAD and PCD, values for electric power, natural gas, and process water are based on 276 days of operation per year at 6 d/wk and 46 wk/yr.

[d] At ANAD and PCD, values for fuel oil are based on 600 hours of operation per year.

[e] At ANAD and PCD, values for potable water are based on 365 days of operation per year.

[f] The number used for process water for Neut/Bio at PCD was from demonstration testing. Subsequent design studies now indicate 5.7 million gal/yr would be used.

[g] Values are based on 38% availability of operations.

Source: Kimmell et al. (2001).

TABLE 3.4-2 Estimates of Annual Operational Input for Neutralization/SCWO by Site and Agent[a]

Input	Input per Site and Type of Agent					
	ANAD		PBA	PCD	BGAD	
Electric power[b]	60 GWh		60 GWh	60 GWh	60 GWh	
Natural gas[b]	69×10^6 scf		52×10^6 scf	149×10^6 scf	52×10^6 scf	
Fuel oil[c]	48,000 gal		48,000 gal	48,000 gal	48,000 gal	
Potable water[d]	6,400,000 gal		5,500,000 gal	6,400,000 gal	6,400,000 gal	
Process water[b]	8,300,000 gal		6,100,000 gal	18,000,000 gal[e]	6,300,000 gal	
	Mustard	Nerve	Nerve	Mustard	Mustard	Nerve
Kerosene[f]	1,000 tons	620 tons	830 tons	1,500 tons	130 tons	810 tons
Compressed air[f]	4 tons	990 tons	2,100 tons	7 tons	1 ton	2,000 tons
Liquid oxygen[f]	5,700 tons	4,000 tons	4,400 tons	7,800 tons	680 tons	4,400 tons
Liquid nitrogen[f]	2,000 tons	2,900 tons	0	7,200 tons	640 tons	810 tons
Water in caustic[f]	660 tons	1,200 tons	2,000 tons	1,300 tons	140 tons	2,000 tons
Sodium hydroxide (in 50% solution)[f]	540 tons	1,200 tons	1,800 tons	1,000 tons	120 tons	1,800 tons
Phosphoric acid[f]	10 tons	630 tons	1,200 tons	30 tons	2 tons	1,200 tons

a Unit conversions: 1 ft^3 = 0.028 m^3. 1 gal = 3.8 L. 1 ton = 0.91 tonne. 1 scf (standard cubic foot) = 0.028 Nm^3 (normal cubic meter).

b Values for electric power, natural gas, and process water are based on 276 days of operation per year at 6 d/wk and 46 wk/yr.

c Values for fuel oil are based on 600 hours of operation per year.

d Values for potable water are based on 365 days of operation per year.

e The number used for process water for Neut/SCWO at PCD was from demonstration testing. Subsequent design studies now indicate 1.3 million gal/yr would be used.

f Based on 38% availability of operations.

Source: Kimmell et al. (2001).

TABLE 3.4-3 Estimates of Annual Operational Input for Neutralization/GPCR/TW-SCWO by Site and Agent[a]

	Input per Site and Type of Agent							
Input	ANAD			PBA		BGAD		
Electric power[b]	26 GWh			26 GWh		26 GWh		
Natural gas[b]	130×10^6 scf			141×10^6 scf		138×10^6 scf		
Fuel oil[c]	48,000 gal			48,000 gal		48,000 gal		
Potable water[d]	6,400,000 gal			6,400,000 gal		6,400,000 gal		
Process water[b]	18,000,000 gal			18,000,000 gal		18,000,000 gal		
	Mustard	GB	VX	GB	VX	Mustard	GB	VX
Liquid oxygen[e]	1,200 tons	2,400 tons	2,700 tons	2,600 tons	770 tons	200 tons	2,300 tons	700 tons
Sodium hydroxide[e]	540 tons	1,400 tons	1,060 tons	1,900 tons	570 tons	120 tons	1,500 tons	500 tons
Kerosene[e]	90 tons	400 tons	310 tons	460 tons	90 tons	20 tons	400 tons	70 tons

[a] Unit conversions: 1 ft^3 = 0.028 m^3. 1 gal = 3.8 L. 1 ton = 0.91 tonne. 1 scf (standard cubic foot) = 0.028 Nm^3 (normal cubic meter).

[b] Values for electric power, natural gas, and process water are based on 276 days of operation per year at 6 d/wk and 46 wk/yr.

[c] Values for fuel oil are based on 600 hours of operation per year.

[d] Values for potable water are based on 365 days of operation per year.

[e] Values are based on 38% availability of operations.

Source: Kimmell et al. (2001).

TABLE 3.4-4 Estimates of Annual Operational Input for Electrochemical Oxidation by Site and Agent[a]

Input	Input per Site and Type of Agent							
	ANAD			PBA		BGAD		
Electric power[b]	105 GWh			121 GWh		122 GWh		
Natural gas[b]	53×10^6 scf			48×10^6 scf		52×10^6 scf		
Fuel oil[c]	48,000 gal			48,000 gal		48,000 gal		
Potable water[d]	6,400,000 gal			6,400,000 gal		6,400,000 gal		
Process water[b]	1,0000,000 gal			900,000 gal		1,000,000 gal		
	Mustard	GB	VX	GB	VX	Mustard	GB	VX
Silver nitrate[e]	1,170 tons	160 tons	120 tons	150 tons	40 tons	200 tons	130 tons	30 tons
Nitric acid[e]	0	0	30 tons	0	7 tons	0	0	1.6 tons
Calcium nitrate[e]	550 tons	220 tons	0	210 tons	0	90 tons	180 tons	0
Oxygen[e]	1,700 tons	1,500 tons	2,100 tons	1,800 tons	750 tons	170 tons	1,500 tons	700 tons
Sodium hydroxide[e]	210 tons	210 tons	290 tons	260 tons	110 tons	20 tons	31 tons	170 tons

[a] Unit conversions: 1 ft^3 = 0.028 m^3. 1 gal = 3.8 L. 1 ton = 0.91 tonne. 1 scf (standard cubic foot) = 0.083 Nm^3 (normal cubic meter).

[b] Values for electric power, natural gas, and process water are based on 276 days of operation per year at 6 d/wk and 46 wk/yr.

[c] Values for fuel oil are based on 600 hours of operation per year.

[d] Values for potable water are based on 365 days of operation per year.

[e] Values are based on 38% availability of operations.

Source: Kimmell et al. (2001).

3.4.2.1 Neutralization/Biotreatment

Both solid wastes and air emissions would result from the Neut/Bio process. Ventilation air and gases generated by processing ACWs would pass through an air pollution abatement system and be monitored before their release to the atmosphere. Sludge solids (consisting of biosolids and biosalts) from biotreatment would be disposed of in a permitted landfill. Because of their salt and heavy metal content, these solids, as well as the salts from the pollution abatement system, might require polymer solidification and encapsulation before disposal. Any wastes identified as hazardous would be stored and disposed of in accordance with RCRA requirements.

All liquids generated by the process and all liquid laboratory wastes would be reused in the process or disposed of through Neut/Bio. The only liquid effluents expected would be sanitary wastes. It is expected that decontaminated metal would be sold for recycling and that nonhazardous wastes associated with routine operation, such as domestic trash and office wastes, would be disposed of either on site or in a commercial landfill.

3.4.2.2 Neutralization/SCWO

Wastes from the Neut/SCWO process would include both air emissions and solid wastes. Ventilation air and gases would pass through a series of filters and would be monitored before release to the atmosphere. The solid waste stream of dried salts from the SCWO process might not meet RCRA requirements with regard to leaching of heavy metals. As a result, secondary treatment might be required (page 22 of PMACWA 1999), or solidification and encapsulation might be used. Encapsulation would also probably be required for dried salts resulting from the brine evaporation process of the pollution abatement system. These solid wastes would be disposed of in a permitted landfill in accordance with RCRA requirements.

All liquids generated by the process and all liquid laboratory wastes would be reused in the process or disposed of through Neut/SCWO. The only liquid effluents expected would be sanitary wastes. It is expected that decontaminated metal would be sold for recycling and that nonhazardous waste associated with routine operation, such as domestic trash and office waste, would be disposed of either on site or in a commercial landfill.

3.4.2.3 Neutralization/GPCR/TW-SCWO

Wastes from the Neut/GPCR/TW-SCWO process would include both air emissions and solid wastes. Ventilation air and gases would pass through a series of scrubbers and filters and would be monitored before being released to the atmosphere. The solid waste stream of dried salts that would result from the TW-SCWO process might not meet RCRA requirements with regard to leaching of heavy metals. In that case, secondary treatment might be required

(PMACWA 2001), or solidification and encapsulation might be used. Encapsulation would also probably be required for the dried salts that would result from the brine evaporation process used in the pollution abatement system. These solid wastes would be disposed of in a permitted landfill in accordance with RCRA requirements.

All liquids generated by the process and all liquid laboratory wastes would be reused in the process or disposed of through the neutralization or SCWO processes. The only liquid effluents expected would be sanitary wastes. It is expected that decontaminated metal would be sold for recycling and that nonhazardous waste would be disposed of in a commercial landfill. Nonhazardous solid waste associated with routine operations, such as domestic trash and office waste, would be disposed of in a commercial landfill.

3.4.2.4 Electrochemical Oxidation

Solid wastes, liquid wastes, and air emissions would result from the Elchem Ox process. It is expected that the solid waste stream of dried salts would be containerized and treated to meet RCRA requirements for disposal. Silver chloride precipitate would be thermally treated to destroy contaminants and shipped off site for silver recovery (PMACWA 2001).

NO_X produced as a result of the SILVER II process would be reformed into nitric acid, and most of it would be reused in the process or recycled. A small waste stream of dilute nitric acid would also require disposal.

Ventilation air and gases would pass through a series of scrubbers and filters and would be monitored before being released to the atmosphere. It is expected that decontaminated metal would be sold for recycling and that nonhazardous solid waste associated with routine operations, such as domestic trash and office waste, would be disposed of in a commercial landfill.

3.5 NO ACTION ALTERNATIVE

The no action alternative is continued storage at the stockpile installations until a destruction system could be implemented (PCD and BGAD) or until the ACW stockpile could be destroyed by the baseline incineration facility already being used for other demilitarization activities (ANAD and PBA).

3.5.1 Storage

No action as well as the proposed action would involve continued storage of ACWs at the current storage locations; that is, the ACWs would not be moved or destroyed. It is assumed that current safety procedures for storage would continue to be followed, including monitoring and surveillance.

The ACW stockpile is currently stored in a variety of configurations in compliance with Army regulations. ACWs are stored in igloos where they are protected from external hazards and monitored for leakage. Leaking munitions are encased in an overpack to prevent any dispersal of agent.

Hazards associated with this alternative would derive from (1) handling during the course of inspection and maintenance activities, (2) external hazardous events (e.g., earthquake, airplane crash), and (3) continued degradation of the agent containers (U.S. Army 1988).

3.5.2 Baseline Incineration

Baseline incineration systems are currently being constructed at ANAD and PBA. At these sites, under both no action and the proposed action, ACWs would be destroyed by incineration. Figure 3.5-1 provides an overview of the baseline incineration process. ACW components would first be disassembled. After disassembly, they would be treated thermally in different types of incinerators. Their destruction would occur inside a structure designed to contain any leakage of chemical agents. Within that structure, agents and energetics would be separated from metal parts, and energetics would be incinerated in a rotary kiln incinerator (deactivation furnace) within a reinforced, explosive-containment structure. Agents would be transferred to the liquid-injection incinerator for destruction. Metal parts, which might contain residual agents and/or energetics, would be treated in a roller hearth incinerator. Contaminated dunnage would be reduced in size before incineration. In addition to the primary chamber, all of the incinerators would have a secondary chamber to destroy any residual agent not incinerated in the primary chamber. See Kimmell et al. (2001) for additional process information.

Scrubbers, HEPA filters, and carbon filters would be used to control emissions to the air. The primary waste materials from the system would consist of scrubber brine salts and incinerator residue (ash and slag). After polymer encapsulation or other treatment that might be required to reduce leaching of heavy metals, the salts, incinerator ash, and slag would be disposed of in a licensed landfill.

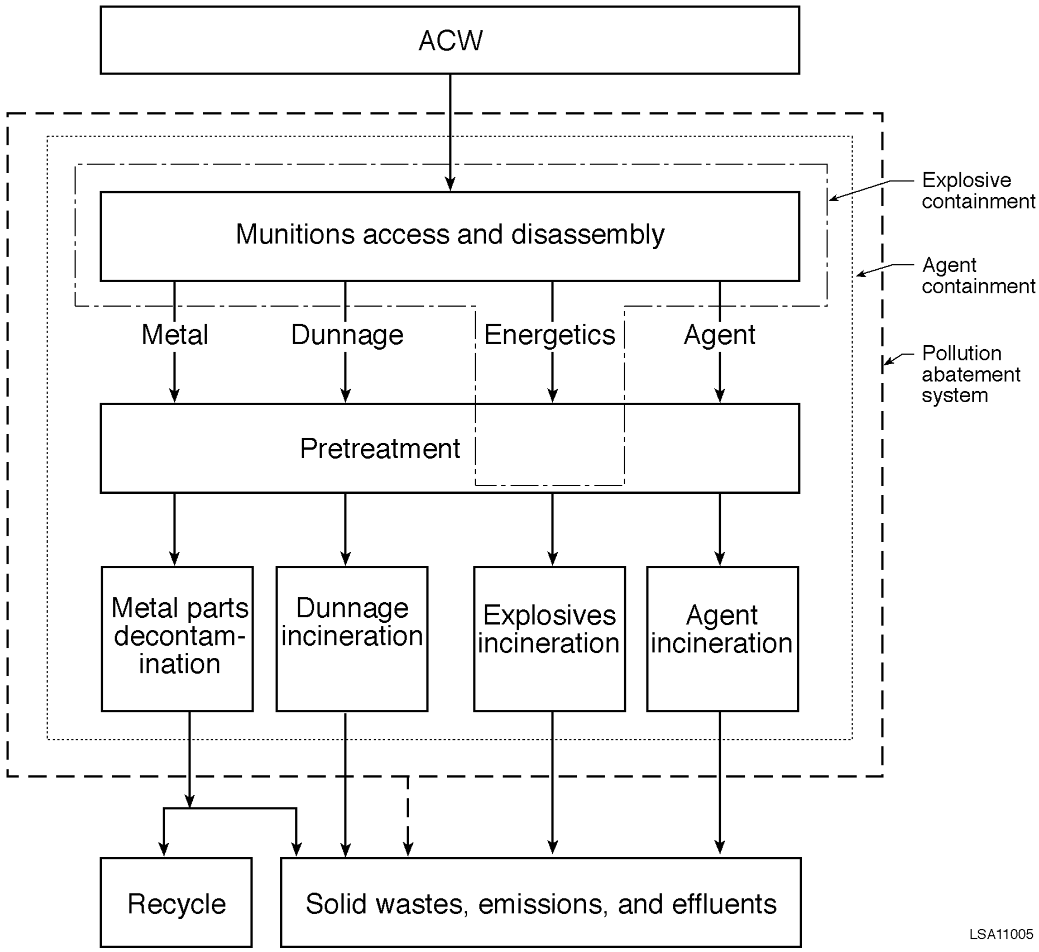

FIGURE 3.5-1 Baseline Incineration Process

3.5.2.1 Annual Resource Requirements

Estimates of annual utility and process input requirements for all four installations, should an incinerator be constructed, are provided in Table 3.5-1. Estimates are based on full-scale operation, assuming system operation of 24 h/d, 7-d/wk, and 365 d/yr.

3.5.2.2 Routine Emissions and Wastes

Air emissions and solid wastes would be the main waste components that would result from the baseline incineration process. Sanitary waste would be the only liquid effluent expected from the facility. All liquids generated by the agent incineration process and liquid laboratory wastes would be disposed of by incineration. The exception is liquid brines, which might be treated, if necessary, and sent to a treatment, storage, and disposal facility (TSDF) for disposition. Solid wastes that are identified as hazardous would be stored and disposed of in accordance with RCRA requirements.

TABLE 3.5-1 Estimates of Annual Operational Input for Baseline Incineration

	Quantity per Year			
Input	ANAD[a]	PBA[b]	PCD[c]	BGAD[d]
Electric power (GWh)	33	33	29	36
Natural gas (scf)[e]	1.3×10^9	1.4×10^9	4.6×10^8	8.4×10^8
Fuel oil (gas)	1,400,000	1,400,000	1,400,000	1,400,000
Potable water (gal)	6,400,000	5,500,000	6,400,000	6,400,000
Process water (gal)	88,000,000	47,000,000	16,000,000	97,000,000
Dry air, process (tons)	82,000	95,000	87,000	93,000
Sodium hydroxide (tons)	900	600	2,000	700
Hydrochloric acid (tons)[f]	1,000	800	3,000	1,000
Sodium hypochlorite (tons)[f]				

a U.S. Army (1991).

b U.S. Army (1997a).

c COE (1987).

d Carnes (2001).

e scf = standard cubic feet.

f The annual consumption rates for hydrochloric acid (HCl) and sodium hypochlorite (NaOCl) are rough order-of-magnitude estimates based on ratios developed by using a detailed mass balance for incineration at PCD entitled “PUCDF M&E Balances,” prepared in October 1995 by Parsons for the U.S. Army Corps of Engineers, Huntsville Division.

3.6 REFERENCES FOR CHAPTER 3

Carnes, S., 2001, e-mail from Carnes (Oak Ridge National Laboratory, Oak Ridge, Tenn.) to M. Goldberg (Argonne National Laboratory, Washington, D.C.) and P. Robtaille (U.S. Army, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md.), March 13.

CBDCOM, 1997, *Solicitation No. DAAM01-97-R-0031*, U.S. Army Army Chemical and Biological Defense Command, Aberdeen Proving Ground, Md., Aug.

COE, 1987, *Chemical Stockpile Disposal Program: Roads and Utilities Project Development Brochure*, prepared by U.S. Army Corps of Engineers, Huntsville Division, Huntsville, Ala., for Pueblo Depot Activity, Dec.

Kimmell, T.A., et al., 2001, *Technology Resource Document for the Assembled Chemical Weapons Assessment Environmental Impact Statement*, ANL/EAD/TM-101, Vols. 1–5 and errata, Argonne National Laboratory, Argonne, Ill.

PMACWA, 1999, *Assembled Chemical Weapons Assessment Program: Supplemental Report to Congress*, U.S. Department of Defense, Program Manager Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md., Md., Sept. 30.

PMACWA, 2001, *Final Technical Evaluation: AEA Technology/CH2MHill SILVER II Electrochemical Oxidation, Foster Wheeler/Eco Logic International/Kvaerner Neutralization/ GPCR/TW-SCWO, Teledyne-Commodore Solvated Electron Systems*, Appendix C in *Assembled Chemical Weapons Assessment Program: Supplemental Report to Congress*, June 2001, U.S. Department of Defense, Program Manager Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md., March.

U.S. Army, 1988, *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Jan.

U.S. Army, 1991, *Final Environmental Impact Statement for Disposal of Chemical Agents and Munitions Stored at Anniston Army Depot, Anniston, Alabama*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground., Md., May.

U.S. Army, 1997a, *Revised Final Environmental Impact Statement for Disposal of Chemical Agents and Munitions Stored at Pine Bluff Arsenal, Arkansas*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Apr.

U.S. Army, 1997b, *Toxic Chemical Agent Safety Standards*, Pamphlet 385-61, Headquarters, Department of the Army, Washington, D.C., March 31.

4 ANNISTON ARMY DEPOT (ANAD), ALABAMA

4.1 INTRODUCTION

ANAD is located in a rural area of northeastern Alabama in Calhoun County, about 90 mi (144 km) west of Atlanta, Georgia; 49 mi (78 km) east of Birmingham, Alabama; and about 10 mi (19 km) west of Anniston (see Figure 4.1-1). ANAD covers 15,279 acres (6,190 ha) of land, with more than 11,000 acres (4,430 ha) of woodlands, about 5 acres (2 ha) of lakes and streams, and about 1,700 acres (680 ha) of improved grounds containing buildings and structures.

ANAD is under the command and control of the U.S. Army Tank Automotive Command (TACOM) and is also host to a number of tenant organizations. ANAD performs depot-level maintenance for combat vehicles, artillery, and various weapons systems. It also provides storage and demilitarization of conventional munitions and storage of chemical surety materiels and munitions.

ANAD has been affected by three Base Realignment and Closure (BRAC) Committee actions, which, for the most part, have resulted in increased mission responsibilities at the depot. First, in 1988, the Coosa River Ammunition Storage Annex was closed, and materiel stored there was relocated to ANAD. Second, in 1993, the ANAD tactical missile maintenance mission was transferred to Letterkenny Army Depot, Pennsylvania. Third, realignments in 1995 resulted in eight missions being transferred to ANAD from four other Army depots between fiscal year (FY) 1994 and FY 1997 (U.S. Navy 1998; Operations Support Command 2000).

4.1.1 Potential Sites and Facility Locations

Site requirements for an ACWA pilot facility are likely to be similar to those for a baseline incinerator. About 25 acres (10 ha) would probably be required for the facility. During construction, part of this land would be required for a construction lay-down area, temporary offices, parking, holding basins for surface water, and temporary utility installations. Together, the facility requirements and other land area requirements of 5 to 52 acres (2 to 21 ha) for infrastructure could total 30 to 77 acres (12 to 31 ha).

Six possible sites were identified in the environmental impact statement (EIS) for the baseline incinerator at Anniston (U.S. Army 1991). Each of these sites was initially considered as a possible site for the ACWA demonstration technologies. Two of the candidate sites, Sites 2 and 6, were eliminated because of their proximity to the perimeter fence to the west of the depot and to potential human populations to the south and west of the depot. Site 3 was also eliminated because of its proximity to the ammunition maintenance facility, ammunition workshop, and

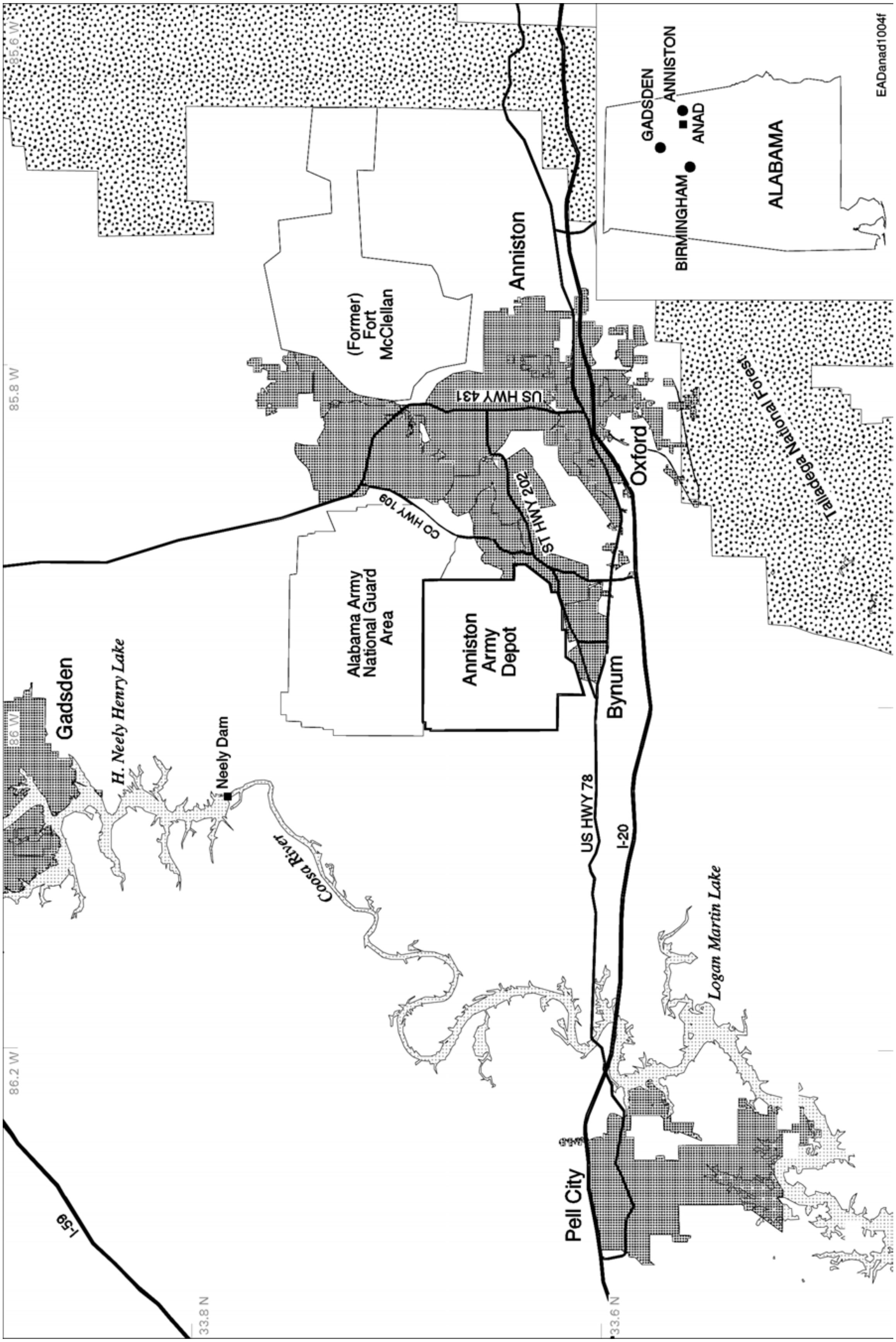

FIGURE 4.1-1 Location of ANAD

ammunition disassembly plant. The three remaining candidate sites are shown in Figure 4.1-2, together with the major facilities and areas at ANAD. Proposed Area A (Site 4 in the incinerator EIS) corresponds to the current location of Building 88 between Block C and G and is 33 acres (13.2 ha) in size. Proposed Area B (Site 1 in the incinerator EIS) is adjacent to and west of the incinerator presently under construction and is 149 acres (60 ha) in size. Proposed Area C (Site 3 in the incinerator EIS) is east of Elwood Road close to the center of the depot and is 32 acres (12.8 ha) in size.

- *Proposed Area A:* Area A is located in the northeast corner of the depot, between Blocks C and G of the chemical storage area, and corresponds to the location of existing Building 88. The area includes approximately 32.6 acres (13.2 ha) of land. Of this, about 12 acres (4.8 ha) lie in a 100-year floodplain along two creeks, leaving about 21 acres (8.4 ha) above the floodplain. Although this area would require substantial grading to provide a platform for a pilot facility, it has adequate land to accommodate a facility. Safety concerns at this location arise from the creek running through the site and from proximity to the road linking the incinerator facility with Gate 5 and Pelham Firing Range to the north. The facility might benefit from being close to utility lines constructed from Gate 5 to the incinerator, unless these lines are dedicated to the incinerator.

- *Proposed Area B:* Area B is situated on the northwest corner of the chemical agent storage area (Block G), close to the north perimeter of the facility and next to the incinerator that was recently constructed. The area includes approximately 149.1 acres (60.2 ha) of land. This area would be available if additional grading were done, and it would provide sufficient space for a demonstration facility. Potential safety concerns associated with this area arise from its proximity to the incinerator itself, the download facility to the south, Pelham Range to the north, demolition pits to the west, the 2,4,6-trinitrotoluene (TNT) burial trench, the road to Gate 5, and the solid waste management facility to the east. The facility might benefit from being next to existing utilities installed between Gate 5 and the incinerator.

- *Proposed Area C:* Area C is located south of Proposed Area A and southwest of the Chemical Limited Area (CLA, where chemical weapons are stored) and close to Elwood Road. The area includes approximately 36.4 acres (14.7 ha) of land. Although land is available at this location, it is unclear whether the 25 acres (12 ha) required for the demonstration facility could be accommodated at this location. Safety concerns associated with this area are its proximity to (1) Elwood Road; (2) the ammunition maintenance facility, ammunition workshop, and ammunition disassembly plant west of the site; and (3) the munitions storage igloos (Blocks E and F) east of the area. Use of this area would require a new dedicated road linking the facility with the CLA

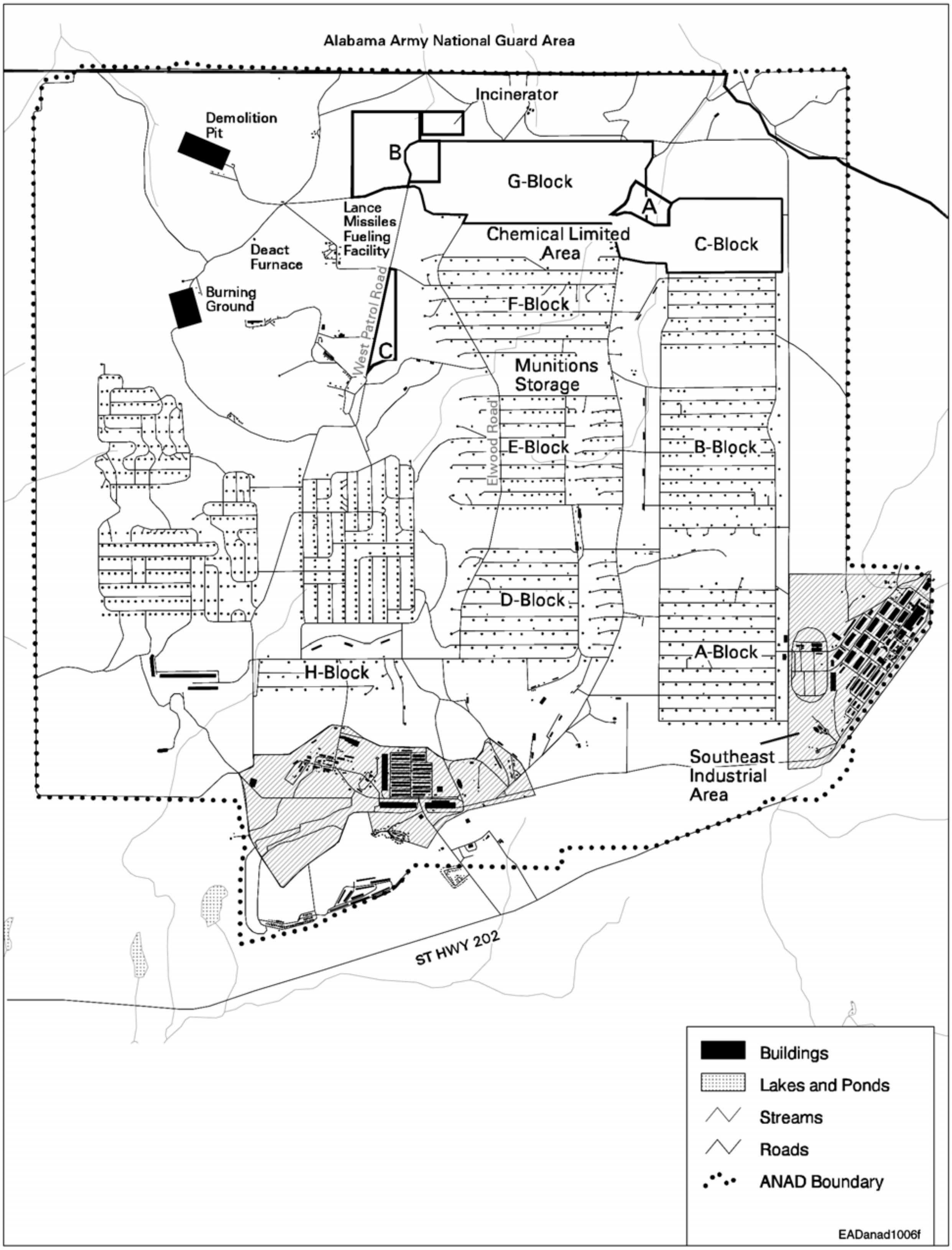

FIGURE 4.1-2 Facilities at ANAD

and an extension in the existing fence around the CLA to include the demonstration facility. The new road would increase the cost of the facility at this area (compared to the cost at the other areas) and would also increase safety concerns because of the need to transport munitions over the relatively long distance between the CLA and an ACWA facility. Another concern would be the increased traffic congestion along Elwood Road during construction and operation of the ACWA facility.

4.1.2 Munitions Inventory

The chemical agent inventory at ANAD currently includes rockets, mines, cartridges, projectiles, and ton containers, filled with mustard (designated as HD and HT) or nerve agent (designated as GB and VX) (see Table 4.1-1).

TABLE 4.1-1 Assembled Chemical Weapons Inventory at ANAD[a]

Type of Munition	Agent	Number in Inventory	Total Weight of Agent (lb)
4.2-in. cartridges	HT	183,552	1,064,600
4.2-in. cartridges	HD	75,360	452,160
105-mm cartridges	HD	23,064	68,500
155-mm projectiles	HD	17,643	206,420
105-mm cartridges	GB	74,014	120,640
105-mm projectiles	GB	26	40
155-mm projectiles	GB	9,600	62,400
8-in. projectiles	GB	16,026	232,380
M55 rockets	GB	42,738	457,300
M56 rocket warheads	GB	24	260
155-mm projectiles	VX	139,581	837,480
M55 rockets	VX	35,636	356,360
M56 rocket warheads	VX	26	260
Mines	VX	44,131	463,380
Ton containers	HD	108	185,080
Total		661,529	4,507,260

[a] Unit conversion: 1 lb = 0.45 kg.

Source: Chemical and Biological Defense Command (CBDCOM) 1997.

4.2 LAND USE

4.2.1 Installation History and Uses

The U.S. Army began construction on a facility called Anniston Ordnance Depot in February 1941. It completed the first ammunition storage magazines on a wooded 18,133-acre (7,338-ha) tract in October of that same year (U.S. Army 1991, 2000). This installation was initially designed as a munitions storage depot, but during World War II, its role was expanded to include combat equipment storage, tank and artillery missions, and materiel handling. It had processed more than 1.2 million tons of military equipment by 1945. During the 1950s, activities at Anniston Ordnance Depot that were related to tank rebuilding and weapons and equipment storage increased, and facilities on the installation were enhanced accordingly to support these additional activities.

In 1962, the installation was renamed Anniston Army Depot (ANAD) and placed under the Army Materiel Command (U.S. Army 1991). In 1976, ANAD was placed under the U.S. Army Depot System Command, a major subordinate command of the U.S. Army Materiel Command (as are currently TACOM and U.S. Army Soldier and Biological Chemical Command [SBCCOM], the parent organizations of ANAD and Anniston Chemical Activity [ANCA], respectively). Throughout these changes, the mission of ANAD evolved. The installation's initial mission was expanded to include overhauling and repairing ordnance vehicles, rebuilding small arms, modifying M4SA1 tanks and M67 flame throwers, and providing logistics support for several missile systems (U.S. Army 2000). Presently, ANAD's mission includes the maintenance of combat vehicles, such as M-1 Abrams, M-60, and M-113 tanks, and a variety of artillery pieces. ANAD has substantial maintenance and manufacturing capabilities and is the only Army depot able to perform maintenance on both heavy- and light-tracked combat vehicles and their components. ANAD's mission also includes the storage of conventional munitions and chemical weapons. ANAD retains substantial ammunition storage capacity with 2.3 million ft^2 (214,000 m^2) of covered storage and 600,000 ft^2 (56,000 m^2) of open storage (U.S. Navy 1998). Supply storage capacity is approximately 3.1 million ft^2 (288,000 m^2) of covered space and 1.8 million ft^2 (167,000 m^2) of open storage (Operations Support Command 2000).

The Army began to store chemical weapons on 762 acres (308 ha) in the northeastern part of ANAD in 1961 (U.S. Army 2000). Currently, the portion of the depot where chemical weapons are stored is called the Chemical Limited Area (CLA) of the Anniston Chemical Activity. Chemical storage facilities in the CLA contain chemical weapons in a series of earth-covered, steel-reinforced concrete bunkers called igloos.

ANAD currently is under the command and control of the U.S. Army TACOM. Key tenant organizations located on the depot include:

- Defense Distribution Depot, Anniston;
- Anniston Munitions Center;
- Anniston Chemical Activity;
- Program Manager for Chemical Demilitarization (PMCD);
- Center of Military History Clearing House;
- 722nd Ordnance Company (Explosive Ordnance Disposal); and
- Defense Reutilization and Marketing Office (DRMO).

4.2.2 Current and Planned On-Post Land Use

Current land use on ANAD primarily includes industrial and related activities associated with the maintenance of combat vehicles. The huge installation includes buildings and structures linked by roads as well as a railroad (U.S. Army 2000). However, the most dominant feature of the installation is the more than 11,000 acres (4,400 ha) of woodland and 5 acres (2 ha) of lakes and streams.

Because of ANAD's size and the complexity of its multifaceted mission, one of the best ways to present current land use on ANAD is to divide the installation into major activity areas (Figure 4.2-1). Characteristics of these areas may be summarized as follows (U.S. Army 1991):

- The administrative area is located east of the warehouse area in the south-central portion of the depot. It consists of a series of permanent structures and the installation headquarters.
- The utility area contains engineering shops; motor pool, vehicle, and equipment repair shops; and property disposal facilities.
- The storage area consists of a processing facility and an area to store vehicles.

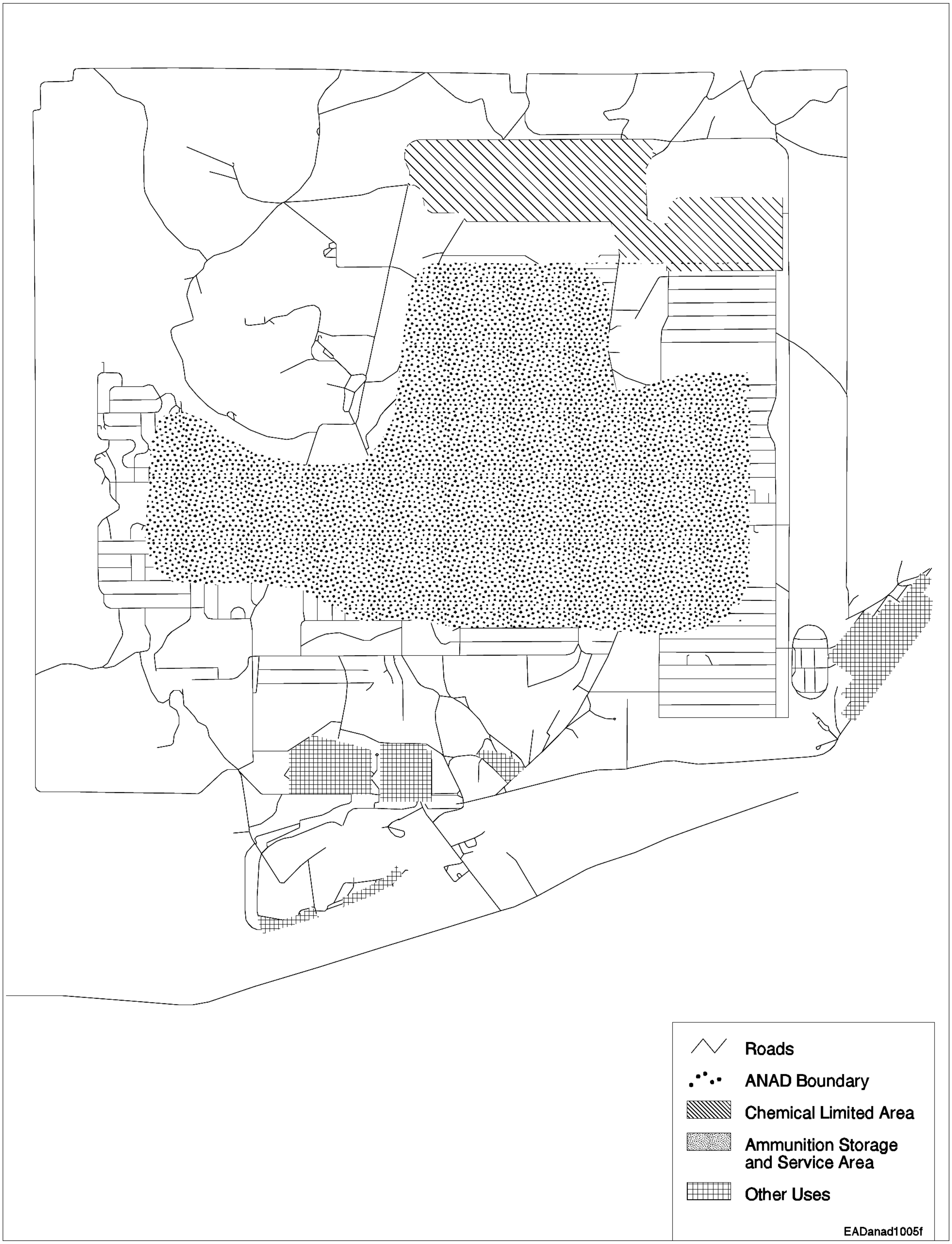

FIGURE 4.2-1 Land Use at ANAD

- The warehouse area in the south-central portion of ANAD contains a general supply, a shipping and receiving building, three large warehouses, and several smaller warehouses.

- The recreation area consists of the installation PX and gymnasium.

- The Nichols Industrial Complex (also called the Southeast Industrial Area [SIA]) in the southeast portion of ANAD contains 1.5 million ft^2 (140,000 m^2) of industrial facilities, including warehouses; depot maintenance, rebuild, and support shops; general supply processing facilities; loading facilities; and vehicle test facilities.

- The Ammunition Storage Area (ASA) occupies the majority of the depot and is located in the controlled-access central portion of ANAD. The ASA contains ammunition storage bunkers, providing 73,000 ft^2 (6,800 m^2) of storage. In the center of the area is an ammunition maintenance workshop complex that consists of the facilities needed for maintenance, demilitarization, and inspection of all types of ammunition and ammunition components. The Lance Missile Fueling Facility and the ammunition disposal areas are also located within this storage and service area.

- The chemical agent storage area is located in the CLA in the northern portion of ANAD.

Chemical weapons are stored in earth-covered bunkers, called igloos. They are constructed of steel-reinforced concrete and capped with soil. The igloos are designed specifically to protect chemical weapons from external factors, such as storms, lightning, and other weather-related events.

In addition to igloos, mustard is also stored in ton containers, which are large steel containers designed specifically to ensure that the agent is stored safely. Ton containers are cylindrical and approximately 6 ft (2 m) long and 3 ft (1 m) in diameter. Each sidewall of a ton container is about 1 in. (2.5 cm) thick. Specially designed valves located at one end of each container minimize the chance of leaks. When empty, ton containers weigh about 1,600 lb (725 kg) (SBCCOM 2000).

Future plans for ANAD are generally consistent with present uses. The main change in ANAD land use that would result from the ACWA Program would be the removal of chemical weapons storage from the north central portion of the depot. Construction of a baseline incinerator for chemical weapons destruction is complete.

4.2.3 Current and Planned Off-Post Land Use

Communities close to ANAD are primarily small towns south and east of the depot. These include the city of Anniston, which is the county seat of Calhoun County roughly 10 mi (16 km) east of ANAD. It has a population of about 30,000. The former Fort McClellan Military Reservation is also located in Calhoun County, about 10 mi (16 km) east of ANAD.

Land use in the vicinity of ANAD is primarily rural, with land cover dominated by forest (U.S. Army 1991). Interspersed among large forested tracts are areas of residential use (some are entire communities and others are isolated residences) and agriculture. In 1997, Calhoun County contained 629 farms covering 77,429 acres (31,336 ha) (U.S. Department of Agriculture [USDA] 1999). Cropland on these farms totaled 38,968 acres (15,770 ha); the remainder was used for grazing. Land ownership near ANAD is predominately private to the west, south, and east of the installation. The Pelham Range abuts ANAD to the north. Calhoun County also includes portions of the Talladega National Forest and Dugger Mountain Wilderness Area, approximately 20 mi (33 km) northeast of ANAD.

Substantial changes in land use in the vicinity of ANAD are not planned at this time. Fort McClellan was closed as an active U.S. Army facility in October 1999 and is slated for commercial development. The Alabama National Guard took over operational control of Pelham Range in December 1999, thus retaining it under military control.

4.2.4 Impacts on Land Use

4.2.4.1 Impacts of the Proposed Action

The proposed ACWA pilot facility at ANAD would have negligible effects on land use both on and off the installation. Proposed testing activities at ANAD would be conducted within the CLA. The CLA boundary would be revised to include the site selected for the pilot facility. Impacts on land reuse at ANAD are expected to be negligible. The locations and activities proposed for an ACWA pilot test facility are consistent with current installation use in the areas reserved for Chem Demil activities and with the historic and planned use of the installation.

Impacts on land use outside ANAD due to normal construction and operation are anticipated to be negligible as well. Normal construction and operation of an ACWA pilot test facility at ANAD would not interfere with activities in other areas of the installation or the surrounding communities. Any release of chemical agents or other chemical compounds as a result of occasional fluctuations in routine operations would be extremely small (see Section 4.6) and would not affect off-post activities.

4.2.4.2 Impacts of No Action

Under the no action alternative, storage of chemical stockpile components at ANAD would continue. Land use in the immediate storage area, already identified for activities associated with chemical weapons, would continue as described for the existing environment. As a result, under normal operating conditions, high and adverse impacts on land use are not anticipated, either on post or in the surrounding area.

4.3 INFRASTRUCTURE

Table 4.3-1 lists the annual utility requirements for an ACWA pilot test facility at ANAD, and Table 4.3-2 lists the approximate acreage needed for construction of an ACWA facility and associated utilities infrastructure. The following sections describe the requirements for an ACWA pilot test facility, current installation utility and infrastructure demands, and the impacts of construction and operation of an ACWA pilot test facility on utilities and infrastructure.

Estimates of infrastructure acreage requirements are based on a 120-ft (36-m) corridor for electricity and 30-ft (10-m) corridors for natural gas, potable water, and domestic sewage. It is assumed that any required additions to infrastructure capacity would occur in existing utility corridors, with corridor extensions to the proposed ACWA sites, as needed. The corridors to each of the proposed sites are shown in Figure 4.3-1. Estimates of existing corridor lengths and required extensions are summarized in Table 4.3-2. It is assumed that any extensions to the existing communications system that would be required for the proposed ACWA sites would not be likely to cause any land disturbance.

TABLE 4.3-1 Current Utility Usage and Approximate Annual Utility Demands for Operation of an ACWA Pilot Test Facility at ANAD

		Annual Demand			
Utility	2000 Usage	Neut/Bio	Neut/SCWO	Neut/GPCR/ TW-SCWO	Elchem Ox
Electric power (GWh)	62	36	60	26	105
Natural gas (scf)	310,000,000[a]	50,000,000	69,000,000	130,000,000	53,000,000
Process water (gal)	Not applicable	7,000,000	8,300,000	18,000,000	1,000,000
Potable water (gal)	260,000,000	6,400,000	6,400,000	6,400,000	6,400,000
Sewage (produced) (gal)	Not available	7,500,000	7,500,000	7,500,000	7,500,000

[a] Unit conversions: 1 scf (standard cubic foot) = 0.28 Nm^3. 1 gal = 3.8 L.

Sources: Freeman (2000) for annual usage; Kimmell et al. (2001) for demand for proposed facilities.

TABLE 4.3-2 Estimated Land Area Disturbed for Construction of an ACWA Pilot Test Facility and Associated Infrastructure at ANAD[a]

	Land Disturbance (acres)		
Construction Activity	Area A	Area B	Area C
Pilot facility and support structures	25	25	25
New utility corridors			
Electricity	9	4	33
Gas/sewer/water	2	1	7
Access road	0	0	12
Maximum area of disturbance	36	30	77

[a] Unit conversion: 1 acre = 0.4 ha.

4.3.1 Electric Power

4.3.1.1 Current Supply and Use

ANAD purchases electric power from Alabama Power Company. The incinerator is served by a 44-kV transmission line and a substation that is located near Proposed Area B. The 44-kV line may provide sufficient capacity. Figure 4.3-1 identifies potential locations for the transmission line corridor to the proposed areas for an ACWA pilot facility.

4.3.1.2 ACWA Pilot Test Facility Requirements

Table 4.3-1 lists the estimated amounts of electricity that the four proposed ACWA pilot test technologies would use during normal operations. Electricity use estimates range up to 60 GWh/yr.

4.3.1.3 Impacts of the Proposed Action

The current on-site infrastructure would not be able to meet the needs for electric power supply to the pilot facility. While the 44-kV transmission line might be adequate, new service connections would have to be added, and a new substation would need to be constructed. The new power supply would supply the pilot facility and associated areas and would be independent

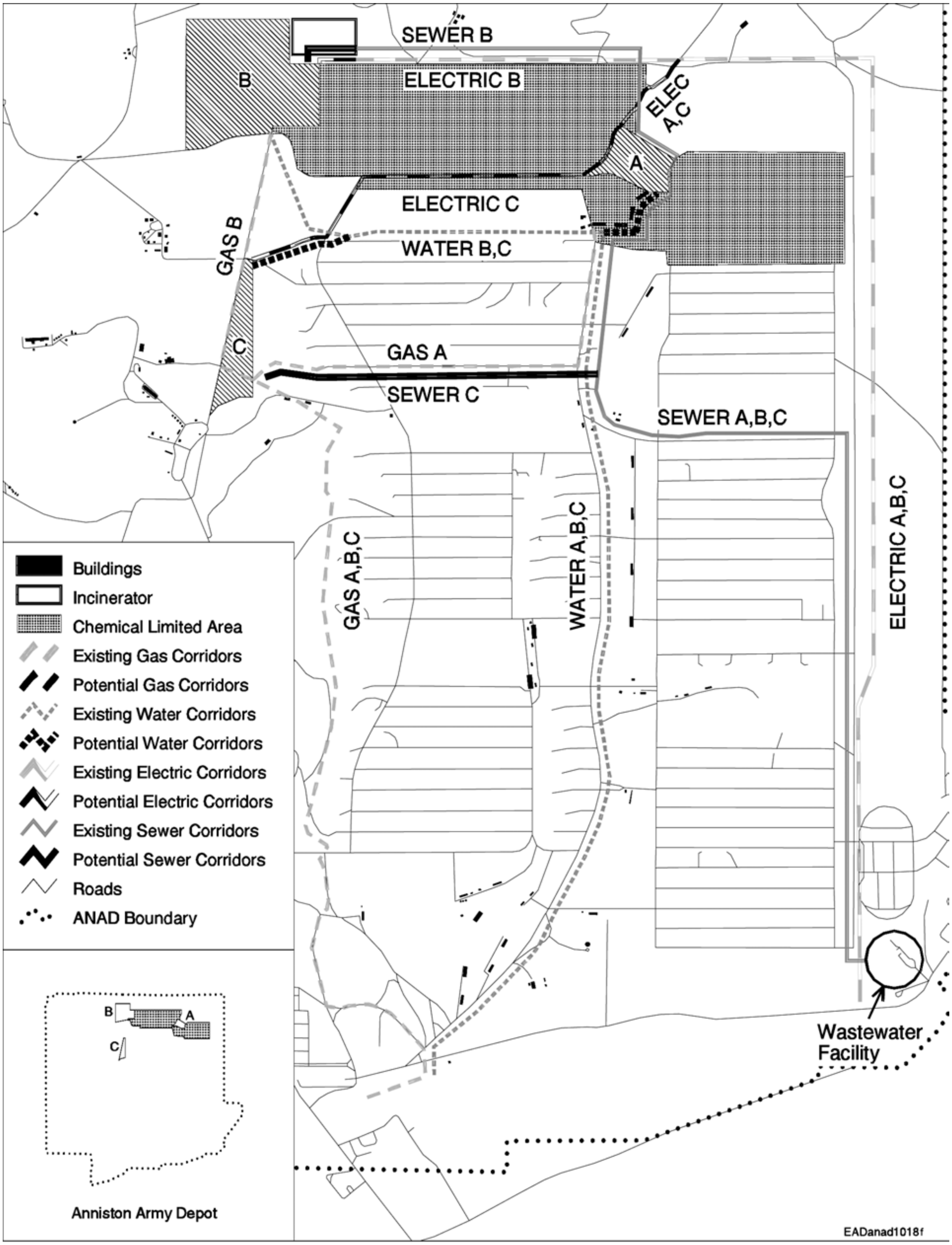

FIGURE 4.3-1 Proposed Utility and Road Access Corridors for an ACWA Pilot Test Facility at ANAD

of the other ANAD power supply infrastructure. Therefore, no impact on the existing electric power supply at ANAD or off site is anticipated.

4.3.1.4 Impacts of No Action

There would be no impacts on the electric power supply infrastructure from the no action alternative. The electric power supply for the installation would remain as described for the existing environment.

4.3.2 Natural Gas

4.3.2.1 Current Supply and Use

An 8-in. (20-cm) main gas pipeline supplies natural gas from Alabama Gas Company (Alagasco). The line runs from the Coosa Gate to the incinerator area through Proposed Areas B and C. A 2-in. (5-cm) branch line runs from the vicinity of Site C to within 0.3 mi (0.4 km) of Proposed Area A. The existing 8-in. (20-cm) gas line is capable of delivering 300,000 ft^3 of gas at an outlet pressure of 45 $lb/in.^2$ (psi).

4.3.2.2 ACWA Pilot Test Facility Requirements

Table 4.3-1 lists the amounts of natural gas the proposed ACWA technologies would use during normal operations. Natural gas use is estimated to range from 50 million to 130 million scf.

4.3.2.3 Impacts of the Proposed Action

The current infrastructure would be likely to meet the needs for natural gas supply to a pilot facility. New pipelines would have to be added to extend the system to the proposed areas for the pilot facility.

4.3.2.4 Impacts of No Action

There would be no impacts on the natural gas supply infrastructure from the no action alternative. The natural gas infrastructure would remain as described for the existing environment.

4.3.3 Water

4.3.3.1 Current Supply and Use

ANAD purchases its water supply from the city of Anniston (U.S. Army 1991). In FY 2000, average water usage at ANAD was 2.9 million ft^3/mo, or 260 million gal/yr (982,000 m^3/yr) (Freeman 2000). The Anniston Water Treatment Facility is located approximately 2 mi (3 km) south of the southeast corner of ANAD. The Anniston water distribution system draws its supply solely from the artesian Coldwater Spring, a groundwater source located between 1 and 2 mi (1.6 and 3.2 km) south of ANAD (Agency for Toxic Substances and Disease Registry [ATSDR] 1999). Coldwater Spring operates at a peak capacity of 24 million gal/d (91 million L/d), and a nearby reservoir can provide 19 million gal/d (72 million L/d). Additional capacity is planned in White Plains Reservoir, which will operate at a capacity of up to 9 million gal/d (34 million L/d) (U.S. Army 1991). The ANAD water distribution system is currently being upgraded to support the incinerator that is under construction. A water tower has been constructed near the incinerator site.

ANAD treats its domestic sewage on post in an existing sewage treatment facility located west of the SIA. Present sewer capacity is 20 million gal/d (75.7 million L/d). Normal use ranges from 10 million gal/d (37.9 million L/d) in summer to 14 million gal/d (53 million L/d) in winter. Wastewater is routed as needed through Choccolocco Creek and nearby tributaries (U.S. Army 1991). The sewage treatment facility is being upgraded to meet the demands of the incinerator currently under construction.

4.3.3.2 ACWA Pilot Test Facility Requirements

Table 4.3-1 lists the amounts of water and other utilities that the proposed ACWA technologies would use during normal operation and the amounts of sanitary sewage that each system would generate. Quantities of process water used range from 1 to 18 million gal/yr (3,700 to 68,000 m^3/yr or 3.1 to 55 acre-ft/yr). Estimates for potable water usage and sanitary sewage generation do not differ among the four potential ACWA technologies. Estimates are 6.4 million gal/yr (24,000 m^3/yr or 19 acre-ft/yr) for potable water usage and 7.5 million gal/yr (28,000 m^3/yr or 23 acre-ft/yr) for sanitary sewage generation. For the purposes of this environmental impact statement (EIS), it is be assumed that potable water usage will be equal to the larger estimate of sanitary sewage generation (i.e., 7.5 million gal/yr).

The ACWA facility is expected to generate about 7.5 million gal/yr (34 million L/yr) of domestic sewage (Table 4.3-1). This sewage would only consist of effluent from bathrooms, showers, laundry facilities, and other common domestic uses. No process water or hazardous materials would be discharged to the ANAD sewage treatment plant. Process water would be decontaminated and reused within the pilot facility.

4.3.3.3 Impacts of the Proposed Action

The existing water supply system would be sufficient to supply the needs of an ACWA pilot facility if pipeline extensions were built. Impacts from any of the ACWA technologies on the water supply infrastructure would be negligible.

The current sewage treatment capacity would need to be expanded to meet the needs of an ACWA pilot facility. The sewage treatment plant would operate in accordance with all applicable regulations and permits. The impacts from the sewage treatment plant on the water supply and use infrastructure would be negligible.

Construction of an ACWA facility would require water for numerous uses, including washing, dust control, preparation of concrete, and fire control. These needs have not been estimated quantitatively; however, the total estimated use would be small when compared with existing capacity. The existing water supply system would be adequate to meet these needs. Impacts on the water supply and sewage treatment infrastructure from construction activities would be negligible. Minor local disruptions in supply might occur when the ACWA facility was connected to the existing infrastructure, but these common types of disruption would be short-lived.

There would be no off-post impacts on the water supply or sewage treatment infrastructure during construction. ANAD sewage infrastructure is self-contained, and projected ACWA facility water requirements would be small when compared with the existing system capacity.

Accidents during construction could affect the personnel who operate the off-post infrastructure for water and sewage treatment. On-post accidents would not affect the off-post water supply or sewage treatment infrastructure.

During operation of an ACWA pilot test facility, the existing water supply system would not be sufficient to provide peak water demands for fire fighting and other potential emergency response needs. To address such needs, the ACWA facility would have a storage tank of sufficient capacity to meet projected emergency needs.

A new or expanded sewage treatment facility would need to be constructed to meet the needs of the proposed ACWA pilot facility. Construction of the ACWA facility and sewage treatment facility would have a negligible impact on the existing sewage treatment infrastructure.

There would be no impacts to water use and supply infrastructure off post.

4.3.3.4 Impacts of No Action

There would be no impacts on the water use and supply infrastructure from the no action alternative.

4.3.4 Communications

4.3.4.1 Current System

No information was available.

4.3.4.2 ACWA Pilot Test Facility Requirements

It is assumed that extension of the existing communications system to the proposed areas for a pilot facility would be required.

4.3.4.3 Impacts of the Proposed Action

Extending the communications system would be unlikely to have any adverse impacts.

4.3.4.4 Impacts of No Action

No impacts on the communications system are likely from the no action alternative.

4.4 WASTE MANAGEMENT

ANAD currently generates a variety of solid and liquid hazardous and nonhazardous wastes, as described in Section 4.4.1. It also stores a large quantity of assembled chemical weapons (ACWs). While in storage, the ACWs are not generally considered wastes, but upon processing and destruction, the residuals become wastes. Wastes associated with operation of the ACWA facilities are primarily from the residuals of the ACW destruction.

4.4.1 Current Waste Generation and Management

4.4.1.1 Hazardous Wastes

ANAD generates a variety of hazardous wastes associated with three of its missions: (1) combat vehicle and equipment maintenance, (2) munitions management, and (3) hazardous material management. Most of these hazardous wastes are packaged and transported off site to appropriately permitted treatment and disposal facilities. The principal activities at ANAD that are sources of these hazardous wastes include:

- Vehicle maintenance (used oil, batteries, coolant, degreaser, electroplating sludge, etc.),
- Facility maintenance (paints, solvents, water conditioners, etc.),
- Chemical agent decontamination (field test materials, toxic chemical analysis agents, personal protective equipment [PPE], etc.),
- Conventional munitions management (explosive-contaminated charcoal, contaminated filters, explosive residues, etc.), and
- Hazardous material management (organic and inorganic lab packs, etc.)

Hazardous wastes accumulated at the initial generation points at ANAD are transferred to facilities for further storage (up to 90 days) while they await transport off post. The waste container storage areas are at Buildings 466, 512, and 527. Wastes generated at ANAD are collected and disposed of off post in accordance with U.S. Army, state, and federal regulations. Any waste listed as hazardous in the *Resource Conservation and Recovery Act* (RCRA) regulations is stored, treated, and disposed of off post as prescribed by the U.S. Environmental Protection Agency (EPA) and applicable state and local regulations.

A number of waste treatment units at ANAD also generate significant amounts of hazardous waste that need to be shipped off post to permitted treatment, storage, and disposal facilities (TSDFs). The Industrial Waste Treatment Plant (IWTP) processes various electroplating solutions and rinses; this activity generates hazardous sludges for off-post disposal. ANAD also has an active open burning area and an open detonation area for the treatment and disposal of unserviceable and obsolete munitions and explosives. The ashes and waste residues obtained from these areas are managed as hazardous wastes and shipped off post to permitted TSDFs. An incinerator for the destruction of chemical agents and munitions stored at ANAD is under construction. This treatment facility, upon completion, will generate many wastes for disposal at an off-post permitted TSDF.

ANAD has a hazardous waste management plan that outlines the treatment and management of hazardous wastes at the installation (ANAD 2000a). This plan describes the procedures, policies, and responsibilities associated with hazardous waste management activities — such as waste identification, handling, storage, treatment, and disposal — performed at the installation. This plan is also designed to ensure that the hazardous waste tasks performed at ANAD comply with applicable federal, state, local, and Army regulations.

4.4.1.2 Nonhazardous Wastes

ANAD generates a wide variety of nonhazardous solid wastes such as office trash, scrap wood, industrial and demolition wastes, used equipment, and uncontaminated PPE. These wastes are collected and disposed off site in a RCRA Subtitle D landfill or recycled, if possible. Sanitary wastes are treated in an on-site sewage treatment plant. Table 4.4-1 lists the hazardous and nonhazardous wastes generated at ANAD during the year 1999.

TABLE 4.4-1 Wastes Generated at ANAD in 1999

Type of Waste	Amount Generated (tons)
Hazardous liquids	390
Hazardous solids	1,430
Nonhazardous solids	3,250
Recyclable solids	8,260
Sanitary waste	6,500

Sources: Phillips (2000); ANAD (1999).

4.4.2 ACWA Pilot Test Facility Waste Generation and Treatment Requirements

The construction and operation of an ACWA pilot test facility would generate an array of solid and liquid wastes, both hazardous and nonhazardous. Estimates of the waste that would be generated during construction of an ACWA facility are based on data on waste generated during the construction of comparable buildings, scaled by building size and number of construction worker full-time equivalent (FTE) employees. The types and amounts of waste expected from the operation of this facility have been estimated by using the techniques of stoichiometric mass balance[1] for each unit process coupled with the analytical results obtained from initial demonstration tests for each technology. This technique relies on a number of assumptions that, as yet, have not been fully verified (Kimmell et al. 2001). How sensitive these estimated results are to the various assumptions used in this procedure has not yet been determined.

An incinerator to be used to destroy some or all of the ACWs in inventory at ANAD has been constructed. For the purposes of this document, any discussions of the affected environment at the site assume that incinerator construction is complete but that operations have not started. Impacts of the ACWA pilot test facility discussed in the proposed action are determined on the basis of the assumption that an operational incinerator is part of the environmental background. The proposed no action alternative considers incineration of all ACWs in inventory at ANAD as presented in previous EISs.

The proposed ACW destruction system would produce brine salts as solid waste. These salts could contain significant amounts of toxic heavy metals (e.g., lead). Such solid waste would probably fail the RCRA Toxicity Characteristic Leaching Procedure (TCLP). If so, the hazardous salt waste would need to be stabilized by a procedure that would reduce leaching of the heavy metal to a level that would allow it to be approved for land disposal as a hazardous solid waste. Salt wastes have proven somewhat difficult to stabilize, so additional studies might be required to identify an effective stabilization technology. If stabilization of the solid salt waste were required, either a waste management facility for stabilizing the waste would need to be constructed at ANAD, or, alternatively, the waste would need to be shipped off post to an appropriately permitted waste treatment facility. Commercial facilities exist for managing this type of waste.

Mustard and nerve agents are not listed wastes in Alabama. If a waste does not demonstrate a hazardous characteristic, the residues are not characterized as hazardous wastes under Alabama Department of Environmental Management (ADEM) regulations. Information on the waste streams that could result from any of the ACWA technologies is not sufficient to determine if these wastes will be characterized as hazardous in Alabama.

It is assumed that most wastes generated by the proposed action would be collected and disposed of off site in accordance with U.S. Army, state, and federal regulations. Any wastes

---

[1] Calculations are based on the principle of mass in chemical reactions (i.e., the total mass in is equal to the mass out).

determined to be hazardous under the RCRA regulations would be stored and disposed of off site as prescribed by the EPA and applicable state and local regulations.

4.4.3 Impacts of the Proposed Action

4.4.3.1 Impacts of Construction

Construction activities associated with the building of the ACWA pilot test facility would generate both solid and liquid nonhazardous wastes. The solid nonhazardous wastes would be primarily in the form of building material debris and excavation spoils. Liquid nonhazardous wastes would include wastewater from washdowns and sanitary wastes. Construction would also generate small amounts of both solid and liquid hazardous wastes such as solvents, paints, cleaning solutions, waste oils, contaminated rags, and pesticides. No changes in ANAD waste management systems would be expected to be needed for the management and disposal of solid and liquid construction wastes.

Estimates of the amounts of waste that would be generated during construction of a pilot test facility at ANAD are shown in Table 4.4-2. Data in this table cover the four technologies being considered: Neut/Bio, Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox. These estimates are based on the proposed building size and an estimated total construction work force representing about 1,100 full-time-equivalent-years (FTE-yr) (Volume 1 of Kimmell et al. 2001). Sanitary wastes and wastewater would be the only significant liquid effluents that would be generated during construction. All of the construction wastes could be treated by existing systems, and no additional environmental impacts from managing these wastes are expected.

4.4.3.2 Impacts of Operations

Munitions are not generally considered wastes while they are in storage. Typically, munitions are reclassified as wastes upon their removal from storage for treatment and disposal or if they are no longer usable. Upon disassembly and destruction of an ACW, the remaining residuals become wastes. In the case of M55 rockets stored at ANAD, the Army has reclassified these munitions as waste due to obsolescence of the rocket. Wastes resulting from the normal operation of an ACWA pilot test facility would include components from the treatment of metal parts and dunnage as well as process residues (e.g., contaminated salts generated from treating chemical agents and energetics). An ACWA pilot test facility would also generate a number of nonprocess wastes (e.g., office trash, PPE, decontamination solution, spent carbon filters). ACWA pilot test facilities would recycle all process liquids obtained in the operation phase back through the reaction vessel. Such recycling would eliminate these liquids from the waste streams. If stabilization of the hazardous solid salt waste obtained in the normal processing of ACWs was

TABLE 4.4-2 Wastes Generated during Construction of an ACWA Pilot Test Facility at ANAD

Waste	Neut/Bio	Neut/SCWO	Neut/GPCR/ TW-SCWO	Elchem Ox
Hazardous wastes				
Solid (yd^3)	80	90	90	100
Liquid (gal)	33,000	38,000	36,000	39,000
Nonhazardous wastes				
Solids				
Concrete (yd^3)	210	210	220	190
Steel (tons)	32	36	29	33
Other (yd^3)	1,700	1,700	1,800	1,500
Liquids				
Wastewater (gal)	2,100,000	2,500,000	2,300,000	2,500,000
Sanitary (gal)	4,700,000	5,600,000	5,100,000	5,600,000

Source: Kimmell et al. (2001).

required, either a waste management facility for stabilizing the waste would need to be built at ANAD, or the waste would need to be shipped off post to an appropriately permitted treatment facility. Depending on the technology chosen for stabilization of the salt waste, a new treatment unit might be required.

Demonstration I provided information for estimating waste generation rates from the processing of ACWs by the Neut/SCWO and Neut/Bio technologies. Demonstration II provided information for estimating waste generation rates from the processing of the ACW inventory by the Neut/GPCR/TW-SCWO and Elchem Ox. Estimates of wastes from processing agents by using the above technologies are presented in this section. The number of operating days for processing each agent was determined by choosing the smaller of the following two numbers: 276 days (the number of full operating days per year) or the number of days it would take to destroy the entire installation inventory of the agent.

Hazardous Wastes. Wastes that would result from the operation of an ACWA pilot test facility are summarized in Table 4.4-3. The numbers in Table 4.4-3 account for only those waste streams produced by the four technologies during the processing of mustard and both types of nerve agent (GB and VX). The table does not include the wastes that would be generated during storage, which would include primarily contaminated solids, such as PPE and pallets, and a small quantity of contaminated liquids in the form of decontamination water. ANAD would continue to generate wastes associated with storage at decreasing rates during the ACWA facility's operation until the stockpile was completely destroyed.

TABLE 4.4-3 Hazardous Wastes Generated Annually from the Operation of an ACWA Pilot Test Facility at ANAD[a]

	Amount of Hazardous Waste (tons/yr) per Technology and Agent Being Processed								
	Neut/Bio	Neut/SCWO		Neut/GPCR/TW-SCWO			Elchem Ox		
Hazardous Waste	Mustard	Mustard	Nerve[b]	Mustard	GB	VX	Mustard	GB	VX
Brine salts (total)	970	1,020	1,930	1,020	2,210	1,800	110	120	170
Sodium phosphate	-	18	1,380	14	1,800	1,260	-	-	-
Sodium fluoride	-		46	-	106	-	-	-	-
Sodium sulfate	345	500	170	500	-	280	-	-	-
Sodium chloride	360	360	-	360	-	-	-	-	-
Sodium bisulfate	72	-	-	-	-	-	-	-	-
Other salts	48	7.0	43	150	22	19	110	120	170
Water in salt cake	124	130	250	130	280	230	-	-	-
Aluminum oxide	-	-	1,200	-	430	280	-	-	-
Anolyte-catholyte waste	-	-	-	-	-	-	720	250	1,200
Biomass (total)	550	-	-	-	-	-	-	-	-
Biomass solids	360	-	-	-	-	-	-	-	-
Water in biomass	190	-	-	-	-	-	-	-	-
Other solids	1	-	-	-	-	-	-	-	-
Hazardous liquids	-	-	-	-	-	-	5	11	14

[a] Values are based on 276 days of operation per year for all technologies. A hyphen means that the waste stream is not generated by the specific technology. Operational durations are 21 months (1.75 years) for Neut/Bio and up to 36 months (3 years) for other technologies.

[b] Value shown for nerve agent includes GB and VX. Separate values were not provided for this technology from the demonstration results.

Sources: Mitretek (2001a–d); Kimmell et al. (2001).

ANAD has substantial amounts of nerve agents GB and VX and mustard agent in its ACW inventory. The Neut/Bio technology has proven effective at treating only the mustard agent, whereas Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox can be used on both nerve and mustard agents. The estimates for the annual waste generation from an ACWA pilot test facility are based on an assumption of 276 days of operation per year, with the last three technologies treating all three agents and the Neut/Bio treating mustard agent only.

Polychlorinated biphenyls (PCBs) have been identified as a constituent in the firing tubes of M55 rockets held in the ACW inventory at ANAD. The concentration of PCBs in these munitions can range from less than 50 to more than 2,000 parts per million (ppm). Therefore, treatment of these munitions with ACWA technologies would involve the treatment of PCB wastes. In addition, the treatment process could generate brine wastes containing more than 50 ppm of PCBs or unacceptable amounts of toxic PCB intermediate by-products, such as dioxins or furans. PCB concentrations in wastes generated during the pilot-scale testing of ACWA technologies will need to be evaluated. Wastes containing PCBs in excess of 50 ppm are subject to regulation under the *Toxic Substances Control Act* (TSCA).

Neutralization/Biotreatment. A number of process-related waste streams would be generated from the Neut/Bio technology. Salts and biomass would be extracted from the bioreactor effluents, treated further, and dried to be disposed of as solid hazardous waste (Table 4.4-3). The liquids obtained from the further treatment of the bioreactor effluents would be recycled back through the bioreactor, thus eliminating the release of any process liquid wastes.

Various types of nonprocess wastes would be generated from Neut/Bio operation. These would include dunnage, PPE, spent carbon filters, pallets, and decontamination solution. All of these nonprocess operation wastes have the potential to be contaminated by an agent, and such contamination would require treatment. Under the Neut/Bio alternative, nonprocess wastes would be treated by the metal parts treater (MPT). Treatment of nonprocess wastes would result in approximately 80 tons of residual brine waste; this amount is included in the overall brine waste numbers shown in Table 4.4-3. Nonprocess waste would also generate about 35 tons of metals waste; this total is included in Table 4.4-4 (Kimmell et al. 2001).

No significant impacts are expected from the generation of hazardous waste during the operation of an ACWA facility. Most of these wastes would be collected and disposed of off post in accordance with U.S. Army, state, and federal regulations. Any wastes determined to be hazardous in the RCRA regulations would be stored and disposed of off post as prescribed by the EPA and applicable state and local regulations.

If the salts and biomass wastes failed the RCRA TCLP tests, some type of stabilization of these wastes would be necessary. Depending on the technology chosen and the amount of loading of the wastes in the stabilization matrix, the amount of stabilized waste could easily exceed the hazardous waste estimates given in Table 4.4-3 by a factor of approximately 2.5. If stabilization of the solid salt waste was required, either a waste management process for stabilizing the waste would be needed at ANAD, or, alternatively, the waste would need to be shipped off post to an appropriately permitted treatment facility. Depending on the treatment chosen, a new facility might need to be constructed at ANAD or an existing off-post commercial facility might need to handle the off-post shipment of solid salt waste.

Neutralization/SCWO. Process effluents from the SCWO units would be combined. Brine salts (mostly sodium sulfate, sodium chloride, and sodium phosphate, see Table 4.4-3) would be extracted and dried for disposal as solid hazardous waste. No liquid wastes would be released from the process, since process liquids would be recycled back into the SCWO units.

TABLE 4.4-4 Nonhazardous Wastes Generated Annually from the Operation of an ACWA Pilot Test Facility at ANAD[a]

	Amount of Waste Generated Annually per Technology			
Nonhazardous Waste	Neut/Bio	Neut/SCWO	Neut/GPCR/ TW-SCWO	Elchem Ox
Sanitary wastes (gal)	7,500,000	7,500,000	7,500,000	7,500,000
Other solid wastes (yd^3)[b]	1,600	1,600	1,600	1,600
Recyclable wastes (yd^3)[c]	660	660	660	660
Metal wastes (mustard) (tons)	2,200	2,200	2,400	2,200
Metal wastes (nerve) (tons)	NA[d]	4,150	NA	NA
Metal wastes (GB) (tons)	NA	NA	3,700	3,600
Metal wastes (VX) (tons)	NA	NA	5,200	5,100

[a] Values are based on 276 d/yr of operation for all technologies. Operational durations are 21 mo (1.75 yr) for Neut/Bio and 57 mo (4.75 yr) for other technologies.

[b] Domestic trash and office waste.

[c] Recyclable wastes include paper and aluminum.

[d] NA = not applicable.

Sources: Mitretek (2001a–d); Kimmell et al. (2001).

Nonprocess operational wastes (e.g., dunnage, PPE, spent carbon filters, pallets, decontamination solution) were estimated by the technology provider (General Atomics 1999). All these wastes could potentially be contaminated by agent. Such contamination would require treatment. Current operating plans include recycling all nonprocess liquids obtained in the operations phase back through the reaction vessel. Such recycling would eliminate these liquids from the waste streams. Recycling of nonprocess wastes would result in approximately 110 tons of brine waste; this amount is included in the overall brine waste numbers shown in Table 4.4-3.

No significant impacts are expected from the generation of hazardous wastes during operation of an ACWA facility unless brine salts were to fail the RCRA TLCP test. It is assumed that most wastes generated during operations would be collected and disposed of off post in accordance with U.S. Army, state, and federal regulations. Any wastes listed as hazardous in the RCRA regulations would be stored and disposed of off post as prescribed by the EPA and applicable state and local regulations.

If the brine salts failed the RCRA TCLP tests, some type of stabilization of the salt would be necessary. Depending on the technology chosen and the amount of loading of the salt wastes in the stabilization matrix, the amount of stabilized salt waste could easily exceed the salt waste estimate given in Table 4.4-3 by a factor of approximately 2.5. If stabilization of the solid salt waste was required, either a waste management process for stabilizing the waste would be needed at ANAD, or, alternatively, the waste would need to be shipped off post to an appropriately permitted treatment facility. Depending on the treatment chosen, a new facility might need to be constructed or an existing off-post commercial facility might need to handle the off-post shipment of solid salt waste.

Neutralization/GPCR/TW-SCWO. This technology would generate several sources of waste during its operation at ANAD. Hydrolysates for both agent and energetics would be combined and sent to the TW-SCWO unit. This unit, operating at supercritical conditions, would rapidly oxidize all input materials. Upon completion of oxidation, the liquid effluents from this unit contain soluble and unsoluble salts and metal oxides. These effluents would be sent to the evaporator/crystallizer unit. The resulting dried brine salts (primarily sodium phosphate, sodium sulfate, and sodium chloride; see Table 4.4-3) would be disposed of as hazardous wastes. The liquid effluent would be recycled back to the neutralizer unit as make-up water.

The GPCR unit would consist of a thermal reduction batch processor (TRBP) and the reactor (GPCR) itself. In the TRBP, contaminated materials, such as dunnage and metal parts contaminated with agent and energetics, would be placed in a heated oven. The resulting volatile organics would be swept by heated hydrogen gas into the reactor, where they would be reduced to simple hydrocarbons (HCs) and acid gases. The gaseous effluent would pass through a caustic scrubber that would generate brine salts from the acid gases. These hazardous salts would be combined with the brine salts obtained from the TW-SCWO unit, listed in Table 4.4-3. All liquids would be recycled.

Nonprocess operational wastes (e.g., PPE, spent carbon filters, pallets, decontamination solution) were estimated by the technology provider (General Atomics 1999). All these wastes could potentially be contaminated by agent. Such contamination would require treatment. Current operating plans include recycling all nonprocess liquids obtained in the operations phase back through the reaction vessel. Such recycling would eliminate these liquids from the waste streams. Recycling of nonprocess wastes would result in approximately 190 tons of brine waste; this amount is included in the overall brine waste numbers shown in Table 4.4-3.

No significant impacts are expected from the generation of hazardous wastes during the operation of an ACWA facility. It is assumed that most hazardous wastes generated during operation would be collected and disposed of off post in accordance with U.S. Army, state, and federal regulations. Any wastes listed as hazardous in the RCRA regulations would be stored and disposed of off post as prescribed by the EPA and applicable state and local regulations.

If the brine salts failed the RCRA TCLP tests, some type of stabilization of the salt would be necessary. Depending on the technology chosen and the amount of loading of the salt wastes in the stabilization matrix, the amount of stabilized salt waste could easily exceed the salt waste estimate given in Table 4.4-3 by a factor of approximately 2.5. If stabilization of the solid salt waste was required, either a waste management process for stabilizing the waste would be needed at ANAD, or, alternatively, the waste would need to be shipped off post to an appropriately permitted treatment facility. Depending on the treatment chosen, a new facility might need to be constructed or an existing off-post facility might need to handle the off-post shipment of solid salt waste.

Electrochemical Oxidation. The operation of this technology would generate several sources of waste. Both agents and energetics would be destroyed by Elchem Ox in the SILVER II process. The SILVER II process would use electrochemical oxidation, which would generate Ag^{+2} ions in aqueous nitric acid. The acid would be circulated through stirred tank reactors (the anolyte and catholyte circuits). Agent and energetics would be oxidized in similar but separate systems. The generated Ag^{+2} ions would oxidize the organic feed when the current was turned on. Silver chloride would be precipitated when organochlorine compounds (such as mustard) are treated. The silver chloride salt cake containing various metal particulates would be collected, dried, and sent away for silver recovery. The remaining salts, solids, and metal impurities would be disposed of as hazardous salts (listed in Table 4.4-3 as anolyte-catholyte waste). The anode-cathode reaction would also generate a number of off-gases, including several acidic gases such as nitrogen oxides (NO_x). Most of the NO_x would be recovered at the NO_x reformer unit as concentrated nitric acid and recycled. Small amounts of dilute nitric acid would be neutralized and disposed of as a hazardous liquid (see Table 4.4.3). The remaining corrosive gas would be swept to a caustic scrubber, where the remaining corrosive gases would be neutralized and dried for disposal as hazardous brine salts (see Table 4.4-3). All liquids from this unit would be recycled as make-up water.

Various types of nonprocess wastes would be generated from the operation of this technology. These would include dunnage, PPE, spent carbon filters, pallets, and decontamination solution. All of these nonprocess wastes could be contaminated by agent, and such contamination would require treatment. Under this alternative, nonprocess wastes would be treated by the MPT. Treatment of nonprocess wastes would result in approximately 130 tons of residual brine waste; this amount is included in the overall brine waste numbers shown in Table 4.4-3.

No significant impacts are expected from the generation of hazardous waste during the operation of an ACWA pilot facility. It is assumed that most wastes generated during operation would be collected and disposed of off post in accordance with U.S. Army, state, and federal regulations. Any wastes listed as hazardous in the RCRA regulations would be stored and disposed of off post as prescribed by the EPA and applicable state and local regulations.

If the salts and the anolyte-catholyte wastes failed the RCRA TCLP tests, some type of stabilization of these wastes would be necessary. Depending on the technology chosen and the amount of loading of the wastes in the stabilization matrix, the amount of stabilized waste could easily exceed the hazardous waste estimates given in Table 4.4-3 by a factor of approximately 2.5. If stabilization of the solid salt waste was required, either a waste management process for stabilizing the waste would be needed at ANAD, or, alternatively, the waste would need to be shipped off post to an appropriately permitted treatment facility. Depending on the treatment chosen, a new facility might need to be constructed or an existing off-post facility might need to handle the off-post shipment of solid salt waste.

Nonhazardous Wastes. Estimates of nonhazardous solid wastes associated with facility operations were estimated by scaling data on comparable buildings for the size of the operating work force (Kimmell et al. 2001) (Table 4.4-4). These numbers are expected to be nearly the same for the four technologies, since the facilities would be of similar size and have similar work force numbers. No impacts are expected from the generation of nonhazardous solid wastes during the operation of an ACWA facility. Nonhazardous solid wastes would be collected and disposed of in a local landfill by a licensed waste hauler. In each technology, recyclable metals would be generated from the decontamination of various munition parts. These are listed in Table 4.4-4. Nonprocess waste would also generate about 40–60 tons of metal waste, which is included in Table 4.4-4.

During normal operations, an estimated 7.5 million gal (29,000 L) of sanitary sewage would be generated per operating year (Table 4.4-4) (Kimmell et al. 2001). Sanitary waste would be treated in an on-post sewage treatment plant. Wastewater generation per operations day related to normal operations would most likely be essentially the same for all four ACWA technologies being considered, since the technologies do not require significant amounts of make-up process water and do not discharge any process water. Because of this, wastewater generation would be related to the number of workers, which is essentially the same for all the technologies being considered. No impacts significant are expected from the generation of wastewater during operation of an ACWA pilot test facility.

4.4.4 Impacts of No Action

4.4.4.1 Hazardous Wastes

No construction activities would be anticipated under the no action/continued storage alternative. Continued storage of munitions at ANAD would generate relatively small quantities of hazardous wastes from leaks, spills, and contaminated solids, such as PPE, pallets, and dunnage. The estimated annual generation associated with storage would be 2.5 tons of liquid wastes (decontamination water) and about 4 tons of hazardous solid waste from PPE and pallets (ANAD 2000a). The continued degradation of agent containers over time would probably generate slowly increasing amounts of waste from leaks, but these quantities would be relatively small.

Continued storage of chemical weapons at ANAD would not adversely affect waste management. Hazardous wastes would be collected and disposed of off post in accordance with

U.S. Army, state, and federal regulations. Any wastes determined to be hazardous under the RCRA regulations would be stored and disposed of off post as prescribed by the EPA and applicable state and local regulations.

The no action alternative considers incineration of all ACWs in the inventory at ANAD, as presented in the ANAD EIS (U.S. Army 1991). An estimate of the wastes generated from such an incinerator can be determined by obtaining information from the ANAD EIS and using the same methodology used to generate waste estimates for the ACWA technologies (Folga 2001a). Estimates of waste generation from operation of an ACW incinerator are given in Table 4.4-5.

4.4.4.2 Nonhazardous Wastes

No construction activities would be expected to occur under the continued storage alternative. Small amounts of nonhazardous solid waste and nonhazardous sanitary waste are generated during storage of chemical weapons. However, these amounts are not significant. Nonhazardous wastes associated with the operation of an ACW incinerator at ANAD are listed in Table 4.4-5. Process liquids from the incinerator are recycled and not released to the environment.

Continued storage of chemical weapons at ANAD would not adversely affect waste management. Facilities exist to handle sanitary waste, and solid wastes are hauled off post by a licensed contractor.

4.5 AIR QUALITY — CRITERIA POLLUTANTS

This section describes existing meteorology, air emissions, and air quality at ANAD and the air emissions and environmental consequences on air quality that might result from constructing and operating an ACWA pilot test facility at ANAD. Data on potential air emissions and impacts on air quality under the no action alternative are also presented. Potential impacts on human health as a result of air emissions during construction and normal operations are described in Sections 4.6 and 4.7. Potential impacts on air quality and human health as a result of air emissions from accidents involving explosives and chemical agents are described in Section 4.21.

The analysis of impacts on air quality from both construction and operations was conducted for Proposed Area A (see Figure 4.3-1), which is closest to the ANAD installation boundary in the direction of the nearest off-site residence. The three potential locations for pilot test facilities are adjacent to one another and would require similar infrastructure. Therefore, the analysis for one location would provide an adequate representation of the potential impacts from construction and operations for any of the three facility locations.

TABLE 4.4-5 Solid Process Wastes Generated during the Operation of an ACW Incinerator at ANAD[a]

Waste Type	Description	Peak-Hour (lb/h)	Average-Day (lb/d)	Annual (tons/yr except as noted)
Hazardous waste				
Brine salt	From brine reduction[b]	4,300	17,300	3,200
Scrap/ash	From liquid incinerator	0	0	0
Scrap/ash	From dunnage furnace	180	1,800	330
Scrap/ash	From deactivation furnace	1,400	NA	NA
Nonhazardous waste				
Metal scrap	From MPT	12,200	25,000	4,600
Sanitary waste	Liquid	-	-	4,200,000 gal
Other wastes[c]	Solids	-	-	1,600 yd^3
Recyclable wastes[d]	Solids	-	-	660 yd^3

[a] NA = not applicable. A hyphen means that the data were not available.

[b] Contains 10–15% moisture.

[c] Other wastes include domestic trash and office waste.

[d] Recyclable wastes include paper, aluminum, etc. generated by the facility.

Because the facility size, number of construction workers, and infrastructure required for each of the ACW destruction systems proposed for pilot testing would be similar, only one model analysis of the impacts from construction on air quality was conducted. The facilities are expected to differ in the amount of fossil fuel they would combust to generate heat.

The analyses presented in the following sections conclude that the total (modeled plus background) concentrations associated with fugitive dust emissions during construction would be below applicable standards. However, total annual average $PM_{2.5}$ levels would be close to the standard because of their higher background levels, which were recorded at most statewide monitoring stations.[2] Accordingly, construction activities should be conducted so as to minimize further impacts on ambient air quality. Because of Neut/GPCR/TW-SCWO's higher process heat requirements, emission levels from fossil fuel combustion would be higher for that technology than for the other three technologies (Neut/SCWO, Neut/Biot, and Elchem Ox technologies). However, concentration increments of air pollutants due to these emissions, by themselves or

[2] PM = particulate matter. PM_{10} = coarse, inhalable PM with a mean aerodynamic diameter of 10 µm or less. $PM_{2.5}$ = fine, inhalable PM with a mean aerodynamic diameter of 2.5 µm or less.

added to background, would be similar for all four destruction technologies and within applicable standards.

4.5.1 Current Meteorology, Emissions, and Air Quality

4.5.1.1 Meteorology

The climate of the area surrounding ANAD is temperate and characterized as subtropical. The summers are long, warm, and humid, while the winters are relatively short and mild. In winter months, there are frequent shifts between mild air, which has been moistened and warmed by the Gulf of Mexico, and dry, cool continental air. Cold waves from Canada have usually been modified substantially by the time they reach the area. In the summer, extended periods of hot and humid weather occur as a result of moist air originating from the Gulf. The following detailed description of climate is based on the data recorded at the Birmingham Municipal Airport located about 42 mi (68 km) west of ANAD (National Oceanic and Atmospheric Administration [NOAA] 1999). Wind data measured at the ANAD meteorological tower (Demil tower[3]) are also presented (Rhodes 2000).

Since July 1998, wind data have been measured at two (33-ft and 100-ft [10-m and 30-m]) levels of the Demil tower, which is located near the northern boundary of ANAD site and is the tower closest to the location of the proposed disposal facilities. The wind roses for the Demil tower for a two-year period (July 1998 through June 2000) are shown in Figure 4.5-1. For comparison, the wind rose at the 22-ft (6.7-m) level of the Birmingham Municipal Airport for the period of 1984–1992 is also presented in Figure 4.5-1 (EPA 2000a). Wind patterns between the 10-m and 30-m levels at the Demil tower are quite different. At the 10-m level (Figure 4.5-1, top left), southeasterly winds were predominant, with a secondary peak from the east-southeast. At the 30-m level (top right), winds were common from the south and south-southeast and, to a lesser extent, from the east-southeast and north-northeast. During the two-year period of 1998 to 2000, the average wind speed was 3.6 miles per hour or mph (1.6 m/s) at the 10-m level and 5.4 mph (2.4 m/s) at the 30-m level. These wind patterns at the Demil tower are also quite different from those at Birmingham Municipal Airport (bottom center), which are characterized by the dominance of northeast winds. Although the terrain at ANAD is hilly, there is no dominant topographic feature that broadly influences the wind by channeling the flow. These wind patterns at ANAD suggest that winds are, to some extent, affected by both nearby vegetation and topographic features.

---

[3] Currently, five meteorological towers (four CSEPP [Chemical Stockpile Emergency Preparedness Program] towers and one Demil tower) are operating at ANAD. Wind data from the Demil tower were selected to represent the conditions at ANAD because the tower meets the EPA's siting criteria and because the instrument and associated data were more comprehensively checked for quality assurance/quality control (QA/QC) than were the data from CSEPP towers (Rhodes 2000).

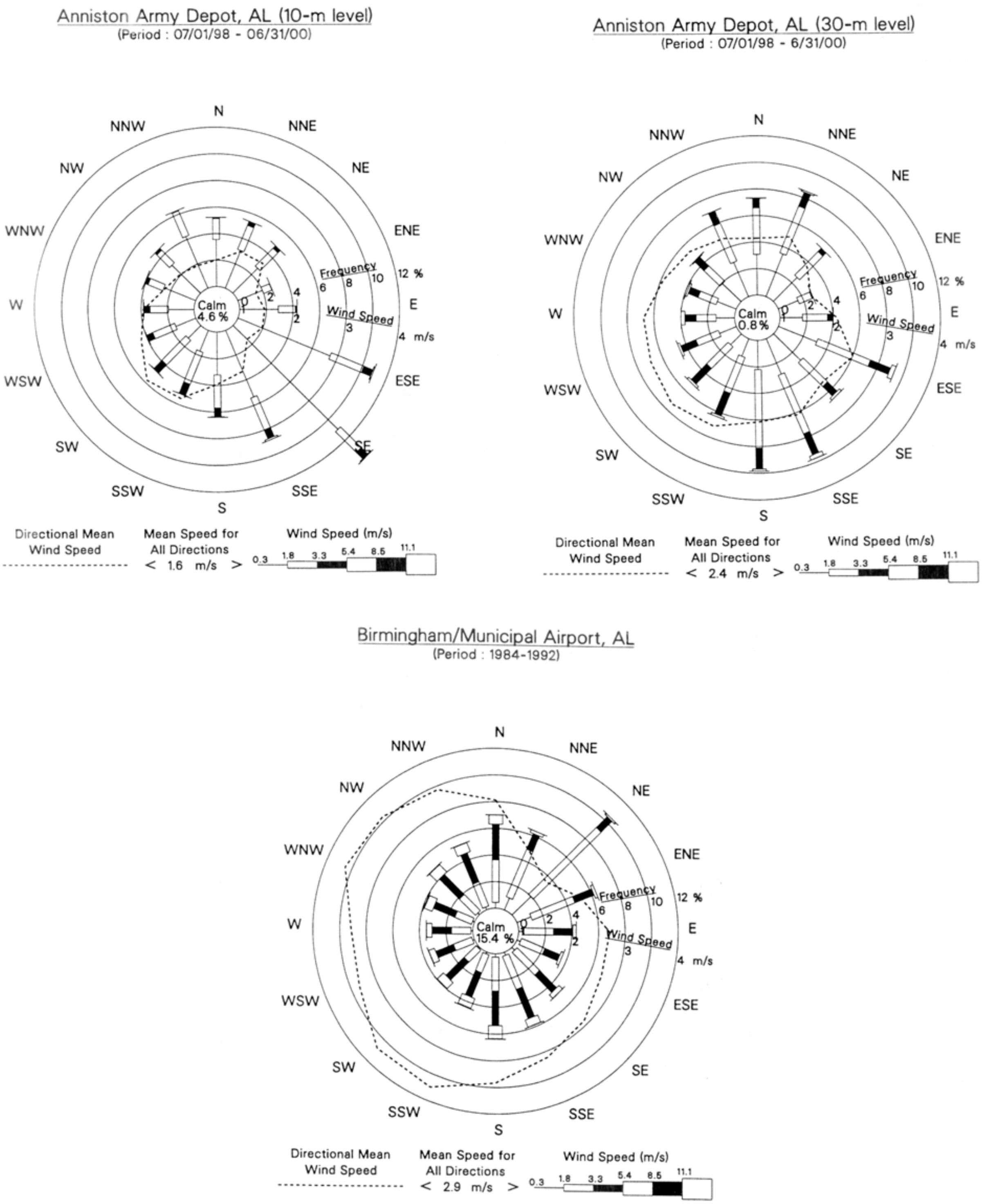

FIGURE 4.5-1 Annual Wind Roses for Two Heights Aboveground at the Demil Tower at ANAD from June 1998 through June 2000 (top left = 10 m, top right = 30 m) and for One Height at Birmingham Municipal Airport from 1984 through 1992 (bottom center = 6.7 m) (Sources: Rhodes 2000 for top left and right; EPA 2000a for bottom center)

The average annual temperature at Birmingham Municipal Airport is 62.4°F (16.9°C). January is the coldest month, averaging 43.3°F (6.3°C), and July is the warmest month, averaging 80.2°F (26.8°C). Extreme temperatures above 100°F (37.8°C) frequently occur, while those below 0°F (–17.8°C) are very rare. Extreme temperatures have ranged from –6°F (–21.1°C) in January 1985 to 106°F (41.1°C) in July 1980. The number of freeze-free days per year (i.e., when the daily minimum temperature is greater than 32°F [0°C]) is about 306 days, and no freeze days occur in May through September.

Annual precipitation is almost entirely in the form of rain. Average annual precipitation at Birmingham Municipal Airport is 54.6 in. (138.6 cm). Precipitation is relatively evenly distributed throughout the year, with a minimum of 2.8 in. (7.1 cm) in October and a maximum of 6.2 in. (15.7 cm) in March. The greatest amount of precipitation in a single month was 17.7 in. (44.9 cm) occurring in February 1961, and the greatest amount in a 24-hour period was 7.1 in. (17.9 cm) in March 1970. Annual snowfall averages about 1.4 in. (3.6 cm). The greatest amount of snow reported in a single month and during a 24-hour period was 13 in. (33 cm), which occurred in March 1993. On rare occasions, there may be a 2- to 4-in. (5.1- to 10.2-cm) snowstorm, but the snow usually melts quickly.

Average annual relative humidity at the Birmingham Municipal Airport is 70%, ranging from 80 to 84% in the first half of the day and from 56 to 62% in the second half. Heavy fogs are rather rare in the area. The annual average number of days with heavy fog (visibility of 0.25 mi [0.4 km] or less) is about eight days, which usually occurs in winter. Thunderstorms can occur in any month but are most frequent during the months of March through September. The mean number of days with thunderstorms at Birmingham Municipal Airport is about 58 per year. They are occasionally accompanied by damaging hail, but the area affected is nearly always small.

In the state of Alabama, the tornado season extends from November through early May, with the greatest frequency in March and April (Ruffner 1985). Frequently, a tropical storm moving inland will spawn several tornados. Tornadoes in the area surrounding ANAD are less frequent and destructive than those in the tornado alley, which stretches north from Texas to Nebraska and Iowa. For the 46-year period of 1950 through 1995, 923 tornadoes were reported in Alabama, with a tornado event frequency of $4.0 \times 10^{-4}/\mathrm{mi}^2$ per year and an average of 20 tornadoes per year (Storm Prediction Center 2000). For the same period, 13 tornadoes were reported in Calhoun County, with a tornado event frequency of $4.6 \times 10^{-4}/\mathrm{mi}^2$ per year. Most tornadoes occurring in Calhoun County are classified, at most, at a level of F3 on the Fujita tornado scale.[4] Only one was rated at F4, on March 27, 1994.

[4] The Fujita scale is used to classify tornadoes in terms of wind damage. F0 = light damage associated with winds travelling at speeds up to 72 mph. F3 = severe damage associated with winds travelling at 158 through 206 mph. F4 = devastating damage associated with winds travelling at 207 through 260 mph. F5 = incredible damage associated with winds travelling at 261 mph and faster.

4.5.1.2 Emissions

The existing sources of criteria pollutants and volatile organic compounds (VOCs) at ANAD include boilers, degreasing operations, paint booths, fuel storage and dispensing, open burning, open detonation, and other miscellaneous sources. Other emissions originate from numerous, very small, nonpoint sources that are associated with depot missions but are not included in any specific source categories (e.g., commuting vehicles, delivery operations). Major sources operate under permits from the ADEM. Data on total annual emissions under operating permits from ADEM in 1999 (Larkins 2000a) are included in Table 4.5-1. Estimated emissions from all categories of sources at ANAD were about 273 tons of PM_{10}; 245 tons of VOCs; 173 tons of sulfur dioxide (SO_2), 45 tons of NO_x, 19 tons of carbon monoxide (CO), and 0.7 ton of lead (Pb). The combined emissions from ANAD sources are large enough to result in ANAD being designated as a major stationary source. Therefore, emissions from the proposed destruction facility would be subject to comprehensive reviews during the air permitting process for the destruction facility.

For comparison, annual estimates of air pollutant emissions in 1996 from Calhoun County and ANAD (EPA 2000b) are listed in Table 4.5-2. The significance of ANAD emissions is expressed as a percentage of the total Calhoun County emissions. As the table indicates, except SO_2, ANAD emissions account for very small fractions of the emissions released from the

TABLE 4.5-1 Estimated Emissions of Air Pollutants from Existing ANAD Sources in 1999

	Emissions (tons/yr)[a]					
Source Category	SO_2	NO_x	CO	VOCs[b]	PM_{10}	Pb
Boilers	172.47	44.04	12.29	0.88	5.75	-
Degreaser/paint stripper/abrasive	-	-	-	63.91	43.72	-
Paint booths	-	-	-	72.5	1.24	0.03
Fuel storage and dispensing	-	-	-	5.19	-	-
Open burning/open detonation	0.19	0.48	6.49	0.43	58.8	0.67
Miscellaneous[c]	-	-	-	102	163	-
Total	172.66	44.52	18.78	244.91	272.51	0.70

[a] A hyphen means that there was no emission, the emission was negligible, or the emission was not estimated.

[b] Includes organic hazardous air pollutants.

[c] Includes numerous, very small, nonpoint sources that are associated with depot missions but are not included in any specific source categories.

Source: Larkins (2000a).

TABLE 4.5-2 Estimated Emissions of Air Pollutants from Calhoun County and ANAD Sources in 1996

	Emissions (tons/yr)[a]	
Air Pollutant	Calhoun County	ANAD[b]
SO_2	3,057	346 (11)
NO_x	10,308	96 (0.9)
CO	58,888	51 (0.09)
VOC	10,804	161 (1.5)
PM_{10}	10,953	307 (2.8)
Pb	-	-

[a] A hyphen indicates that data are not available.

[b] Numbers in parentheses are ANAD emissions as a percentage of Calhoun County emissions.

Source: EPA (2000b).

Calhoun County, about 2.8%, 1.5%, 0.9%, and 0.09% of the total for PM_{10}, VOC, NO_x, and CO, respectively. SO_2 emissions account for about 11% of the total Calhoun County emissions due to coal-burning boilers at ANAD. Recently, these boilers were replaced with natural-gas boilers (backed up by diesel fuel); accordingly, SO_2 emissions from the ANAD site were significantly reduced (Larkins 2000b).

4.5.1.3 Air Quality

The Alabama State Ambient Air Quality Standards (SAAQS) for six criteria pollutants — SO_2, PM, CO, ozone (O_3), nitrogen dioxide (NO_2), and Pb — are identical to the National Ambient Air Quality Standards (NAAQS), as shown in Table 4.5-3 (ADEM 1999). In 1997, the EPA revised the NAAQS for O_3 and PM. The standards were challenged, and the lower court decision was appealed to the U.S. Supreme Court. On February 27, 2001, the U.S. Supreme Court unanimously upheld the constitutionality of the CAA as the EPA had interpreted it in setting the $PM_{2.5}$ and O_3 standards. However, the case was remanded back to the D.C. Circuit Court of Appeals to resolve the remaining issues, which include EPA's justification for the numerical levels. While the case is pending, the O_3 and fine particle standards remain in effect as a legal matter, because the D.C. Circuit Court decision did not vacate the standards. The EPA has not, however, started implementing the revised $PM_{2.5}$ and O_3 standards. The monitoring stations nearest to ANAD are Birmingham/Fairfield for SO_2 and CO, Helena in Shelby County for NO_2, and Ashland in Clay County for O_3 (EPA 2001). In Anniston, PM_{10} monitoring was

TABLE 4.5-3 National Ambient Air Quality Standards (NAAQS), Maximum Allowable Increments for Prevention of Significant Deterioration (PSD), and Highest Background Levels Representative of ANAD[a]

		NAAQS[b]		PSD Increment (µg/m³)		Highest Background Level	
Pollutant	Averaging Time	Primary	Secondary	Class I	Class II	Concentration[c]	Location (Year)
SO_2	3 hours	-	0.50 ppm (1,300 µg/m³)	25	512	0.133 ppm (27)	Fairfield (2000)
	24 hours	0.14 ppm (365 µg/m³)	-	5	91	0.057 ppm (41)	Fairfield (2000)
	Annual	0.03 ppm (80 µg/m³)	-	2	20	0.012 ppm (40)	Fairfield (2000)
NO_2	Annual	0.053 ppm (100 µg/m³)	0.053 ppm (100 µg/m³)	2.5	25	0.011 ppm (21)	Helena (2000)
CO	1 hour	35 ppm (40,000 µg/m³)	-	-	-	12.4 ppm (35)	Birmingham (1995)
	8 hours	9 ppm (10,000 µg/m³)	-	-	-	7.2 ppm (80)	Fairfield (1995)
O_3	1 hour	0.12 ppm) (235 µg/m³)	0.12 ppm (235 µg/m³)	-	-	0.126 ppm (105)	Ashland (1995)
	8 hours	0.08 ppm (157 µg/m³)	0.08 ppm (157 µg/m³)	-	-	0.099 ppm (124)	Ashland (19989)
PM_{10}	24 hours	150 µg/m³	150 µg/m³	8	30	68 µg/m³ (45)	Anniston (1995)
	Annual	50 µg/m³	50 µg/m³	4	17	26.4 µg/m³ (53)	Anniston (1998)
$PM_{2.5}$	24 hours	65 µg/m³	65 µg/m³	-	-	46.2 µg/m³ (71)	Ashland (1999)
	Annual	15 µg/m³	15 µg/m³	-	-	14.41 µg/m³ (96)[d]	Ashland (1999)
Pb	Calendar quarter	1.5 µg/m³	1.5 µg/m³	-	-	0.26 µg/m³ (17)	Gadsden (1996)

[a] A hyphen indicates that no standards exist.

[b] Refer to 40 CFR 50 for detailed information on the implementation of the new $PM_{2.5}$ and O_3 standard and the interim treatment of the existing standards.

[c] Values in parentheses are monitored concentrations as a percentage of NAAQS.

[d] The number of data are insufficient to determine the annual average, so the arithmetic average from available data is presented.

Sources: 40 CFR 50; 40 CFR 52.21; ADEM 1999; EPA 2000c.

discontinued after 1998. Currently, the monitoring stations nearest to ANAD are Talladega in Talladega County for PM_{10} and Ashland in Clay County for $PM_{2.5}$ (Figure 4.5-2). As a direct result of phase-out of leaded gasoline in automobiles, lead concentrations in urban areas decreased dramatically. Thus, ambient lead concentration is no longer monitored in many parts of the country. Until 1996, lead was monitored in Etowah, Jefferson (including Birmingham), and Pike Counties. In Alabama, lead is currently monitored only in Troy in Pike County. The values highest for background air quality data recorded at the monitoring station nearest to ANAD for criteria pollutants subject to the NAAQS (EPA 2001) are also presented in Table 4.5-3.

ANAD, situated near the southwest corner of Calhoun County, is located in the East Alabama Intrastate Air Quality Control Region (AQCR, Code 003), which covers the east central part of Alabama (Figure 4.5-2). Currently, Calhoun County is designated as being in attainment for all NAAQS (Title 40, Part 81, Section 301 of the *Code of Federal Regulations* [40 CFR 81.301]). On the basis of recent six-year monitoring data, concentration levels for SO_2, NO_2, and PM_{10} around ANAD are well below their respective NAAQS. The 8-hour CO levels are about 80% of the standard, but such levels are limited to urban centers. $PM_{2.5}$ levels are below but close to the standard. Note that annual average $PM_{2.5}$ levels tend to be close to or above the standard at most statewide monitoring stations. The highest O_3 concentrations of regional concern are somewhat higher than the applicable NAAQS, as they are in most cities in the Southeast.

Prevention of significant deterioration (PSD) regulations (40 CFR 52.21) limit the maximum allowable incremental increases in ambient concentrations of SO_2, NO_2, and PM_{10} above established baseline levels, as shown in Table 4.5-3. The PSD regulations, which are designed to protect ambient air quality in attainment areas, apply to major new sources and major modifications to existing sources.[5] Within the State of Alabama, the PSD Class I area nearest to ANAD is the Sipsey Wilderness Area, located 91 mi (146 km) northwest of ANAD. The next closest Class I area is the Cohutta Wilderness Area in Georgia, which is 105 mi (169 km) northeast of ANAD. On the basis of the assumption that wind data at Birmingham Municipal Airport (Figure 4.51c) are representative of the region, these wilderness areas are located upwind of ANAD.

---

[5] In 1975, the EPA developed a classification system to allow some economic development in clean air areas while still protecting air from significant deterioration. These classes are defined in the 1977 *Clean Air Act Amendments* (CAAA). Very little deterioration is allowed in Class I areas (e.g., larger national parks and wilderness areas). Class II areas allow moderate deterioration. Class III areas allow deterioration up to the secondary standard.

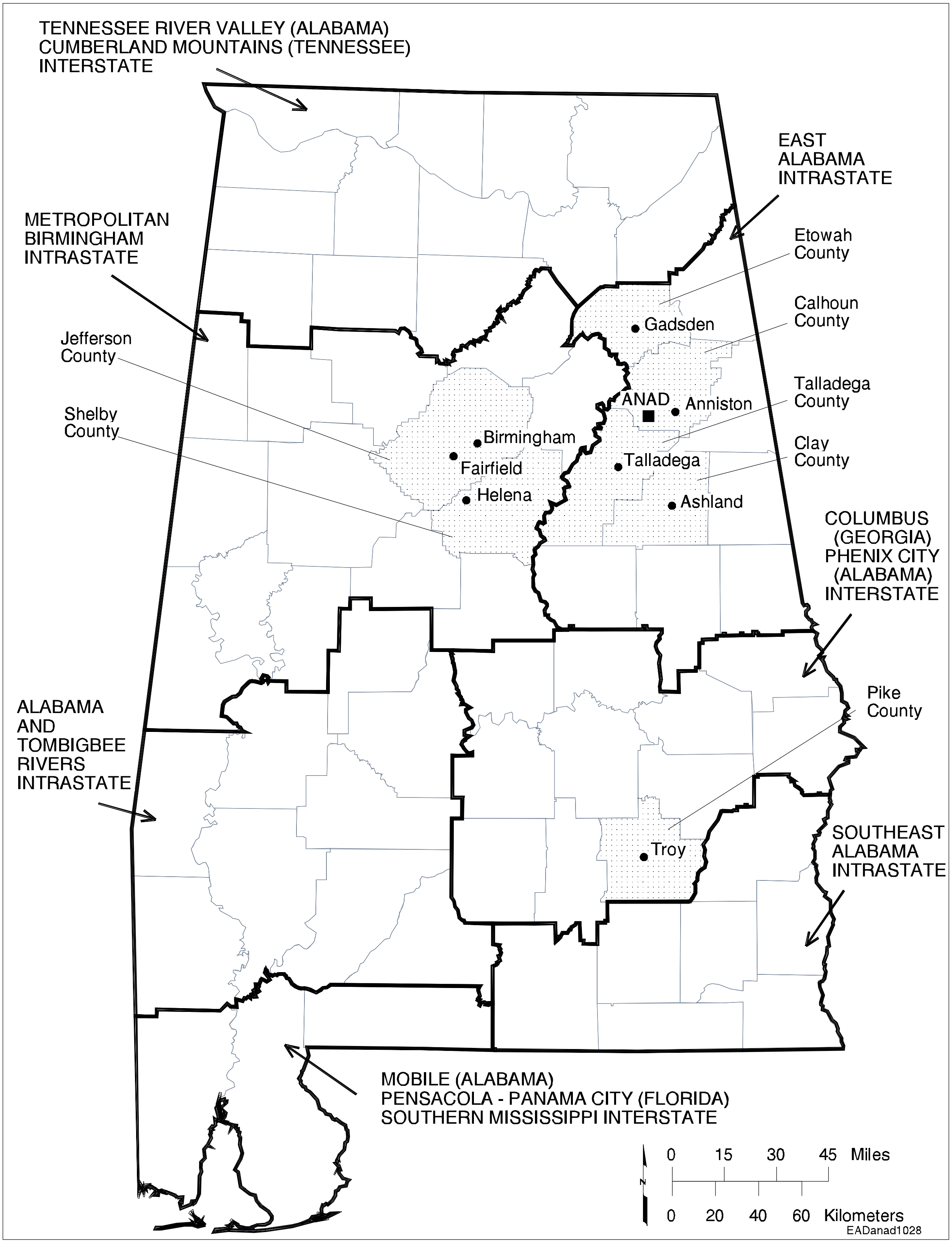

FIGURE 4.5-2 ANAD and Air Quality Control Regions in Alabama

4.5.2 ACWA Facility Emissions

4.5.2.1 Emissions from Construction

Emissions of criteria pollutants (such as SO_2, NO_x, CO, PM_{10}, and $PM_{2.5}$) and VOCs during the construction period would include fugitive dust emissions from earthmoving activities and exhaust emissions from equipment and commuter and delivery vehicles. Exhaust emissions are expected to be relatively small when compared with fugitive dust emissions from earth-moving activities (Kimmell et al. 2001). Also, impacts from exhaust emissions would be smaller because of their elevated buoyant release, different from ground-level fugitive dust emissions. Accordingly, only the potential impacts on ambient air quality from fugitive emissions of PM_{10} and $PM_{2.5}$ from earth-moving activities were analyzed. Emission factors and other assumptions used in estimating emission rates of PM_{10} and $PM_{2.5}$ are described in Appendix B.

4.5.2.2 Emissions from Operations

The emission levels currently permitted to ANAD are more than 100 tons/yr of a regulated air pollutant. Therefore, ANAD is classified as a major stationary source of air emissions. Emission factors and other assumptions that were used to estimate emission rates of criteria pollutants and VOCs during operations are described in Appendix B. Maximum short-term and annual total emission rates, along with stack parameters (i.e., heights, inside diameters, gas exit temperatures, gas exit velocities) used in the dispersion modeling, are listed in Table 4.5-4 for Neut/Bio, Table 4.5-5 for Neut/SCWO, Table 4.5-6 for Neut/GPCR/TW-SCWO, and Table 4.5-7 for Elchem Ox.

Neutralization/Biotreatment. In a Neut/Bio pilot test facility, air pollutants would be emitted from five different types of stacks. Three would be similar to the first three types of stacks used in the Neut/SCWO facility described in the next paragraph. The fourth stack would be a biotreatment vent (waste gas) instead of a SCWO stack. The fifth stack would be a laboratory filter area stack. (In other systems, the laboratory effluents are combined with other emission streams.) No emissions from the laboratory filter area stack would be anticipated during normal (incident-free) operations.

Neutralization/SCWO. In a Neut/SCWO pilot test facility, air pollutants would be emitted from four types of stacks: (1) three stacks for natural-gas-burning boilers (two operating, one on standby) used to generate process steam and building heat, (2) two stacks for the diesel-powered generators used as a backup system to provide emergency electricity, (3) a filter farm stack for building circulating air and non-SCWO air effluents (e.g., rotary hydrolyzer, MPT), and

TABLE 4.5-4 Emission Rates of Criteria Air Pollutants and Volatile Organic Compounds and Stack Parameters Associated with Normal Operations of the Neutralization/Biotreatment Technology at ANAD

Stack Parameters and Estimated Peak Emission Rates	Steam Boilers	Emergency Diesel Generators
Stack parameters[a]		
Height	70 ft (21.3 m)	47 ft (14.3 m)
Inside diameter	0.79 ft (0.24 m)	0.67 ft (0.20 m)
Gas exit temperature	325°F (436 K)	925°F (769 K)
Gas exit velocity	60 ft/s (18 m/s)	323 ft/s (98 m/s)
Estimated rates[b]		
SO_2	0.009 lb/h (0.02 ton/yr)	3.2 lb/h (0.95 ton/yr)
NO_x	2.1 lb/h (3.50 tons/yr)	48.4 lb/h (14.5 tons/yr)
CO	1.3 lb/h (2.10 tons/yr)	10.4 lb/h (3.12 tons/yr)
PM_{10}	0.11 lb/h (0.19 ton/yr)	3.4 lb/h (1.02 tons/yr)
$PM_{2.5}$[c]	0.11 lb/h (0.19 ton/yr)	3.4 lb/h (1.02 tons/yr)
VOCs	0.08 lb/h (0.14 ton/yr)	4.0 lb/h (1.18 tons/yr)

[a] For the modeling analysis, emissions from the three boilers were assumed to occur from one stack location. Similarly, emissions from the two emergency generators were assumed to occur from one stack location.

[b] Estimated peak emission rates are for the simultaneous operations of three steam boilers and two emergency generators at full load.

[c] $PM_{2.5}$ emissions were conservatively assumed to be 100% of PM_{10} emissions for natural-gas-fired boilers and diesel generators (EPA 2000c).

Source: Kimmell et al. (2001).

(4) a stack for exhaust from the SCWO process. The principal sources of criteria pollutant and VOC emissions would be boilers and emergency generators, while the primary sources of hazardous air pollutant (HAP) emissions would be the filter farm stack and the SCWO stack. (HAPs are discussed in Sections 4.6 and 4.7.)

Neutralization/GPCR/TW-SCWO. In a Neut/GPCR/TW-SCWO pilot test facility, air pollutants would be emitted from four types of stacks, similar to those of the Neut/SCWO facility. The only difference is that a process gas burner stack would replace a SCWO stack. This stack would be used to discharge treated supplementary process fuel gas produced from the GPCR process (which consists of a central reactor for destroying organic waste streams). This stack would emit criteria pollutants, VOCs, and various HAPs. Its criteria pollutants and VOC emissions would amount to much less than those from boilers or diesel generators.

TABLE 4.5-5 Emission Rates of Criteria Air Pollutants and Volatile Organic Compounds and Stack Parameters Associated with Normal Operations of the Neutralization/SCWO Technology at ANAD

Stack Parameters and Estimated Peak Emission Rates	Steam Boilers	Emergency Diesel Generators
Stack parameters[a]		
Height	70 ft (21.3 m)	47 ft (14.3 m)
Inside diameter	0.9 ft (0.27 m)	0.67 ft (0.20 m)
Gas exit temperature	325°F (436 K)	925°F (769 K)
Gas exit velocity	60 ft/s (18 m/s)	323 ft/s (98 m/s)
Estimated rates[b]		
SO_2	0.01 lb/h (0.02 ton/yr)	3.2 lb/h (0.95 ton/yr)
NO_x	2.9 lb/h (4.83 tons/yr)	48.4 lb/h (14.5 tons/yr)
CO	1.8 lb/h (2.90 tons/yr)	10.4 lb/h (3.12 tons/yr)
PM_{10}	0.16 lb/h (0.26 ton/yr)	3.4 lb/h (1.02 tons/yr)
$PM_{2.5}$[c]	0.16 lb/h (0.26 ton/yr)	3.4 lb/h (1.02 tons/yr)
VOCs	0.11 lb/h (0.19 ton/yr)	4.0 lb/h (1.18 tons/yr)

[a] For the modeling analysis, emissions from the three boilers were assumed to occur from one stack location. Similarly, emissions from the two emergency generators were assumed to occur from one stack location.

[b] Estimated peak emission rates are for the simultaneous operations of three steam boilers and two emergency generators at full load.

[c] $PM_{2.5}$ emissions were conservatively assumed to be 100% of PM_{10} emissions for natural-gas-fired boilers and diesel generators (EPA 2000c).

Source: Kimmell et al. (2001).

Electrochemical Oxidation. In an Elchem Ox pilot test facility, air pollutants would be emitted from three types of stacks. The major difference from a Neut/SCWO facility is the absence of a SCWO stack. Thus, the assumption is that all air effluents from all treatment processes would be emitted into the atmosphere via the filter farm stack.

Other Sources. Other sources of air pollution during operations would include vehicle traffic, such as cars, pickup trucks, and buses transporting personnel to and from the facility. Trucks and forklifts would be used to deliver supplies to the facility. Parking lots and access roads to the facility would be paved with asphalt or concrete to minimize fugitive dust emissions. Other potential emissions would include VOCs from the aboveground and underground fuel storage tanks. However, these emissions would be negligible because diesel fuel has a low

TABLE 4.5-6 Emission Rates of Criteria Air Pollutants and Volatile Organic Compounds and Stack Parameters Associated with Normal Operations of the Neutralization/GPCR/TW-SCWO Technology at ANAD

Stack Parameters and Estimated Peak Emission Rates	Steam Boilers	Emergency Diesel Generators	Process Gas Burner
Stack parameters[a]			
Height	70 ft (21.3 m)	47 ft (14.3 m)	80 ft (24.4 m)
Inside diameter	1.0 ft (0.30 m)	0.67 ft (0.20 m)	0.50 ft (0.15 m)
Gas exit temperature	325°F (436 K)	925°F (769 K)	77°F (298 K)
Gas exit velocity	60 ft/s (18 m/s)	323 ft/s (98 m/s)	57 ft/s (17 m/s)
Estimated rates[b]			
SO_2	0.02 lb/h (0.03 ton/yr)	3.2 lb/h (0.95 ton/yr)	0.004 lb/h (0.007 ton/yr)
NO_x	3.7 lb/h (6.14 tons/yr)	48.4 lb/h (14.5 tons/yr)	0.11 lb/h (0.18 ton/yr)
CO	2.2 lb/h (3.69 tons/yr)	10.4 lb/h (3.12 tons/yr)	0.17 lb/h (0.28 ton/yr)
PM_{10}	0.2 lb/h (0.33 ton/yr)	3.4 lb/h (1.02 tons/yr)	0.03 lb/h (0.05 ton/yr)
$PM_{2.5}$[c]	0.2 lb/h (0.33 ton/yr)	3.4 lb/h (1.02 tons/yr)	0.03 lb/h (0.05 ton/yr)
VOCs	0.1 lb/h (0.24 ton/yr)	4.0 lb/h (1.18 tons/yr)	0.05 lb/h (0.08 ton/yr)

[a] For the modeling analysis, emissions from the three boilers were assumed to occur from one stack location. Similarly, emissions from the two emergency generators were assumed to occur from one stack location.

[b] Estimated peak emission rates are for the simultaneous operations of three steam boilers and two emergency generators at full load.

[c] $PM_{2.5}$ emissions were conservatively assumed to be 100% of PM_{10} emissions for natural-gas-fired boilers, diesel generators, and a process gas burner (EPA 2000c).

Source: Kimmell et al. (2001).

volatility and because facility operation would consume a low level of fuel and thus require infrequent refilling.

4.5.3 Impacts of the Proposed Action

Potential impacts of air pollutant emissions during pilot facility construction and operation were evaluated by estimating maximum ground-level concentration increments of criteria air pollutants resulting from construction and operations, adding these estimates to background concentrations, and comparing the results with applicable ambient air quality standards. As indicated in Table 4.5-3, the Alabama SAAQS for criteria air pollutants are identical to the NAAQS (ADEM 1999).

TABLE 4.5-7 Emission Rates of Criteria Air Pollutants and Volatile Organic Compounds and Stack Parameters Associated with Normal Operations of the Electrochemical Oxidation Technology at ANAD

Stack Parameters and Estimated Peak Emission Rates	Steam Boilers	Emergency Diesel Generators
Stack parameters[a]		
Height	70 ft (21.3 m)	47 ft (14.3 m)
Inside diameter	0.8 ft (0.24 m)	0.67 ft (0.20 m)
Gas exit temperature	325°F (436 K)	925°F (769 K)
Gas exit velocity	60 ft/s (18 m/s)	323 ft/s (98 m/s)
Estimated rates[b]		
SO_2	0.01 lb/h (0.02 ton/yr)	3.2 lb/h (0.95 ton/yr)
NO_x	2.2 lb/h (3.71 tons/yr)	48.4 lb/h (14.5 tons/yr)
CO	1.3 lb/h (2.23 tons/yr)	10.4 lb/h (3.12 tons/yr)
PM_{10}	0.12 lb/h (0.2 ton/yr)	3.4 lb/h (1.02 tons/yr)
$PM_{2.5}$[c]	0.12 lb/h (0.2 ton/yr)	3.4 lb/h (1.02 tons/yr)
VOCs	0.09 lb/h (0.15 ton/yr)	4.0 lb/h (1.18 tons/yr)

[a] For the modeling analysis, emissions from the three boilers were assumed to occur from one stack location. Similarly, emissions from the two emergency generators were assumed to occur from one stack location.

[b] Estimated peak emission rates are for the simultaneous operations of three steam boilers and two emergency generators at full load.

[c] $PM_{2.5}$ emissions were conservatively assumed to be 100% of PM_{10} emissions for natural-gas-fired boilers and diesel generators (EPA 2000c).

Source: Kimmell et al. (2001).

To evaluate air quality impacts from ANAD operations with respect to PSD requirements, estimated maximum increments in ground-level concentrations that would result from the operation of the proposed facility were compared with allowable PSD increments above the baseline. Applicable PSD increments are also summarized in Table 4.5-3.

The air quality model, model input data (meteorological data, source and receptor locations, elevation data), and other assumptions used in estimating potential construction and operational impacts on ambient air quality at the ANAD boundaries and surrounding areas are described in Appendix B.

4.5.3.1 Impacts of Construction

The modeling results for both PM_{10} and $PM_{2.5}$ concentration increments that would result from construction-related fugitive emissions are summarized in Table 4.5-8. At the installation boundaries, for both PM_{10} and $PM_{2.5}$, the maximum 24-hour and annual average concentration increments above background would occur about 1.0 mi (1.6 km) and 0.9 mi (1.5 km) north-northwest of the proposed facility, respectively. At these locations, for PM_{10}, the maximum 24-hour and annual concentration increments above background would be about 14 and 1.7% of the NAAQS, respectively. For $PM_{2.5}$, the maximum 24-hour and annual concentration increments above background would be about 16% and 2.8% of the NAAQS, respectively.

To obtain the overall concentrations for comparison with applicable NAAQS, the maximum PM_{10} and $PM_{2.5}$ concentration increments (Table 4.5-8) were added to background values (from Table 4.5-3). For PM_{10}, the maximum estimated 24-hour and annual average concentrations would be about 59 and 54% of the NAAQS, respectively. For $PM_{2.5}$, the maximum estimated 24-hour and annual average $PM_{2.5}$ concentrations would be about 87% and 99% of the NAAQS, respectively. Maximum predicted concentrations would occur at the northern ANAD boundaries adjoining the Pelham Range. Accordingly, concentration levels at the publicly accessible site boundaries (e.g., eastern boundaries) would be much lower. The annual average $PM_{2.5}$ background concentration of 14.4 $\mu g/m^3$ around the ANAD area is already close to the standard of 15 $\mu g/m^3$. Accordingly, construction activities should be conducted so as to minimize further impacts on ambient air quality.

In summary, the maximum estimated 24-hour and annual concentration increments of PM_{10} and $PM_{2.5}$ that would result from construction-related fugitive emissions would be relatively small fractions of the applicable NAAQS. The total (maximum increments plus background) estimated 24-hour and annual concentrations of PM_{10} would be equal to or less than 59% of the applicable NAAQS. The total estimated 24-hour and annual concentrations of $PM_{2.5}$ would be below but close to their applicable NAAQS, primarily because of high background concentration levels.

4.5.3.2 Impacts of Operations

In the air quality analysis for the operational period, air quality impacts were modeled for each of the four ACWA technologies. The results are presented in tabular format for each case. The modeling results for concentration increments of SO_2, NO_2, CO, PM_{10}, and $PM_{2.5}$ due to emissions from the proposed facility operations are summarized in Tables 4.5-9 through 4.5-12 for the four technologies. The receptor locations where maximum concentration increments would occur are also listed in these tables.

TABLE 4.5-8 Maximum Predicted Off-Post Concentration Increments and Total Concentrations of PM_{10} and $PM_{2.5}$ during Construction at ANAD

		Concentration (µg/m³)				
Pollutant	Averaging Time	Maximum Increment[a,b]	Background[c]	Total[d]	NAAQS	Percent of NAAQS[e]
PM_{10}	24 hours	20.3	68	88.3	150	59 (14)
	Annual	0.84	26.4	27.2	50	54 (1.7)
$PM_{2.5}$	24 hours	10.1	46.2	56.3	65	87 (16)
	Annual	0.42	14.4	14.8	15	99 (2.8)

[a] The maximum concentration increments were estimated by using the Industrial Source Complex (ISCST3) model (Version 00101; EPA 1995).

[b] Maximum modeled 24-hour and annual average concentrations occur at receptors about 1.0 mi (1.6 km) and 0.9 mi (1.5 km) to the north-northwest of the proposed facility, respectively.

[c] See Table 4.5-3.

[d] Total equals maximum modeled concentration plus background concentration.

[e] The values are total concentration as a percent of NAAQS. The values in parentheses are maximum concentration increments as a percent of NAAQS.

The estimated maximum concentration increments due to operation of the proposed facility would contribute less than 9% of applicable NAAQS for all pollutants (Tables 4.5-9 through 4.5-12). Irrespective of the ACWA technology chosen, concentration increments would be almost the same. In most cases, maximum predicted concentrations would occur at the northern ANAD boundaries adjoining Pelham Range. Accordingly, potential impacts from the proposed facility operations at publicly accessible ANAD boundaries or nearby communities would be much lower.

The maximum 3-hour, 24-hour, and annual SO_2 concentration increments predicted to result from the proposed facility operations (Tables 4.5-9 through 4.5-12) would be less than 5% of the applicable PSD increments (Table 4.5-3). The maximum predicted increments in annual average NO_2 concentrations due to the proposed facility operations would be about 3% of the applicable PSD increments. The 24-hour and annual PM_{10} concentration increases predicted to result from the proposed operations would be less than about 18% of the applicable PSD increments. The predicted concentration increment at a receptor located 30 mi (50 km) away from the proposed facility (the maximum distance the Industrial Source Complex ISCST3 model

TABLE 4.5-9 Maximum Predicted Off-Post Concentration Increments and Total Concentrations of Criteria Pollutants during Normal Operations of the Neutralization/Biotreatment Technology at ANAD

		Concentration ($\mu g/m^3$)					Receptor Location[e]	
Pollutant	Averaging Time	Maximum Increment[a]	Background[b]	Total[c]	NAAQS	Percent of NAAQS[d]	Distance [mi (km)]	Direction
SO_2	3 hours	13.5	346	360	1,300	28 (1.0)	1.4 (2.3)	NW
	24 hours	4.9	149	154	365	42 (1.3)	1.4 (2.3)	NW
	Annual	0.03	32	32	80	40 (0.04)	1.4 (2.3)	NW
NO_2	Annual	0.66	21	22	100	22 (0.7)	1.4 (2.3)	NW
CO	1 hour	63	14,171	14,234	40,000	36 (0.16)	1.4 (2.2)	ESE
	8 hours	31	8,000	8,031	10,000	80 (0.31)	1.4 (2.3)	NW
PM_{10}	24 hours	5.5	68	74	150	49 (3.7)	1.4 (2.3)	NW
	Annual	0.04	26.4	26.4	50	53 (0.1)	1.4 (2.3)	NW
$PM_{2.5}$	24 hours	5.5	46.2	51.7	65	80 (8.5)	1.4 (2.3)	NW
	Annual	0.04	14.4	14.4	15	96 (0.3)	1.4 (2.3)	NW

[a] Maximum concentration increments were estimated by using the ISCST3 model (Version 00101; EPA 1995).

[b] See Table 4.5-3.

[c] Total equals maximum concentration increment plus background concentration.

[d] The values are total concentration as percent of NAAQS. The values in parentheses are maximum concentration increments as a percentage of NAAQS.

[e] Receptor locations (distance and directions) of maximum concentrations are from the approximate center of the Neut/Bio facility.

could reliably estimate concentrations) in the direction of the nearest Class I PSD area (the Sipsey Wilderness Area) would be less than 1.6% of the applicable PSD increments. Concentration increments at the Sipsey Wilderness Area, which is located about 91 mi (146 km) northwest of ANAD, would be much lower.

Concentration increments for the two remaining criteria pollutants, lead and ozone, were not modeled. As a direct result of the phase-out of leaded gasoline in automobiles, average lead concentrations in urban areas throughout the country have decreased dramatically. It is expected that emissions of lead from the proposed facility operations would be negligible and therefore would have no adverse impacts on lead concentrations in surrounding areas. Contributions to the production of ozone, a secondary pollutant formed from complex photochemical reactions involving ozone precursors including NO_x and VOCs, cannot be accurately quantified. As discussed in Section 4.5.1, Calhoun County, including ANAD, is currently in attainment for ozone (40 CFR 81.301). Ozone precursor emissions from the proposed facility operations would

TABLE 4.5-10 Maximum Predicted Off-Post Concentration Increments and Total Concentrations of Criteria Pollutants during Normal Operations of the Neutralization/SCWO Technology at ANAD

		Concentration (µg/m³)					Receptor Location[e]	
Pollutant	Averaging Time	Maximum Increment[a]	Background[b]	Total[c]	NAAQS	Percent of NAAQS[d]	Distance [mi (km)]	Direction
SO_2	3 hours	13.4	346	359	1,300	28 (1.0)	1.4 (2.3)	NW
	24 hours	4.8	149	154	365	42 (1.3)	1.4 (2.3)	NW
	Annual	0.03	32	32	80	40 (0.04)	1.4 (2.3)	NW
NO_2	Annual	0.69	21	22	100	22 (0.7)	1.4 (2.3)	NW
CO	1 hour	69	14,171	14,240	40,000	36 (0.2)	1.2 (2.0)	E
	8 hours	32	8,000	8,032	10,000	80 (0.3)	1.4 (2.3)	NW
PM_{10}	24 hours	5.4	68	73	150	49 (3.6)	1.4 (2.3)	NW
	Annual	0.05	26.4	26.5	50	53 (0.1)	1.4 (2.3)	NW
$PM_{2.5}$	24 hours	5.4	46.2	51.6	65	79 (8.3)	1.4 (2.3)	NW
	Annual	0.05	14.4	14.5	15	96 (0.3)	1.4 (2.3)	NW

[a] Maximum concentration increments were estimated by using the ISCST3 model (Version 00101; EPA 1995).

[b] See Table 4.5-3.

[c] Total equals maximum concentration increment plus background concentration.

[d] The values are total concentration as a percentage of NAAQS. The values in parentheses are maximum concentration increments as percent of NAAQS.

[e] Receptor locations (distance and directions) of maximum concentrations are from the approximate center of the Neut/SCWO facility.

be small, making up about 0.2 and 0.01% of the 1996 actual emissions of NO_x and VOCs, respectively, from Calhoun County. As a consequence, the cumulative impacts of potential releases from ANAD facility operations on regional ozone concentrations would not be of any concern.

The total concentrations of criteria pollutants obtained by adding the predicted maximum concentration increments to background values (from Table 4.5-3) are compared with applicable NAAQS (Tables 4.5-9 through 4.5-12). Except for 8-hour CO and $PM_{2.5}$, maximum estimated concentrations of criteria pollutants are less than or equal to 53% of the NAAQS. Total 8-hour CO and $PM_{2.5}$ concentrations would be close to, but still below their applicable standards, primarily due to high background levels.

TABLE 4.5-11 Maximum Predicted Off-Post Concentration Increments and Total Concentrations of Criteria Pollutants during Normal Operations of the Neutralization/GPCR/TW-SCWO Technology at ANAD

		Concentration ($\mu g/m^3$)					Receptor Location[e]	
Pollutant	Averaging Time	Maximum Increment[a]	Background[b]	Total[c]	NAAQS	Percent of NAAQS[d]	Distance [mi (km)]	Direction
SO_2	3 hours	13.5	346	360	1,300	28 (1.0)	1.4 (2.3)	NW
	24 hours	4.8	149	154	365	42 (1.3)	1.4 (2.3)	NW
	Annual	0.04	32	32	80	40 (0.05)	1.4 (2.3)	NW
NO_2	Annual	0.78	21	22	100	22 (0.8)	1.0 (1.6)	NNW
CO	1 hour	75	14,171	14,246	40,000	36 (0.2)	1.2 (2.0)	E
	8 hours	35	8,000	8,035	10,000	80 (0.4)	1.4 (2.3)	NW
PM_{10}	24 hours	5.5	68	74	150	49 (3.7)	1.4 (2.3)	NW
	Annual	0.05	26.4	26.5	50	53 (0.1)	1.0 (1.6)	NNW
$PM_{2.5}$	24 hours	5.5	46.2	51.7	65	80 (8.5)	1.4 (2.3)	NW
	Annual	0.05	14.4	14.5	15	96 (0.3)	1.0 (1.6)	NNW

[a] Maximum concentration increments were estimated by using the ISCST3 model (Version 00101; EPA 1995).

[b] See Table 4.5-3.

[c] Total equals maximum concentration increment plus background concentration.

[d] The values are total concentration as a percentage of NAAQS. The values in parentheses are maximum concentration increments as percent of NAAQS.

[e] Receptor locations (distance and directions) of maximum concentrations are from the approximate center of the Neut/GPCR/TW-SCWO facility.

4.5.3.3 Impacts of Fluctuating Operations

To assess potential impacts that could result from possible fluctuations in operations that could occur during pilot testing, it was assumed that levels of organic compound emissions would be 10 times higher than the estimated annual average for 5% of the time and that levels of inorganic compound emissions would be 10 times higher than the estimated annual average for 20% of the time. These assumptions were based on EPA guidance (EPA 1994, as cited in National Research Council 1997a).

Over long time periods, such conditions would be assumed to increase organic emissions to 145% of their normal values and metal emissions to 280% of their normal values (EPA 1994, as cited in National Research Council 1997a). VOCs contribute to the formation of ozone, a criteria pollutant; multiplying VOCs emissions from the proposed facility by 1.45 would result in about 2 tons per year, or less than 0.02% of the 1996 VOCs emissions in Calhoun County

TABLE 4.5-12 Maximum Predicted Off-Post Concentration Increments and Total Concentrations of Criteria Pollutants during Normal Operations of the Electrochemical Oxidation Technology at ANAD

		Concentration ($\mu g/m^3$)					Receptor Location[e]	
Pollutant	Averaging Time	Maximum Increment[a]	Background[b]	Total[c]	NAAQS	Percent of NAAQS[d]	Distance [mi (km)]	Direction
SO_2	3 hours	13.5	346	360	1,300	28 (1.0)	1.4 (2.3)	NW
	24 hours	4.9	149	154	365	42 (1.3)	1.4 (2.3)	NW
	Annual	0.03	32	32	80	40 (0.04)	1.4 (2.3)	NW
NO_2	Annual	0.66	21	22	100	22 (0.7)	1.4 (2.3)	NW
CO	1 hour	63	14,171	14,234	40,000	36 (0.2)	1.4 (2.2)	ESE
	8 hours	31	8,000	8,031	10,000	80 (0.3)	1.4 (2.3)	NW
PM_{10}	24 hours	5.5	68	74	150	49 (3.7)	1.4 (2.3)	NW
	Annual	0.04	26.4	26.4	50	53 (0.1)	1.4 (2.3)	NW
$PM_{2.5}$	24 hours	5.5	46.2	51.7	65	80 (8.5)	1.4 (2.3)	NW
	Annual	0.04	14.4	14.4	15	96 (0.3)	1.4 (2.3)	NW

[a] Maximum concentration increments were estimated by using the ISCST3 model (Version 00101; EPA 1995).

[b] See Table 4.5-3.

[c] Total equals maximum concentration increment plus background concentration.

[d] The values are total concentration as a percentage of NAAQS. The values in parentheses are maximum concentration increments as percent of NAAQS.

[e] Receptor locations (distance and directions) of maximum concentrations are from the approximate center of the Elchem Ox facility.

(Table 4.5-2). Therefore, the potential increase in ozone concentration that could result from VOC emissions from proposed facility operations under fluctuating conditions would be almost the same as that under normal operating conditions. Lead (Pb) is the only metal among criteria pollutants. Emissions of lead from the proposed facility are currently too small to quantify; therefore, increasing these emissions by 280% of their normal value would probably not cause any appreciable increase in atmospheric lead concentrations. Therefore, when fluctuating operations are considered, the potential impacts of criteria pollutants involved would still be expected to be insignificant.

4.5.4 Impacts of No Action

The principal sources of air pollutant emissions associated with stockpile maintenance activities are exhaust emissions and road dust generated by vehicles. These emissions contribute to the background air quality at the installation. Emissions of air pollutants from these sources are minor both in absolute terms and in comparison with emissions from other natural and anthropogenic sources on and off ANAD. Therefore, impacts on air quality that would occur as a result of the continued storage of the stockpile are expected to be minimal.

4.6 AIR QUALITY — TOXIC AIR POLLUTANTS

4.6.1 Current Emissions and Air Quality

Under its Title V *Clean Air Act* (CAA) permit application, ANAD is classified as a major source emitter for VOCs, methylene chloride, methyl ethyl ketone, toluene, xylene, and trichloroethylene (ANAD 1997). Any new equipment installed that could release substances classified as HAPs, as defined in Section 112, Title III, of the CAA, must demonstrate compliance with EPA National Emission Standards for Hazardous Air Pollutants (NESHAP) prior to issuance of a permit to operate.

Permitted sources of emissions at ANAD in 1999 included open burning and open detonation, paint booths, degreaser units, boilers, and fuel storage and dispensing (Larkins 2000a). A summary of the compounds and quantities released is given in Table 4.6-1. Methyl ethyl ketone, methylene chloride, and trichloroethylene from paint booths and degreasing were the compounds released in the highest quantities. (The organic HAP emissions are also included in reported VOC emissions addressed in Section 4.5 and tabulated in Table 4.5-1).

4.6.2 ACWA Facility Emissions

A summary of the estimated emissions of toxic air pollutants[6] that would result from operation of an ACWA pilot facility at ANAD is given in Kimmell et al. (2001). Estimated emissions (including those from diesel generators and boilers) from a Neut/Bio, a Neut/SCWO, a Neut/GPCR/TW-SCWO, and an Elchem Ox facility are provided in Tables 4.6-2 through 4.6-5. For the destruction facility stacks (SCWO vent, biotreatment vent, product gas burner vent, catalytic oxidation unit [CatOx]/filter farm stack vent), emission estimates were based on demonstration test data and site-specific munitions inventories compiled by Mitretek Corp. (2001a–d). Estimates of emissions from diesel generators and boilers were based on standard algorithms that used fuel consumption estimates as input (Kimmell et al. 2001). For many

---

[6] Many of the toxic air pollutants that would be emitted are HAPs as defined in Section 112, Title III, of the CAA. The term “toxic air pollutants” is broader in that it includes some pollutants that are not HAPs.

TABLE 4.6-1 Emissions from ANAD in 1999

Substance	Quantity (lb)	Source[a]
Antimony compounds	40	Paint booths
Benzene	200	OB/OD, fuel storage and dispensing
Chromium	700	OB/OD, degreasing, paint booths
Dibenzofurans	20	OB/OD
Ethyl benzene	560	OB/OD, paint booths, fuel storage and dispensing
Hexamethylene-1,6-diisocyanate	260	Paint booths
Hexane	160	OB/OD, fuel storage and dispensing
Hydrogen cyanide	1,380	OB/OD
Methyl ethyl ketone	33,940	Paint booths
Methyl isobutyl ketone	1,300	Paint booths
Methylene chloride	106,940	Degreasing, paint booths
Nickel compounds	120	Degreasing
Styrene	480	OB/OD
Toluene	12,500	OB/OD, paint booths, fuel storage and dispensing
Trichloroethylene	20,880	Degreasing
Xylenes (isomers and mixtures)	6,060	OB/OD, paint booths, fuel storage and dispensing
Total	185,540	

[a] OB/OD = open burning and open detonation.

Source: Larkins (2000a).

substances (e.g., acetaldehyde, formaldehyde), the estimated emissions from boilers and diesel generators would exceed the after-treatment emissions from destruction facility processes by many orders of magnitude (Tables 4.6-2 through 4.6-5).

The estimates of air emissions from operating the pilot facilities were based on the assumption that organic substances from the filter farm stacks and the SCWO vent would be filtered from stack emissions by a series of six carbon filters, each having a removal efficiency of 95%. For particulate matter (e.g., dioxins and furans on PM and metals), it was assumed that two high-efficiency particulate air (HEPA) filters, each with a removal efficiency of 99.97%, would be used for treatment. For the Neut/Bio facility (Table 4.6-2), it is not known whether the emissions from the biotreatment vent would require further treatment. The provider of the equipment used during the ACWA technology demonstrations has stated that further treatment would not be necessary. In this assessment, both treatment and no treatment of biotreatment vent stack emissions are assessed. For the Neut/GPCR/TW-SCWO facility (Table 4.6-4), it was assumed that emissions from the product gas burner vent would not be further treated after release from the facility’s scrubber system.

TABLE 4.6-2 Estimated Toxic Air Pollutant Emissions from Neutralization/Biotreatment Technology at ANAD

	Emissions (μg/s)[b]				
Compound[a]	Diesel Generator	Boiler	Biotreatment Vent, Treated[c]	Biotreatment Vent, Untreated[c]	Filter Farm Stack[d]
1,1,1-Trichloroethane	-	-	-	-	2.1×10^{-10}
1,2,3,4,6,7,8,9-OCDD	-	-	4.1×10^{-10}	4.7×10^{-3}	4.2×10^{-13}
1,2,3,4,6,7,8,9-OCDF	-	-	8.8×10^{-11}	1.1×10^{-3}	1.1×10^{-12}
1,2,3,4,6,7,8-HpCDD	-	-	8.8×10^{-11}	1.1×10^{-3}	8.4×10^{-13}
1,2,3,4,6,7,8-HpCDF	-	-	9.7×10^{-11}	1.1×10^{-3}	8.4×10^{-13}
1,2,3,4,7,8,9-HpCDF	-	-	2.5×10^{-11}	2.6×10^{-4}	9.5×10^{-14}
1,2,3,4,7,8-HxCDD	-	-	4.2×10^{-12}	4.7×10^{-5}	9.5×10^{-14}
1,2,3,4,7,8-HxCDF	-	-	2.9×10^{-11}	3.2×10^{-4}	8.4×10^{-13}
1,2,3,6,7,8-HxCDD	-	-	8.4×10^{-12}	1.1×10^{-4}	3.2×10^{-13}
1,2,3,6,7,8-HxCDF	-	-	1.3×10^{-11}	1.6×10^{-4}	4.2×10^{-13}
1,2,3,7,8,9-HxCDD	-	-	1.7×10^{-11}	2.1×10^{-4}	3.2×10^{-13}
1,2,3,7,8,9-HxCDF	-	-	-	-	4.2×10^{-14}
1,2,3,7,8-PeCDD	-	-	4.7×10^{-13}	5.3×10^{-6}	9.5×10^{-14}
1,2,3,7,8-PeCDF	-	-	1.3×10^{-11}	1.6×10^{-4}	2.1×10^{-13}
1,2-Dichloroethane*	-	-	1.5×10^{-7}	1.1×10^{1}	2.1×10^{-5}
1,2-Dichloropropane*	-	-	-	-	4.2×10^{-10}
1,3-Butadiene*	1.1	-	-	-	-
1,4-Dichlorobenzene*	-	-	-	-	4.2×10^{-9}
2,3,4,6,7,8-HxCDF	-	-	1.3×10^{-11}	1.6×10^{-4}	4.2×10^{-13}
2,3,4,7,8-PeCDF	-	-	2.1×10^{-11}	2.1×10^{-4}	5.3×10^{-13}
2,3,7,8-TCDD*	-	-	6.5×10^{-13}	5.3×10^{-6}	-
2,3,7,8-TCDF	-	-	2.1×10^{-11}	2.1×10^{-4}	2.1×10^{-12}
2-Methylnaphthalene	-	4.5×10^{-2}	-	-	-
3/4-Methy phenol*	-	-	-	-	2.1×10^{-9}
3-Methylchloranthrene	-	3.4×10^{-3}	-	-	-
Acenaphthene	3.9×10^{-2}	3.4×10^{-3}	-	-	-
Acenaphthylene	1.4×10^{-1}	3.4×10^{-3}	-	-	-
Acetaldehyde*	2.1×10^{1}	-	4.2×10^{-7}	2.6×10^{1}	-
Acrolein*	2.6	-	-	-	-
Aldehydes	1.9×10^{3}	-	-	-	-
Anthracene	5.2×10^{-2}	4.5×10^{-3}	-	-	-
Arsenic*	-	3.8×10^{-1}	-	-	-
Barium	-	8.3	-	-	-
Benz(a)anthracene	2.6×10^{1}	3.4×10^{-3}	-	-	-
Benzene*	4.7×10^{-2}	4.0	-	-	1.1×10^{-8}
Benzo(a)pyrene	5.2×10^{-3}	2.3×10^{-3}	-	-	-
Benzo(b)fluoranthene	2.7×10^{-3}	3.4×10^{-3}	-	-	-
Benzo(g,h,i)perylene	1.4×10^{-2}	2.3×10^{-3}	-	-	-
Benzo(k)fluoranthene	4.3×10^{-3}	3.4×10^{-3}	-	-	-
Beryllium*	-	2.3×10^{-2}	-	-	-
Bis (2-chloroethyl) ether*	-	-	1.1×10^{-7}	5.3×10^{1}	-
Bis (2-ethylhexyl) phthalate*	-	-	1.6×10^{-7}	1.1×10^{1}	1.1×10^{-8}

TABLE 4.6-2 (Cont.)

	Emissions (µg/s)[b]				
Compound[a]	Diesel Generator	Boiler	Biotreatment Vent, Treated[c]	Biotreatment Vent, Untreated[c]	Filter Farm Stack[d]
Bromomethane*	-	-	4.3×10^{-7}	2.6×10^{1}	3.2×10^{-7}
Butane	-	4.0×10^{3}	-	-	-
Cadmium*	-	2.1	-	-	-
Carbon disulfide*	-	-	-	-	3.2×10^{-7}
Carbon tetrachloride*	-	-	-	-	4.2×10^{-9}
Chlorobenzene*	-	-	-	-	4.2×10^{-7}
Chloroethane*	-	-	-	-	5.3×10^{-9}
Chloroform*	-	-	-	-	7.4×10^{-7}
Chloromethane*	-	-	3.9×10^{-7}	2.6×10^{1}	4.2×10^{-6}
Chromium*	-	2.6	-	-	2.1×10^{-7}
Chrysene	9.8×10^{-3}	3.4×10^{-3}	-	-	-
Cobalt*	-	1.6×10^{-1}	-	-	2.1×10^{-7}
Copper	-	1.6	-	-	-
Dibenzo(a,h)anthracene	1.6×10^{-2}	2.3×10^{-3}	-	-	-
Dibenzofuran*	-	-	-	-	4.2×10^{-9}
Dichlorobenzene*	-	2.3	-	-	-
Diethylphthalate	-	-	1.7×10^{-7}	1.1×10^{1}	-
Dimethylbenz(a)anthracene	-	3.0×10^{-2}	-	-	-
Dimethylphthalate*	-	-	-	-	2.1×10^{-8}
Ethane	-	5.9×10^{3}	-	-	
Ethyl benzene*	-	-	1.3×10^{-6}	1.1×10^{2}	1.1×10^{-9}
Fluoranthene	2.1×10^{-1}	5.7×10^{-3}	-	-	-
Fluorene	8.1×10^{-1}	5.3×10^{-3}	-	-	-
Formaldehyde*	3.3×10^{1}	1.4×10^{2}	3.5×10^{-6}	2.1×10^{2}	-
Glycol ethers (2-butoxy ethanol)	-	-	1.1×10^{-6}	5.3×10^{1}	-
H (mustard)[e]	-	-	-	-	2.8×10^{2}
Hexane(n)*	-	3.4×10^{3}	-	-	-
Indeno(1,2,3-cd)pyrene	1.0×10^{-2}	3.4×10^{-3}	-	-	-
Lead*	-	9.5×10^{-1}	-	-	1.1×10^{-8}
m,p-Xylene*	7.9	-	1.1×10^{-5}	5.3×10^{2}	5.3×10^{-8}
Manganese*	-	7.2×10^{-1}	-	-	8.4×10^{-8}
Mercury*	8.3×10^{-3}	4.9×10^{-1}	4.7×10^{-5}	5.3	2.1×10^{-8}
Methyl ethyl ketone*	-	-	-	-	2.1×10^{-5}
Methyl ethyl ketone/butyraldehydes*	-	-	1.3×10^{-7}	1.1×10^{1}	-
Methylene chloride*	-	-	3.4×10^{-6}	2.1×10^{2}	3.2×10^{-8}
Molybdenum	-	2.1	-	-	-
Naphthalene*	2.3	1.2	1.0×10^{-7}	5.3	6.3×10^{-8}
Nickel*	-	4.0	-	-	2.1×10^{-7}
OCDD	-	-	7.9×10^{-11}	1.1×10^{-3}	-
OCDF	-	-	3.2×10^{-11}	3.7×10^{-4}	-
o-Xylene*	-	-	-	-	3.2×10^{-9}
Particulates	-	-	-	-	6.3×10^{-4}

TABLE 4.6-2 (Cont.)

Compound[a]	Emissions (µg/s)[b]				
	Diesel Generator	Boiler	Biotreatment Vent, Treated[c]	Biotreatment Vent, Untreated[c]	Filter Farm Stack[d]
Pentane(n)	-	4.9×10^{3}	-	-	-
Phenanthrene	8.1×10^{-1}	3.2×10^{-2}	-	-	-
Phenol*	-	-	4.7×10^{-8}	3.2	7.4×10^{-9}
Phosphorus*	-	-	-	-	2.1×10^{-8}
PAHs*	4.7	-	-	-	-
POM (fluorene)	-	-	-	-	4.2×10^{-8}
Propanal (propionaldehyde)*	-	-	1.7×10^{-7}	1.1×10^{1}	-
Propane	-	3.0×10^{3}	-	-	-
Propylene	7.1×10^{1}	-	-	-	-
Pyrene	1.3×10^{-1}	9.5×10^{-3}	-	-	-
Selenium*	-	4.5×10^{-2}	-	-	2.1×10^{-9}
Styrene*	-	-	-	-	1.1×10^{-12}
Tetrachloroethene*	-	-	-	-	3.2×10^{-10}
Toluene*	1.1×10^{1}	6.4	2.3×10^{-7}	1.6×10^{1}	6.3×10^{-8}
Total HpCDD	-	-	1.6×10^{-10}	1.6×10^{-3}	2.1×10^{-12}
Total HpCDF	-	-	1.6×10^{-10}	1.6×10^{-3}	1.1×10^{-12}
Total HxCDD	-	-	1.0×10^{-10}	1.1×10^{-3}	3.2×10^{-12}
Total HxCDF	-	-	1.6×10^{-10}	1.1×10^{-3}	3.2×10^{-12}
Total PeCDD	-	-	-	-	3.2×10^{-12}
Total PeCDF	-	-	1.4×10^{-10}	1.6×10^{-3}	6.3×10^{-12}
Total TCDD*	-	-	3.6×10^{-12}	4.2×10^{-5}	2.1×10^{-12}
Total TCDF	-	-	6.5×10^{-11}	5.3×10^{-4}	2.1×10^{-8}
Vanadium	-	4.4	-	-	-

[a] Substances designated with an asterisk (*) are listed as HAPs under Title III, Section 112 of the CAA. PAHs = polycyclic aromatic hydrocarbons. POM = polycyclic organic matter. Polychlorinated dioxins/ furans are as follows: HpCDD = heptachlorodibenzo-p-dioxin, HpCDF = heptachlorodibenzo-p-furan, HxCDD = hexachlorodibenzo-p-dioxin; HxCDF = hexachlorodibenzo-p-furan, OCDD = octachlorodibenzo-p-dioxin, OCDF = octachlorodibenzo-p-furan, PeCDD = pentachlorodibenzo-p-dioxin; PeCDF = pentachlorodibenzo-p-furan; TCDD = tetrachlorodibenzo-p-dioxin; TCDF = tetrachlorodibenzo-p-furan.

[b] A hyphen indicates that the compound was not detected from this source during demonstration testing.

[c] The untreated values assume direct release to the stack after processing through the catalytic oxidation unit (CatOx). The treated values for organics assume that after passing through the CatOx, emissions are passed through six carbon filters in series, each at 95% efficiency. It is assumed that PM passes through two HEPA filters in series, each at 99.97% efficiency.

[d] Filter farm stack emissions are assumed to be treated by using carbon filters to capture organics and by using HEPA filters to capture PM, as in footnote c above.

[e] The after-treatment emission rate from the filter farm stack for mustard agent is a worst-case estimate; it assumes emissions at the detection limit of 0.006 µg/m^3 (Kimmell et al. 2001). It is assumed that no mustard would be emitted from the biotreatment vent; none would be present after neutralization and treatment in the immobilized cell bioreactor (ICB).

TABLE 4.6-3 Estimated Toxic Air Pollutant Emissions from Neutralization/SCWO Technology at ANAD

	Emissions (μg/s)[b]					
			Mustard Agent Processing[c]		Nerve Agent Processing[c]	
Compound[a]	Diesel Generator	Boiler	SCWO Vent	Filter Farm Stack	SCWO Vent	Filter Farm Stack
	-	-	-	-	-	-
1,3-Butadiene*	1.1	-	-	-	-	-
2-Methylnaphthalene	-	6.3×10^{-2}	-	-	-	-
3-Methylchloranthrene	-	4.7×10^{-3}	-	-	-	-
Acenaphthene	3.9×10^{-2}	4.7×10^{-3}	-	-	-	-
Acenaphthylene	1.4×10^{-1}	4.7×10^{-3}	-	-	-	-
Acetaldehyde*	2.1×10^{1}	-	1.2×10^{-7}	-	6.1×10^{-8}	-
Acrolein*	2.6	-	-	-	-	-
Aldehydes	1.9×10^{3}	-	-	-	-	-
Anthracene	5.2×10^{-2}	6.3×10^{-3}	-	-	-	-
Antimony*	-	-	1.9×10^{-7}	-	1.6×10^{-8}	-
Arsenic*	-	5.3×10^{-1}	5.4×10^{-8}	-	2.2×10^{-9}	-
Barium	-	1.2×10^{1}	-	-	-	-
Benz(a)anthracene	2.6×10^{1}	4.7×10^{-3}	-	-	-	-
Benzene*	4.7×10^{-2}	5.5	-	-	-	-
Benzo(a)pyrene	5.2×10^{-3}	3.2×10^{-3}	-	-	-	-
Benzo(b)fluoranthene	2.7×10^{-3}	4.7×10^{-3}	-	-	-	-
Benzo(g,h,i)perylene	1.4×10^{-2}	3.2×10^{-3}	-	-	-	-
Benzo(k)fluoranthene	4.3×10^{-3}	4.7×10^{-3}	-	-	-	-
Beryllium*	-	3.2×10^{-2}	1.2×10^{-8}	-	4.5×10^{-10}	-
Butane	-	5.5×10^{3}	-	-	-	-
Cadmium*	-	2.9	1.2×10^{-8}	-	8.0×10^{-9}	-
Chromium*	-	3.7	3.6×10^{-7}	-	8.0×10^{-8}	-
Chrysene	9.8×10^{-3}	4.7×10^{-3}	-	-	-	-
Cobalt*	-	2.2×10^{-1}	9.5×10^{-8}	-	9.5×10^{-9}	-
Copper	-	2.2	-	-	-	-
Dibenzo(a,h)anthracene	1.6×10^{-2}	3.2×10^{-3}	-	-	-	-
Dichlorobenzene*	-	3.2	-	-	-	-
Dimethylbenz(a)anthracene	-	4.2×10^{-2}	-	-	-	-
Ethane	-	8.1×10^{3}	-	-	-	-
Ethyl benzene*	-	-	1.4×10^{-6}	-	1.4×10^{-7}	-
Fluoranthene	2.1×10^{-1}	7.9×10^{-3}	-	-	-	-
Fluorene	8.1×10^{-1}	7.4×10^{-3}	-	-	-	-
Formaldehyde*	3.3×10^{1}	2.0×10^{2}	1.5×10^{-7}	-	9.5×10^{-9}	-
GB[d]	-	-	-	-		2.8
H (mustard)[d]	-	-	-	2.8×10^{2}	-	-
Hexane(n)*	-	4.7×10^{3}	-	-	-	-
Indeno(1,2,3-cd)pyrene	1.0×10^{-2}	4.7×10^{-3}	-	-	-	-
Lead*	-	1.3	2.2×10^{-7}	-	7.6×10^{-8}	-

TABLE 4.6-3 (Cont.)

	Emissions (µg/s)[b]					
			Mustard Agent Processing[c]		Nerve Agent Processing[c]	
Compound[a]	Diesel Generator	Boiler	SCWO Vent	Filter Farm Stack	SCWO Vent	Filter Farm Stack
m,p-Xylene*	7.9	-	-	-	-	-
Manganese	-	1.0	3.4×10^{-7}	-	7.0×10^{-8}	-
Mercury*	8.3×10^{-3}	6.8×10^{-1}	-	-	9.1×10^{-9}	-
Methyl ethyl ketone/butyraldehydes*	-	-	3.6×10^{-8}	-	1.9×10^{-9}	-
Molybdenum	-	2.9	-	-	-	-
m-Xylene*	-	-	1.3×10^{-6}	-	1.3×10^{-7}	-
Naphthalene*	2.3	1.6	-	-	7.7×10^{-11}	-
Nickel*	-	5.5	1.3×10^{-6}	-	3.6×10^{-7}	-
Particulates	-	-	5.8×10^{-5}	-	8.6×10^{-6}	-
p-Cresol (4-methylphenol)*	-	-	1.1×10^{-7}	-	1.1×10^{-8}	-
Pentane(n)	-	6.8×10^{3}	-	-		-
Phenanthrene	8.1×10^{-1}	4.5×10^{-2}	-	-		-
Phosphorus*	-	-	1.7×10^{-5}	-	2.7×10^{-6}	-
PCBs[e]	-	-	-	-	1.5×10^{-9}	-
PAHs*	4.7	-	-	-	-	-
Propane	-	4.2×10^{3}	-	-	-	-
Propylene	7.1×10^{1}	-	-	-	-	-
Pyrene	1.3×10^{-1}	1.3×10^{-2}	-	-	-	-
Selenium*	-	6.3×10^{-2}	5.6×10^{-8}	-	1.3×10^{-8}	-
Toluene*	1.1×10^{1}	8.9	-	-	-	-
Total HpCDF	-	-	1.6×10^{-16}	-	-	-
Total TCDD	-	-	1.5×10^{-12}	-	1.5×10^{-13}	-
Vanadium	-	6.0	-	-	-	-
VX[d]	-	-	-	-		2.8

[a] Substances designated with an asterisk (*) are listed as HAPs under Title III, Section 112 of the CAA. PAHs = polycyclic aromatic hydrocarbons. PCBs = polychlorinated biphenyls. HpCDF = heptachlorodibenzo-p-furan. TCDD = tetrachlorodibenzo-p-dioxin.

[b] A hyphen indicates that the compound was not detected from this source during demonstration testing.

[c] For SCWO and filter farm stack emissions, organics are assumed to be treated by being passed through six carbon filters in series, each at 95% efficiency. PM is assumed to pass through two HEPA filters in series, each at 99.97% efficiency.

[d] The after-treatment emission rate from the filter farm stack for chemical agent (GB, VX, mustard) is a worst-case estimate; it assumes emissions at the detection limit (Kimmell et al. 2001). It is assumed that no agent would be emitted from the SCWO stack; none would be present after neutralization and SCWO treatment.

[e] Although PCB destruction was not included in demonstration testing, for these analyses, it was assumed that SCWO technology would have a destruction efficiency of 99.9999%, and that further treatment as in footnote c would be applied.

TABLE 4.6-4 Estimated Toxic Air Pollutant Emissions from Neutralization/GPCR/TW-SCWO Technology at ANAD

	Emissions (μg/s)[b]							
			Mustard Processing[c]		GB Processing[c]		VX Processing[c]	
Compound[a]	Diesel Generator	Boiler	Product Gas Burner	Filter Farm Stack	Product Gas Burner	Filter Farm Stack	Product Gas Burner	Filter Farm Stack
(R)-(-)-2,2-Dimethyl-1,3-dioxolane-4-methanol	-	-	-	3.1×10^{-8}	-	-	-	-
1,1,1-Trichloroethane	-	-	1.1×10^{-1}	-	6.8×10^{-2}	7.6×10^{-8}	6.1×10^{-2}	-
1,2,3,4,6,7,8-HpCDF	-	-	1.7×10^{-8}	-	1.1×10^{-8}	-	9.4×10^{-6}	-
1,2,3,4,7,8-HxCDF	-	-	1.3×10^{-7}		8.2×10^{-8}		7.3×10^{-5}	-
1,2,3,6,7,8-HxCDF	-	-	5.0×10^{-8}		3.1×10^{-8}		2.5×10^{-5}	-
1,2,4-Trimethylbenzene	-	-	-		-	8.3×10^{-9}	-	2.9×10^{-6}
1,3-Butadiene*	1.1	-	-	-	-	-	-	-
1,4-Dichlorobenzene*	-	-	-	-	-	-	-	6.7×10^{-9}
1-Ethyl-2,2,6-trimethylcyclohexane	-	-	-	-	-	-	-	2.2×10^{-6}
1-Hexanol, 2-ethyl-	-	-	3.4×10^{1}	-	2.1×10^{1}	-	1.9×10^{1}	-
1H-Indene	-	-	8.5	-	5.2	-	4.6	-
1H-Indene, 2,3-dihydro-	-	-	-	-	-	4.9×10^{-8}	-	-
1-Propene, 3,3,3-trichloro-	-	-	-	5.3×10^{-9}	-	-	-	-
2-(2-Butoxyethoxy) ethanol	-	-		-	-	-	-	2.5×10^{-6}
2,3,7,8-TCDF	-	-	7.9×10^{-8}	-	4.8×10^{-8}	-	4.3×10^{-5}	-
2,4-Dimethylphenol	-	-	3.4		2.1	-	1.8	-
2-Butanone (methyl ethyl ketone)*	-	-	1.2	-	7.2×10^{-1}	-	6.4×10^{-1}	-
2-Methylnaphthalene	-	8.0×10^{-2}	-	8.4×10^{-8}	-	1.9×10^{-8}	-	1.1×10^{-6}
2-Nitrophenol	-	-	-	-	-	5.4×10^{-9}	-	-
3-Methylchloranthrene	-	6.0×10^{-3}	-	-	-	-	-	-
9H-Fluoren-9-one	-	-	-	-	-	2.9×10^{-6}	-	-
Acenaphthene	3.9×10^{-2}	6.0×10^{-3}	-	-	-	9.7×10^{-10}	-	-
Acenaphthylene	1.4×10^{-1}	6.0×10^{-3}	-	-	-	-	-	-
Acetaldehyde*	2.1×10^{1}	-	-	6.8×10^{-9}	-	-	-	-
Acetic acid	-	-	-	-	-	-	-	8.1×10^{-7}
Acetone	-	-	3.2×10^{1}	4.3×10^{-7}	1.8×10^{2}	-	1.6×10^{2}	-
Acrolein*	2.6	-	-	-	-	-	-	-
Aldehydes	1.9×10^{3}	-	-	-	-	-	-	-
Aluminum	-	-	1.1×10^{1}	-	7.0	-	6.2	-
Anthracene	5.2×10^{-2}	8.0×10^{-3}	-	-	-	1.1×10^{-8}	-	6.0×10^{-9}
Antimony*	-	-	-	-	2.3×10^{-2}	1.8×10^{-9}	2.1×10^{-2}	1.5×10^{-6}
Arsenic*	-	6.7×10^{-1}	8.5×10^{-2}	2.4×10^{-9}	3.3×10^{-1}	7.2×10^{-9}	2.9×10^{-1}	-
Barium	-	1.5×10^{1}	5.0×10^{-1}	-	3.1×10^{-1}	-	2.7×10^{-1}	-
Benz(a)anthracene	4.7×10^{-2}	6.0×10^{-3}	-	-	-	2.1×10^{-9}	4.9×10^{-2}	-
Benzaldehyde	-	-	-	3.0×10^{-8}	7.3	3.0×10^{-8}	6.5	-
Benzaldehyde, 4-ethyl-	-	-	2.7	-	1.6	-	1.5	-
Benzaldehyde, ethyl-	-	-	1.7	-	1.0	-	9.0×10^{-1}	-
Benzaldehyde, ethyl-benzenemethanol, 4-(1-methylethyl)-	-	-	1.5	-	9.4×10^{-1}	-	8.3×10^{-1}	-
Benzene*	2.6×10^{1}	7.0	7.9	1.2×10^{-7}	5.1	1.3×10^{-6}	4.5	1.9×10^{-6}
Benzene, 1,2,3-trimethyl-	-	-	-	-	-	-	-	5.6×10^{-7}
Benzene, 1,2,4,5-tetramethyl-	-	-	-	-	-	-	-	2.7×10^{-6}
Benzene, 1-methyl-2-propyl-	-	-	-	-	-	-	-	2.6×10^{-6}
Benzene, 1-methyl-3-propyl-	-	-	-	-	-	-	-	6.4×10^{-7}

TABLE 4.6-4 (Cont.)

	Emissions (µg/s)[b]							
			Mustard Processing[c]		GB Processing[c]		VX Processing[c]	
Compound[a]	Diesel Generator	Boiler	Product Gas Burner	Filter Farm Stack	Product Gas Burner	Filter Farm Stack	Product Gas Burner	Filter Farm Stack
Benzo(a)pyrene	5.2×10^{-3}	4.0×10^{-3}	-	-	-	-	-	-
Benzo(b)fluoranthene	2.7×10^{-3}	6.0×10^{-3}	-	-	-	-	-	-
Benzo(g,h,i)perylene	1.4×10^{-2}	4.0×10^{-3}	-	-	-	-	-	-
Benzo(k)fluoranthene	4.3×10^{-3}	6.0×10^{-3}	-	-	-	-	-	-
Benzyl alcohol	-	-	1.6	1.4×10^{-8}	1.3	-	1.2	2.5×10^{-6}
Beryllium*	-	4.0×10^{-2}	-	-	6.0×10^{-3}	7.7×10^{-10}	5.3×10^{-3}	-
Bis(2-ethylhexyl)phthalate*	-	-	6.3×10^{-1}	5.8×10^{-9}	1.5	7.1×10^{-9}	1.3	9.2×10^{-9}
Butanal	-	-	-	5.0×10^{-8}	-	8.4×10^{-9}	-	4.2×10^{-8}
Butane	-	7.0×10^{3}	-	-	-	-	-	-
C3-Alkyl benzenes	-	-	-	2.6×10^{-6}	-	5.2×10^{-7}	-	-
Cadmium*	-	3.7	1.7×10^{-2}	1.9×10^{-9}	9.5×10^{-2}	3.2×10^{-9}	8.4×10^{-2}	4.4×10^{-7}
Calcium	-	-	2.3×10^{1}	5.9×10^{-6}	1.6×10^{1}	9.2×10^{-6}	14	1.0×10^{-4}
Carbon disulfide*	-	-	3.3×10^{-1}	-	2.0×10^{-1}	-	1.8×10^{-1}	-
Chloroform*	-	-	5.0	-	3.1	-	2.7	-
Chromium*	-	4.7	1.4	3.7×10^{-9}	8.5×10^{-1}	-	7.5×10^{-1}	-
Chrysene	9.8×10^{-3}	6.0×10^{-3}	-	-	-	4.2×10^{-9}	-	-
Cobalt*	-	2.8×10^{-1}	4.4×10^{-2}	3.5×10^{-8}	2.8×10^{-2}	1.0×10^{-8}	2.5×10^{-2}	2.6×10^{-7}
Copper	-	2.8	9.4×10^{-1}	-	1.6	-	1.4	-
Cyclododecane	-	-	-	-	2.2	-	2.0	-
Cyclohexane, 2-butyl-1,1,3-trimethyl-	-	-	-	-	-	-	-	5.0×10^{-7}
Cyclohexane, butyl-	-	-	-	2.3×10^{-7}	-	6.1×10^{-9}	-	4.0×10^{-6}
Cyclohexane, hexyl-	-	-	-	-	-	-	-	5.8×10^{-7}
Cyclohexane, propyl-	-	-	-	2.6×10^{-7}	-	-	-	-
Cyclohexanol	-	-	-	-	-	-	-	1.3×10^{-6}
Cyclohexanone	-	-	-	1.9×10^{-8}	-	4.1×10^{-8}	-	1.1×10^{-8}
Cyclohexasiloxane, dodecamethyl-	-	-	-	1.0×10^{-8}	-	-	-	-
Cyclotetrasiloxane, octamethyl-	-	-	3.7	-	2.2	-	2.0	-
Decane	-	-	-	1.1×10^{-6}	-	6.7×10^{-8}	-	1.6×10^{-5}
Decane, 2,6,7-trimethyl-	-	-	-	-	-	5.5×10^{-9}	-	-
Decane, 2-methyl-	-	-	-	-	-	-	-	3.7×10^{-6}
Decane, 3-methyl-	-	-	-	2.7×10^{-7}	-	-	-	2.8×10^{-6}
Decane, 4-methyl-	-	-	-	3.6×10^{-9}	-	7.2×10^{-9}	-	2.0×10^{-6}
Decane, 5-methyl-	-	-	-	-	-	2.6×10^{-8}	-	-
Dibenzo(a,h)anthracene	1.6×10^{-2}	4.0×10^{-3}	-	-	-	-	-	-
Dibenzofuran*	-	-	-	-	8.1×10^{-1}	6.4×10^{-8}	7.2×10^{-1}	9.9×10^{-8}
Dichlorobenzene*	-	4.0	-	-	-	-	-	-
Diethylene glycol	-	-	-	-	-	-	-	7.5×10^{-6}
Diethylphthalate	-	-	2.2	-	1.4	-	1.2	-
Dimethylbenz(a)anthracene	-	5.3×10^{-2}	-	-	-	-	-	-
Di-n-butylphthalate (bis-(2-ethylhexyl)phthalate)*	-	-	4.7	-	2.8	-	2.5	-
Diphenylmethane	-	-	-	-	-	5.4×10^{-9}	-	-
Dodecane	-	-	1.5	4.3×10^{-7}	8.9×10^{-1}	1.2×10^{-7}	7.9×10^{-1}	6.3×10^{-6}
Dodecane, 2,6,10-trimethyl-	-	-	-	-	-	7.7×10^{-9}	-	-
Dodecane, 4-methyl-	-	-	-	-	-	2.2×10^{-8}	-	-
Dodecane, 6-methyl-	-	-	-	4.1×10^{-9}	-	1.4×10^{-8}	-	2.0×10^{-6}
Ethane	-	1.0×10^{4}	-	–	-	-	-	-
Ethanol, 2-(2-butoxyethoxy)-, acetate	-	-	-	1.7×10^{-8}	-	2.6×10^{-8}	-	-
Ethanone, 1-(3-methylphenyl)-	-	-	-	-	-	8.2×10^{-9}	-	-

TABLE 4.6-4 (Cont.)

	Emissions (µg/s)[b]							
			Mustard Processing[c]		GB Processing[c]		VX Processing[c]	
Compound[a]	Diesel Generator	Boiler	Product Gas Burner	Filter Farm Stack	Product Gas Burner	Filter Farm Stack	Product Gas Burner	Filter Farm Stack
Ethanone, 1-phenyl-	-	-	-	-	-	5.9×10^{-8}	-	-
Ether	-	-	-	-	1.5×10^{2}	-	1.4×10^{2}	-
Ethylbenzene*	-	-	1.1×10^{-1}	-	4.7	-	4.1	-
Ethylene glycol*	-	-	-	1.7×10^{-7}	-	2.3×10^{-7}	-	2.6×10^{-6}
Fluoranthene	2.1×10^{-1}	1.0×10^{-2}	-	-	-	1.3×10^{-8}	-	1.2×10^{-8}
Fluorene	8.1×10^{-1}	9.4×10^{-3}	-	-	3.7×10^{-2}	2.3×10^{-8}	3.3×10^{-2}	3.4×10^{-8}
Formaldehyde*	3.3×10^{1}	2.5×10^{2}	-	-	-	-	-	-
GB[d]	-	-	-	-	-	3.7	-	-
H (mustard)[d]	-	-	-	3.7×10^{2}	-	-	-	-
Heptdecane	-	-	-	-	-	1.8×10^{-8}	-	-
Heptanal	-	-	-	1.3×10^{-7}	-	3.0×10^{-7}	-	-
Heptane, 3-ethyl-2-methyl-	-	-	-	-	-	1.8×10^{-8}	-	1.2×10^{-6}
Hexadecane, 2,6,10,14-tetramethyl-	-	-	-	-	-	3.4×10^{-8}	-	-
Hexanal	-	-	-	3.2×10^{-8}	-	1.1×10^{-7}	-	1.5×10^{-7}
Hexane(n)*	-	6.0×10^{3}	-	-	-	-	-	-
Hydrochloric acid*	-	-	3.7×10^{1}	3.8×10^{2}	6.0×10^{1}	4.8×10^{-6}	53	4.1×10^{1}
Hydrogen fluoride*	-	-	1.7	-	1.0	5.0×10^{1}	9.3×10^{-1}	-
Hydrogen cyanide*	-	-	6.8	-	4.1	-	3.7	-
Hydrogen sulfide*	-	-	1.7×10^{1}	-	6.1×10^{3}	-	5.4×10^{3}	-
Indeno(1,2,3-cd)pyrene	1.0×10^{-2}	6.0×10^{-3}	-	-	-	-	-	-
Iron	-	-	1.7×10^{1}	5.1×10^{-7}	1.0×10^{1}	9.0×10^{-7}	9.1	-
Isobutyl alcohol	-	-	-	-	-	9.6×10^{-8}	-	2.5×10^{-6}
Lead*	-	1.7	9.9×10^{-2}	1.9×10^{-8}	1.2×10^{-1}	4.0×10^{-8}	1.1×10^{-1}	1.6×10^{-5}
m,p-Xylene*	7.9	-	-	-	-	-	-	-
Magnesium	-	-	3.2	1.7×10^{-6}	2.4	2.9×10^{-6}	2.1	2.7×10^{-5}
Malonic acid	-	-	-	7.8×10^{-6}	-	2.2×10^{-5}	-	-
Manganese*	-	1.3	1.2×10^{1}	2.3×10^{-7}	2.3×10^{1}	1.3×10^{-7}	2.0×10^{1}	8.8×10^{-5}
Mercury*	8.3×10^{-3}	8.7×10^{-1}	-	-	-	1.8×10^{-8}	-	-
Methylene chloride*	-	-	9.1×10^{-1}	3.4×10^{-7}	8.2	1.3×10^{-4}	7.3	1.0×10^{-6}
Molybdenum	-	3.7	8.1×10^{-1}	1.4×10^{-8}	6.7×10^{1}	4.7×10^{-8}	6.0×10^{1}	3.1×10^{-6}
m-Tolualdehyde	-	-	-	-	-	7.6×10^{-8}	-	7.2×10^{-8}
Naphthalene*	2.3	2.0	-	1.1×10^{-7}	1.2×10^{-1}	1.3×10^{-7}	1.0×10^{-1}	8.5×10^{-7}
Naphthalene, 1,2,3,4-tetrahydro-	-	-	-	-	-	-	-	1.4×10^{-6}
Naphthalene, 1,2,3,4-tetrahydro-6-methyl-	-	-	-	-	-	-	-	7.4×10^{-7}
Naphthalene, 1,7-dimethyl	-	-	-	-	-	-	-	8.0×10^{-7}
Naphthalene, 1-methyl	-	-	-	-	-	2.0×10^{-8}	-	-
Nickel*	-	7.0	1.6	2.1×10^{-8}	9.8×10^{-1}	2.7×10^{-8}	8.7×10^{-1}	-
Nitrobenzene*	-	-	-	-	3.5×10^{-1}	6.8×10^{-8}	3.1×10^{-1}	-
Nonane, 2,6-dimethyl-	-	-	-	-	-	2.1×10^{-8}	-	6.8×10^{-6}
Nonane, 3,7-dimethyl-	-	-	-	-	-	-	-	1.0×10^{-6}
Nonane, 3-methyl-	-	-	-	-	-	-	-	5.2×10^{-7}
n-Propylbenzene	-	-	-	1.6×10^{-7}	-	-	-	-
Octane, 2,6-dimethyl-	-	-	-	4.1×10^{-7}	-	-	-	-
Octane, 3,6-dimethyl-	-	-	-	-	-	-	-	2.4×10^{-6}
Octane, 3-methyl-	-	-	-	1.5×10^{-7}	-	-	-	-
Pentadecane	-	-	-	4.1×10^{-9}	-	1.1×10^{-8}	-	1.7×10^{-6}
Pentanal	-	-	-	1.0×10^{-7}	-	1.4×10^{-7}	-	-
Pentane(n)	-	8.7×10^{3}	-	-	-	-	-	-

TABLE 4.6-4 (Cont.)

	Emissions (μg/s)[b]							
			Mustard Processing[c]		GB Processing[c]		VX Processing[c]	
Compound[a]	Diesel Generator	Boiler	Product Gas Burner	Filter Farm Stack	Product Gas Burner	Filter Farm Stack	Product Gas Burner	Filter Farm Stack
Phenanthrene	8.1×10^{-1}	5.7×10^{-2}	-	7.6×10^{-10}	-	5.6×10^{-8}	-	8.1×10^{-8}
Phenol*	-	-	6.3×10^{-1}	-	3.0	1.6×10^{-8}	2.7	-
Phosphorus*	-	-	6.0	4.0×10^{-7}	4.5	1.4×10^{-5}	4.0	2.8×10^{-4}
PCBs[e]	-	-	-	-	9.6×10^{-2}	-	9.6×10^{-2}	-
PAHs*	4.7	-	-	-	-	-	-	-
Potassium	-	-	-	7.7×10^{-7}	-	-	-	1.3×10^{-4}
Propanal (propionaldehyde)*	-	-	-	-	-	1.0×10^{-7}	-	1.3×10^{-7}
Propane	-	5.3×10^{3}	-	-	-	-	-	-
Propylene	7.1×10^{1}	-	-	-	-	-	-	-
Pyrene	1.3×10^{-1}	1.7×10^{-2}	-	-	-	7.0×10^{-9}	-	5.6×10^{-9}
Selenium*	-	8.0×10^{-2}	2.1×10^{-1}	4.7×10^{-9}	1.3×10^{-1}	-	1.2×10^{-1}	-
Silver	-	-	2.0×10^{-2}	5.7×10^{-10}	8.3×10^{-2}	9.2×10^{-9}	7.4×10^{-2}	9.4×10^{-8}
Sodium	-	-	3.1×10^{2}	-	2.0×10^{2}	-	1.8×10^{2}	9.7×10^{-5}
Styrene*	-	-	7.0×10^{-1}	-	4.3×10^{-1}	-	3.8×10^{-1}	-
Sulfur, mol. (S8)	-	-	-	1.2×10^{-7}	-	-	-	-
Tetrachloroethene*	-	-	1.0×10^{-1}	-	6.1×10^{-2}	-	5.4×10^{-2}	-
Tetradecane	-	-	-	2.4×10^{-7}	-	7.6×10^{-8}	-	7.8×10^{-6}
Thallium	-	-	-	-	3.0×10^{-2}	-	2.7×10^{-2}	-
Tin	-	-	2.0	-	1.2	-	1.1	-
Toluene*	1.1×10^{1}	1.1×10^{1}	1.1	-	6.8×10^{-1}	4.3×10^{-7}	6.1×10^{-4}	3.5×10^{-7}
Total HpCDD	-	-	-	4.2×10^{-14}	-	-	-	-
Total HpCDF	-	-	1.9×10^{-6}	-	1.2×10^{-9}	-	1.1×10^{-9}	-
Total HxCDD	-	-	1.0×10^{-6}	1.9×10^{-14}	6.1×10^{-7}	-	5.4×10^{-10}	-
Total HxCDF	-	-	2.1×10^{-6}	-	1.3×10^{-6}	-	1.1×10^{-9}	-
Total PeCDD	-	-	5.7×10^{-7}	3.9×10^{-13}	3.5×10^{-7}	-	3.1×10^{-7}	-
Total PeCDF	-	-	7.1×10^{-7}	2.4×10^{-14}	4.3×10^{-7}	-	3.8×10^{-7}	-
Total TCDD*	-	-	4.7×10^{-7}	2.4×10^{-12}	2.8×10^{-7}	-	2.5×10^{-7}	-
Total TCDF	-	-	1.0×10^{-6}	2.2×10^{-13}	6.2×10^{-7}	-	5.5×10^{-7}	-
Trichloroethene*	-	-	1.0×10^{-1}	-	6.1×10^{-2}	-	5.4×10^{-2}	-
Tridecane	-	-	-	2.9×10^{-7}	-	1.2×10^{-7}	-	3.5×10^{-6}
Tridecane, 2-methyl	-	-	-	-	-	-	-	2.1×10^{-6}
Tridecane, 4-methyl-	-	-	-	-	-	-	-	1.0×10^{-6}
Tridecane, 6-propyl-	-	-	-	-	-	-	-	7.7×10^{-7}
Undecane	-	-	-	7.3×10^{-7}	-	1.1×10^{-7}	-	1.0×10^{-5}
Undecane, 2,10-dimethyl-	-	-	-	-	-	3.4×10^{-8}	-	4.6×10^{-7}
Undecane, 2,6-dimethyl-	-	-	-	-	-	4.2×10^{-8}	-	-
Undecane, 2-methyl-	-	-	-	-	-	2.7×10^{-8}	-	-
Undecane, 3,6-dimethyl-	-	-	-	-	-	-	-	1.6×10^{-6}
Undecane, 4-methyl-	-	-	-	-	-	-	-	1.1×10^{-6}
VX[d]	-	-	-	-	-	-	-	3.7
Vanadium	-	7.7	3.8×10^{-2}	4.2×10^{-10}	9.0×10^{-2}	1.7×10^{-9}	8.0×10^{-2}	1.6×10^{-7}
p-Xylene*	-	-	-	3.7×10^{-7}	-	2.5×10^{-8}	-	-
Xylenes*	-	-	5.2×10^{-1}	-	3.2×10^{-1}	-	2.8×10^{-1}	-
Zinc	-	-	2.0	4.7×10^{-8}	1.2	-	1.1	-

Footnotes appear on next page.

TABLE 4.6-4 (Cont.)

---

[a] Substances designated with an asterisk (*) are listed as HAPs under Title III, Section 112 of the CAA. PAHs = polycyclic aromatic hydrocarbons. PCBs = polychlorinated biphenyls. Polychlorinated dioxins/furans are as follows: HpCDD = heptachlorodibenzo-p-dioxin, HpCDF = heptachlorodibenzo-p-furan, HxCDD = hexachlorodibenzo-p-dioxin; HxCDF = hexachlorodibenzo-p-furan, PeCDD = pentachlorodibenzo-p-dioxin; PeCDF = pentachlorodibenzo-p-furan; TCDD = tetrachlorodibenzo-p-dioxin; TCDF = tetrachlorodibenzo-p-furan.

[b] A hyphen indicates that the compound was not detected from this source during demonstration testing.

[c] For the filter farm stack emissions, organics are assumed to be treated by passing through six carbon filters in series, each at 95% efficiency. Particulate matter (metals, dioxins/furans) is assumed to pass through two HEPA filters in series, each at 99.97% efficiency. Product gas burner emissions are assumed not to receive further treatment after release from facility scrubbers.

[d] The after-treatment emission rate from the filter farm stack for chemical agent (GB, VX, mustard) is a worst-case estimate; it assumes emissions at the detection limit (Kimmell et al. 2001). It is assumed that no agent would be emitted from the product gas burner stack; none would be present after neutralization and SCWO treatment.

[e] Although PCB destruction was not included in demonstration testing, for these analyses, it was assumed that Neut/GPCR/TW-SCWO technology would have a destruction efficiency of 99.9999%.

4.6.3 Impacts of the Proposed Action

4.6.3.1 Impacts of Construction

During construction, low-level emissions of potentially toxic air pollutants would result from the use of construction chemicals such as paints, thinners, and aerosols. These emissions would be expected to be minor and were not quantitatively estimated for this EIS. The main emissions from construction-related heavy equipment and from the commuter vehicles used by construction workers would consist of criteria pollutants (Kimmell et al. 2001) and HAPs. HAP emissions were not quantified for this assessment because of insufficient data (e.g., whether the engine type is two-stroke, four-stroke, or diesel) (EPA 2000d). Although not quantified, the emission levels would be expected to be less than reportable quantities and similar across the technology systems evaluated.

4.6.3.2 Impacts of Operations

Estimates of emissions of toxic air pollutants that would result from the operation of pilot destruction facilities are provided in Tables 4.6-2 through 4.6-5. Many of the toxic air pollutants that would be emitted from the pilot test facility stacks are HAPs as defined in Title III, Section 112 of the *Clean Air Act*. However, a pilot test facility would not be a major source of HAP emissions and would not fall into any of the source categories regulated by NESHAP. Therefore, no regulatory action under NESHAP would be necessary for the HAP emissions from a pilot test facility.

TABLE 4.6-5 Estimated Toxic Air Pollutant Emissions from Electrochemical Oxidation Technology at ANAD

	Emissions (μg/s)[b]				
			CatOx/Filter Farm Stack		
Compound[a]	Diesel Generator	Boiler	Mustard Processing[c]	GB Processing[c]	VX Processing[c]
1,1-Dichloroethene*	-	-	5.1×10^{-7}	-	-
1,3-Butadiene*	1.1	-	-	-	-
1,5-Pentanediol, dinitrate	-	-	-	3.3×10^{-6}	2.1×10^{-6}
1-Butanol, 3-methyl-, nitrate	-	-	-	1.5×10^{-5}	9.2×10^{-6}
1-Hexanol, 2-ethyl-	-	-	-	1.8×10^{-7}	1.2×10^{-7}
2-Heptanone	-	-	-	3.4×10^{-7}	2.1×10^{-7}
2-Hexanone	-	-	4.9×10^{-8}	3.3×10^{-6}	2.3×10^{-6}
2-Methylnaphthalene	-	4.8×10^{-2}	-	-	-
2-Octanone	-	-	1.1×10^{-8}	6.0×10^{-7}	4.3×10^{-7}
2-Pentanol, nitrate	-	-	-	2.0×10^{-5}	1.3×10^{-5}
3-Methylchloranthrene	-	3.6×10^{-3}	-	-	-
4-Methyl-2-pentanone	-	-	3.6×10^{-8}	3.0×10^{-7}	3.4×10^{-7}
4-Octene, (E)-	-	-	1.6×10^{-8}	1.4×10^{-7}	1.5×10^{-7}
Acenaphthene	3.9×10^{-2}	3.6×10^{-3}	-	-	-
Acenaphthylene	1.4×10^{-1}	3.6×10^{-3}	-	-	-
Acetaldehyde*	2.1×10^{1}	-	-	-	-
Acetamide, N,N-dimethyl-	-	-	-	1.1×10^{-6}	7.0×10^{-7}
Acetic acid	-	-	4.6×10^{-7}	3.9×10^{-6}	4.4×10^{-6}
Acetone	-	-	1.2×10^{-6}	2.3×10^{-8}	2.6×10^{-8}
Acrolein*	2.6	-	-	-	-
Aldehydes	1.9×10^{3}	-	-	-	-
Anthracene	5.2×10^{-2}	4.8×10^{-3}	-	-	-
Arsenic*	-	4.0×10^{-1}	-	-	-
Barium	-	8.9	-	-	-
Benz(a)anthracene	4.7×10^{-2}	3.6×10^{-3}	-	-	-
Benzene*	2.6×10^{1}	4.2	1.4×10^{-8}	1.2×10^{-6}	8.5×10^{-7}
Benzo(a)pyrene	5.2×10^{-3}	2.4×10^{-3}	-	-	-
Benzo(b)fluoranthene	2.7×10^{-3}	3.6×10^{-3}	-	-	-
Benzo(g,h,i)perylene	1.4×10^{-2}	2.4×10^{-3}	-	-	-
Benzo(k)fluoranthene	4.3×10^{-3}	3.6×10^{-3}	-	-	-
Beryllium*	-	2.4×10^{-2}	-	-	-
Bis(2-ethylhexyl)phthalate*	-	-	-	5.1×10^{-7}	3.2×10^{-7}
Butane	-	4.2×10^{3}	-	-	-
Cadmium*	-	2.2	-	-	-
Carbon disulfide*	-	-	3.6×10^{-6}	4.4×10^{-5}	2.8×10^{-5}
Chloroethane*	-	-	1.1×10^{-7}	-	-
Chloroform*	-	-	1.4×10^{-7}	-	-
Chloromethane	-	-	4.5×10^{-7}	-	-

TABLE 4.6-5 (Cont.)

	Emissions (μg/s)[b]				
			CatOx/Filter Farm Stack		
Compound[a]	Diesel Generator	Boiler	Mustard Processing[c]	GB Processing[c]	VX Processing[c]
Chromium*	-	2. 8	-	-	-
Chrysene	9.8×10^{-3}	3.6×10^{-3}	-	-	-
Cobalt*	-	1.7×10^{-1}	-	-	-
Copper	-	1.7	-	-	-
Cyclohexane, 1,2,3-trimethyl-	-	-	5.6×10^{-8}	4.7×10^{-7}	5.3×10^{-7}
Decane	-	-	6.4×10^{-8}	3.2×10^{-6}	2.3×10^{-6}
Decanenitrile	-	-	1.3×10^{-8}	5.6×10^{-7}	4.1×10^{-7}
Dibenzo(a,h)anthracene	1.6×10^{-2}	2.4×10^{-3}	-	-	-
Dichlorobenzene*	-	2.4	-	-	-
Dimethylbenz(a)anthracene	-	3.2×10^{-2}	-	-	-
Dodecane	-	-	7.7×10^{-8}	4.4×10^{-6}	3.1×10^{-6}
Ethane	-	6.3×10^{3}	-	-	
Ethylbenzene*	-	-	-	8.0×10^{-8}	5.1×10^{-8}
Fluoranthene	2.1×10^{-1}	6.1×10^{-3}	-	-	-
Fluorene	8.1×10^{-1}	5.6×10^{-3}	-	-	-
Formaldehyde*	3.3×10^{1}	1.5×10^{2}	-	-	-
GB[d]	-	-	-	3.4	-
H (mustard)[d]	-	-	3.4×10^{2}	-	-
Heptanal	-	-	1.8×10^{-8}	8.2×10^{-7}	6.0×10^{-7}
Heptanenitrile	-	-	-	4.3×10^{-7}	2.8×10^{-7}
Hexadecane	-	-	8.8×10^{-9}	7.7×10^{-7}	2.6×10^{-6}
Hexane(n)*	-	3.6×10^{3}	-	-	-
Hexanenitrile	-	-	-	3.9×10^{-7}	2.5×10^{-7}
Indeno(1,2,3-cd)pyrene	1.0×10^{-2}	3.6×10^{-3}	-	-	-
Isopropyl nitrate	-	-	2.6×10^{-7}	9.3×10^{-5}	6.0×10^{-5}
Lead*	-	1.0×10^{-1}	-	-	-
m,p-Xylene*	7.9	-	-	-	-
Manganese*	-	7.7×10^{-1}	-	-	-
Mercury*	8.3×10^{-3}	5.2×10^{-1}	-	-	-
Methylene chloride*	-	-	5.3×10^{-7}	-	-
Molybdenum		2.2	-	-	-
MPA	-	-	-	-	1.1×10^{-11}
Naphthalene*	2.3	1.2	5.4×10^{-6}	4.5×10^{-5}	5.1×10^{-5}
Nickel*	-	4.2	-	-	-
Nitric acid esters	-	-	-	3.5×10^{-6}	2.2×10^{-6}
Nitric acid, butyl ester	-	-	-	1.6×10^{-5}	1.0×10^{-5}
Nitric acid, decyl ester	-	-	1.9×10^{-8}	1.5×10^{-6}	1.0×10^{-6}
Nitric acid, ethyl ester	-	-	-	9.1×10^{-6}	5.8×10^{-6}
Nitric acid, hexyl ester	-	-	-	9.0×10^{-6}	5.7×10^{-6}
Nitric acid, nonyl ester	-	-	5.9×10^{-8}	3.3×10^{-6}	2.3×10^{-6}
Nitric acid, pentyl ester	-	-	-	9.4×10^{-6}	6.0×10^{-6}
Nitric acid, propyl ester	-	-	-	9.7×10^{-6}	6.2×10^{-6}

TABLE 4.6-5 (Cont.)

	Emissions (µg/s)[b]				
			CatOx/Filter Farm Stack		
Compound[a]	Diesel Generator	Boiler	Mustard Processing[c]	GB Processing[c]	VX Processing[c]
Nonanal	-	-	1.5×10^{-7}	1.3×10^{-6}	1.4×10^{-6}
Nonanenitrile	-	-	1.6×10^{-8}	9.3×10^{-7}	6.6×10^{-7}
Octanal	-	-	1.0×10^{-7}	1.4×10^{-6}	1.3×10^{-6}
Octanenitrile	-	-	-	9.7×10^{-7}	6.2×10^{-7}
Pentadecane	-	-	1.4×10^{-8}	1.5×10^{-6}	1.0×10^{-6}
Pentane(n)	-	5.2×10^{3}	-	-	-
Phenanthrene	8.1×10^{-1}	3.4×10^{-2}	-	-	-
PCBs[e]	-	-	-	1.5×10^{-9}	1.5×10^{-9}
PAHs*	4.7	-	-	-	-
Propane	-	3.2×10^{3}	-	-	-
Propylene	7.1×10^{1}	-	-	-	-
Pyrene	1.3×10^{-1}	1.0×10^{-2}	-	-	-
Selenium*	-	4.8×10^{-2}	-	-	-
Tetradecane	-	-	7.0×10^{-8}	5.0×10^{-6}	3.5×10^{-6}
Toluene*	1.1×10^{1}	6.9	-	3.0×10^{-7}	1.9×10^{-7}
Trichloroethene*	-	-	6.9×10^{-7}	-	-
Tridecane	-	-	-	-	4.4×10^{-6}
Undecane	-	-	7.2×10^{-8}	3.9×10^{-6}	2.8×10^{-6}
VX[d]	-	-	-	-	3.4
Vanadium	-	4.6	-	-	-
Vinyl chloride*	-	-	5.8×10^{-7}	-	4.6×10^{-7}
Xylenes*	-	-	2.7×10^{-8}	5.5×10^{-7}	-

[a] Substances designated with an asterisk are listed as HAPs under Title III, Section 112 of the CAA. PAHs = polycyclic aromatic hydrocarbons. PCBs = polychlorinated biphenyls.

[b] A hyphen indicates that the compound was not detected from this source during demonstration testing.

[c] For the CatOx/filter farm stack emissions, organics are assumed to be treated by being passed through six carbon filters in series, each at 95% efficiency. Particulate matter (metals, dioxins/furans) is assumed to pass through two HEPA filters in series, each at 99.97% efficiency.

[d] The after-treatment emission rate from the filter farm stack for chemical agent (GB, VX, mustard) is a worst-case estimate; it assumes emissions at the detection limit (Kimmell et al. 2001).

[e] Although PCB destruction was not included in demonstration testing, for these analyses it was assumed that Elchem Ox technology would have a destruction efficiency of 99.9999% and that further treatment, as in footnote c, would be applied.

PCBs have been identified as a constituent in the firing tubes of M55 rockets (see Section 4.4.2.2). PCBs were not tested as part of the ACWA demonstration project, since doing so would have triggered regulatory requirements under TSCA that would have added considerably to the cost and difficulty of the demonstration. Demonstration tests were conducted by using wood spiked with pentachlorophenol (PCP, a chlorinated substance similar to PCBs). Results showed degradation of the PCP in the test systems, indicating that PCBs would also likely be destroyed. For pilot testing of M55 rocket destruction systems, appropriate TSCA regulations on monitoring PCBs and limiting them in effluents would be followed, and a permit with treatment standards would be obtained before rocket pilot testing. For the purposes of this assessment, it was assumed that the technology systems evaluated would achieve a PCB destruction efficiency of 99.9999. For filtered stacks, further removal by carbon filtration was also assumed.

In order to assess health risks associated with toxic air pollutant emissions (Section 4.7), the locations of maximum on-post and off-post concentrations of the emitted compounds listed in Tables 4.6-2 through 4.6-5 were identified through air modeling. The ISCST3 model (EPA 1995) was used in the same way as it was used for assessing criteria air pollutant emissions in Section 4.5. Details on the modeling conducted are presented in Appendix C.

The main emissions from commuter vehicles and delivery trucks are criteria pollutants (as summarized in Section 4.5); toxic air pollutant emissions have not been quantified.

4.6.3.3 Impacts of Fluctuating Operations

To account for possible fluctuations in operations that could occur during pilot testing, it was assumed that levels of organic compounds would be 10 times higher than the estimated annual average for 5% of the time and that levels of inorganic compounds would be 10 times higher than the estimated annual average for 20% of the time. These assumptions were based on EPA guidance (EPA 1994, as cited in National Research Council 1997a) and were used to generate ambient annual air concentrations for exposure estimates, as detailed in Appendix C.

During fluctuating operations, it is possible that agent could be released from the filter farm stack, which is the ventilation stack for the Munitions Demilitarization Building (MDB) process area. Regardless of the ACWA technology selected for implementation at ANAD, the filter farm stack would be equipped with multiple carbon filter banks and with agent monitoring devices between banks. These devices would ensure that, in the unlikely event that some agent was not destroyed in the neutralization process and subsequent treatment, it would be detected and the causes mitigated immediately.

For the purpose of estimating the maximum potential emissions of chemical agent, only the MDB process area was assumed to be a potential source. The filter systems would be designed to remove agent from the ventilation air stream to a level below the detectable level

(Kimmell et al. 2001). Therefore, if any agent were detected in the exhaust stream, alarms would sound, the cause would be identified and mitigated, and the emission of agent (if any) would be short-term and at low levels. Since no estimates of potential chemical agent emission levels were made on the basis of demonstration test results, it was conservatively assumed for this assessment that an agent could hypothetically be emitted continuously from the stack at the detection limit level for that agent. Modeling dispersion from the source at these levels resulted in the maximum hypothetical on-post and off-post agent concentrations presented in Table 4.6-6. All these values are less than 1% of the allowable concentrations for general public exposure established by the Centers for Disease Control and Prevention (CDC 1988). In practice, the facility stacks would have continuous agent monitoring devices that would sound if any agent were detected in the stacks. The reasons for the presence of the agent would then be identified, and the agent would be eliminated.

4.6.4 Impacts of No Action

Activities associated with continued storage at ANAD would include inspection, monitoring, and conducting an annual inventory of all munitions; overpacking any leaking munitions discovered during inspections; and transporting the overpacked leakers to a separate RCRA-permitted storage igloo. All chemical munition storage igloos are routinely inspected and monitored in accordance with strict U.S. Army regulations. All of the permitted igloos containing the overpacked leakers would continue to be inspected and monitored in accordance with the applicable State of Alabama-issued RCRA permit conditions. Upon discovery of a leaker, a filter would be installed, and the entry door would be sealed. The amount of agent that might spill from a leaking munition would be likely to be small, and any vapor that might form as a result of the spill would be likely to be contained within the igloo. These statements are especially true for mustard agent and VX, which have very low volatilities (900 and 10 mg/m^3 at 25°C [77°F], respectively). Liquid that could leak from a munition would tend to spill slowly over the munition(s) and onto the igloo floor. Evaporation from a VX or HD liquid spill would occur at a very slow rate because of the still air conditions inside the igloo in combination with the low volatility of the agent. In addition, with igloo temperatures typically below 15.6°C [60°F], a mustard leak (liquid spill on igloo floor) would be much less likely considering the relatively high freezing point, 14.5°C (58°F), of mustard. Because of GB's greater volatility (21,000 mg/m^3), a liquid spill would more readily evaporate. However, because of the still air conditions inside igloos and the small spill areas that typically occur, spilled liquid and vapors coming from a GB munition leak would probably remain contained inside the igloo long enough for inspection crews to detect and remediate them. If the munition leak were from an M55 rocket, the shipping and handling containers for these munitions would contain any GB or VX liquid that might leak from the rocket. During Chemical Stockpile Emergency Preparedness Program (CSEPP) exercises, maximum credible events (MCEs) involving the spill of agent onto the igloo floor have been simulated with the D2PC model. These exercises have shown that the hazard zone from such an event would be contained within the Chemical Limited Area for ANAD.

TABLE 4.6-6 Maximum Annual Average Estimated On-Post and Off-Post Concentrations of Agent during ACWA Pilot Facility Operations at ANAD[a]

	Maximum Annual Average Off-Post Concentration (µg/m^3)		Maximum Annual Average On-Post Concentration (µg/m^3)		Percent of Limit Off Post[b]		Percent of Limit On Post[b]	
Technology	Mustard	GB/VX	Mustard	GB/VX	Mustard	GB/VX	Mustard	GB/VX
Neut/SCWO	9.7×10^{-5}	9.7×10^{-7}	3.1×10^{-4}	3.1×10^{-6}	0.01	0.03	0.31	0.1
Neut/Bio	9.7×10^{-5}	NA[c]	3.2×10^{-4}	NA	0.01	NA	0.32	NA
Neut/GPCR/ TW-SCWO	1.1×10^{-4}	1.1×10^{-6}	3.4×10^{-4}	3.4×10^{-6}	0.01	0.04	0.34	0.11
Elchem Ox	1.1×10^{-4}	1.1×10^{-6}	2.6×10^{-4}	2.6×10^{-6}	0.01	0.04	0.26	0.09

[a] Estimated concentrations account for fluctuating operations.

[b] The general population exposure limits for 72-hour time-weighted average exposures, as estimated by CDC (1988), are as follows: mustard = 0.1 µg/m^3, GB and VX = 0.003 µg/m^3.

[c] NA = not applicable.

4.7 HUMAN HEALTH AND SAFETY — ROUTINE OPERATIONS

Impacts on human health from routine operations are generally assessed by estimating exposures to the toxic substances that are emitted from a facility on a routine basis and by estimating the potential for those exposures to cause adverse health effects. Because the degree of exposure is partially determined by where the human population is located with respect to the emission points, this section gives data on the locations of workers and the general public around the proposed facilities. Guidance for the estimation of exposure and risk from routine low-level exposures is available from the EPA. The assessment for this EIS generally followed the principles of the EPA's Risk Assessment Guidance for Superfund, which includes the estimation of risk for a reasonably maximally exposed individual (MEI) (EPA 1989, 1997). For example, the risk for the off-site public would be assessed by assuming that the MEI resided in the area of off-site maximum contaminant concentrations (generally but not always the fence line). Other assumptions on intake levels and susceptibility are made to ensure that, whenever possible, exposures and risks will be overestimated rather than underestimated. The reasoning is that if the MEI risk is found to be within acceptable limits, then the risk to the general public will be lower and also generally acceptable.

In addition to risks from exposures to facility emissions, occupational hazard risks of injury and fatality are presented for the facility workers. Some risk of on-the-job injury or fatality is associated with any industry, and a screening estimation of this risk is presented. The main determinant of this type of risk is the type of work (construction or facility operation) being done and the number of employees who are doing it.

4.7.1 Current Environment

4.7.1.1 Existing Environmental Contamination and Remediation Efforts

Forty-seven (47) solid waste management units (SWMUs) have been designated at ANAD. There are 29 in the SIA, 15 in the ASA, and three in other areas (ANAD 2000b). No past contamination has been identified at the areas being considered for an ACWA pilot test facility. Environmental cleanup of contamination from past operations at ANAD is being addressed in other environmental compliance documentation and is beyond the scope of this EIS.

4.7.1.2 On-Post Workers

Employment at ANAD currently stands at 3,838 (Burdell 2000c), including ANAD employees, tenant employees, and contractors. This includes 90 workers in the CLA (Burdell 2000d).

Types of workers currently employed at ANAD include environmental protection specialists, fire and emergency services specialists, facility management and maintenance workers, and administrative and office workers. The hazards associated with these jobs vary; workers receive training to address their specific job hazards. Although occupational hazards exist for all types of work (rates for various industry classifications are published in various documents; see National Safety Council [1999] for an example), hazards can be minimized when workers adhere to safety standards and use protective equipment as necessary.

There is only one residence on post at ANAD, that of the post commander. Occupants of this residence and on-post workers at ANAD could be exposed to industrial chemicals released to air, water, or soil. As discussed in Section 4.6.2, toxic air pollutants released at ANAD are from open burning and open detonation, paint booths, degreaser units, and fuel storage and dispensing. VOCs (i.e., methylene chloride, methyl ethyl ketone) are released in the highest quantities. Industrial workers at ANAD may work extensively with paints and coating containing VOCs. Paint booths are used to minimize emissions and employee inhalation exposures. ANAD operations comply with Occupational Safety and Health Administration (OSHA) regulations on maximum contaminant levels (MCLs) in air.

Most VOC emissions occur in the SIA, more than 3 mi (5 km) from the single occupied house on the site (Figure 4.2-1). Potential health risks to ANAD residents from air emissions would be expected to be minimal because they are located relatively far from the emission points and ANAD releases to air are in compliance with regulatory standards under the CAA.

Contaminant levels in ANAD releases to water are subject to applicable NPDES regulations. Nonhazardous solid waste is sent to off-post landfills, and hazardous solid waste is stored in approved facilities (see Section 4.4), so that any contamination of water or soil at ANAD from routine operations should be minor and should not result in increased health risk to workers or on-site residents.

4.7.1.3 Off-Post Public

The off-post public near the ANAD installation could be exposed to chemicals released to air, water, or soil. As discussed in Section 4.6.1, toxic pollutants released to air at ANAD are from open burning and open detonation, paint booths, degreaser units, and fuel storage and dispensing. VOCs (i.e., methylene chloride, methyl ethyl ketone) are released in the highest quantities. Most emissions occur in the SIA, which is about 1 mile (1.6 km) from an off-post residential area. Potential health risks to off-post residents from air emissions are not expected because the residences are located relatively far from the emission points and ANAD releases to air are in compliance with regulatory standards under the CAA. However, no measurements or modeling of ambient concentrations in the residential area are currently available.

Contaminant levels in ANAD releases to water are subject to applicable NPDES regulations. Nonhazardous solid waste is sent to off-post landfills, and hazardous solid waste is stored in approved facilities (see Section 4.4), so that any contamination of water or soil at ANAD from existing operations should be minor and should not result in increased health risk to the off-post public. Procedures are in place to minimize risks associated with accidents (see Section 4.7.1).

4.7.1.4 Emergency Response

ANAD has procedures for on-post emergency response actions involving toxic chemical munitions, which are contained in its 2001 publication, *Chemical Accident/Incident Response and Assistance Plan*. This plan establishes policies and procedures that ensure adequately trained personnel and appropriate equipment are present on post at all times to respond to emergency situations; it is currently being revised.

The Chemical Stockpile Emergency Preparedness Program (CSEPP) has further enhanced the depot's ability to respond to a chemical accident by providing facilities and equipment and by supporting a framework for exchanging information and coordinating assistance with the state and six surrounding counties. As part of CSEPP, ANAD operates an emergency operations center (EOC) in Building 363 for 24 hours a day, seven days a week. This facility enables the depot to respond expeditiously to any accident that may occur. In the unlikely event of a chemical accident or incident, EOC staff can readily run plume projections by using the Emergency Management Information System (EMIS), determine the protective action recommendation (PAR), alert the off-post response community, signal depot staff to respond, and activate the on-post outdoor warning system. The warning system consists of 17 on-post sirens capable of emitting several tones and voice messages. ANAD is also in the process of installing an enhanced visual/audio warning system (EVAWS) in the high-noise areas of the industrial portions of the depot. This system consists of indoor sirens and strobe lights.

CSEPP has also encouraged cooperation among ANAD, the six CSEPP counties, and the state with regard to communications, event classification and notification, exercises, public affairs, and planning. Joint communication links include a dedicated CSEPP hotline, commercial telephones, radios, e-mail, and the exchange of information on a CSEPP-Wide Area Network maintained by the Alabama Emergency Management Agency. A memorandum of agreement (MOA) for notification allows for the rapid exchange of information and sounding of outdoor warning devices. Calhoun and Talladega Counties are installing tone-alert radios off post. Joint exercises have been held annually since 1992. Public affairs efforts are coordinated and include a joint information center located on Fort McClellan, with an MOA among all participants.

ANAD also has plans for responding to other potential spill hazards. Procedures for responding to on-post spills of oil or a hazardous substance are contained in the *Anniston Army Depot Oil and Hazardous Substances Spill Contingency Plan*, which was published in 1997. This contingency plan describes controls designed to prevent spills of oil or hazardous substances and minimize the impact of spills on the environment. In addition, this contingency plan establishes policies and procedures that ensure adequately trained personnel and appropriate equipment are present on post at all times to respond to emergency situations.

The ANAD Fire and Emergency Services Division is staffed at all times with firefighter and emergency medical personnel. Equipment present on post for use in emergencies includes fire-fighting equipment and vehicles, ambulances with paramedic personnel, an emergency response vehicle, heavy equipment, and spill kits.

ANAD has medical mutual aid agreements with local fire departments and medical facilities to augment its emergency preparedness, as detailed in the 1991 U.S. Army Pamphlet 50-6, *Chemical Accident/Incident Response and Assistance Operations*, dated May 17. Current agreements for fire and rescue services are with Oxford EMS, City of Talladega, City of Anniston, and City of Oxford. Agreements for medical support are through U.S. Army Medical Department Activity, Fort Benning, Georgia, and are with:

- Northeast Alabama Regional Medical Center and Stringfellow Hospital, Anniston;
- Riverview Regional Medical Center and Gadsden Regional Medical, Gadsden;
- Citizens Baptist Medical Center, Talladega;

- Anniston Emergency and Rescue Squad, Anniston; and
- Oxford Emergency Medical Services, Inc., Oxford.

These local fire departments and medical facilities have agreed to provide emergency response assistance to ANAD upon request when it is possible to do so. In return, the ANAD Fire and Emergency Services Division and the Dear Occupational Health Clinic have agreed to do the same for these local entities, within their capabilities.

The Alabama Emergency Management Agency, Alabama Department of Public Health, and the Regional Medical Center located in Anniston have implemented a system in which a medical EOC coordinates all aspects of the medical response to a CSEPP incident. This includes the transfer of medical calls from the county's 911 center for dispatch, coordination of all hospitals in the county, ambulance and first responder dispatch, distant and hospital triage of patients, control of drugs, and management of other medical equipment logistic issues. Talladega and Etowah Counties are developing similar coordinating systems.

4.7.2 Impacts of the Proposed Action

This section discusses the potential environmental consequences on human health and safety from constructing and operating an ACWA pilot test facility at ANAD. Factors affecting human health and safety include occupational hazards to workers during continued storage and construction and operations and potential release of chemical agent or other hazardous materials during routine operations.

4.7.2.1 Impacts of Construction

Facility Workers. Impacts from construction would include occupational hazards to workers. While such hazards from can be minimized when workers adhere to safety standards and use protective equipment, as necessary, injuries associated with construction work can still occur.

The expected number of worker fatalities and injuries associated with the construction of an ACWA facility was calculated on the basis of estimates of total worker hours required for construction activities for each option as given in Kimmell et al. (2001) and rate data from the U.S. Bureau of Labor Statistics (BLS) as reported by the National Safety Council (1999). Construction of the Neut/Bio, Neut/SCWO, Neut/GPCR/TW-SCWO, or Elchem Ox facility is estimated to require approximately 412, 515, 525, or 554 FTEs per year, respectively, and could require up to 34 months. Annual construction fatality and injury rates used were as follows:

13.9 fatalities per 100,000 full-time workers and 4.4 injuries per 100 full-time workers. Annual fatality and injury risks were calculated as the product of the appropriate incidence rate (given above) and the number of FTE employees.

The annual fatality and injury rates for construction of ACWA facilities are shown in Table 4.7-1. No distinctions were made among categories of workers (e.g., supervisors, laborers), because the available fatality and injury statistics by industry are not refined enough to warrant analysis of worker rates in separate categories. The estimated number of fatalities for all the ACWA technologies assessed is less than one; the estimated annual number of injuries for construction of a Neut/Bio facility is 18, a Neut/SCWO facility is 23, a Neut/GPCR/TW-SCWO facility is 23, and an Elchem Ox facility is 24.

The calculation of risks of fatality and injury from industrial accidents was based solely on historical industrywide statistics and therefore did not consider a threshold (i.e., it was assumed that any activity would result in some estimated risk of fatality and injury). Whatever technology is implemented will be accompanied by best management practices, which should reduce fatality and injury incidence rates.

TABLE 4.7-1 Annual Occupational Hazard Rates Associated with Continued Munitions Maintenance (No Action) and ACWA Facility Construction and Operations at ANAD

Impact to Workers[a]	Neut/Bio	Neut/SWCO	Neut/GPCR/ TW-SCWO	Elchem Ox	No Action
Fatalities					
Construction	0.07	0.06	0.07	0.08	NA[b]
Systemization	0.01	0.01	0.01	0.01	NA
Operations	0.02	0.02	0.02	0.02	0.003
Injuries					
Construction	18	23	23	24	NA
Systemization	14	14	14	14	NA
Operations	31	31	31	31	4

[a] Impacts are based on the projected work force over the lifetime of the project. Fatality estimates of less than one should be interpreted as “no expected fatalities.” For the ACWA technologies, construction is estimated to require up to 34 months, and operations are conservatively estimated to require a maximum of about 3 years (except for Neut/Bio, which would require only 2 years for mustard-only processing). Under the terms of the CWC, the no action alternative could not extend beyond 2012, or about 11 years.

[b] NA = not applicable; i.e., construction and systemization phases are not associated with the no action alternative.

Other On-Post Workers and Residents. The main pollutant emissions associated with construction of an ACWA facility would be PM (see Section 4.5). Most of the on-post workers would be located 1 mi (1.6 km) or more from the proposed ACWA facility areas. PM_{10} and $PM_{2.5}$ levels associated with ACWA facility construction were modeled at off-post locations about 1.2 mi (2 km) east of proposed Area A (closest boundary where residences could potentially be located) (Section 4.5; Table 4.5-8). PM concentrations at the on-post locations of workers would presumably be similar because of the similar distance. The incremental PM levels estimated for the off-post area varied between 2% and 16% of the health-based 24-hour or annual NAAQS levels; therefore, adverse health impacts to on-post workers would not be expected from the inhalation of construction-related emissions. However, the background level for $PM_{2.5}$ is already almost equal to the annual NAAQS standard level, so there is a potential for adverse health impacts to workers from the existing environment**.**

Off-Post Public. The main pollutant emissions associated with construction of an ACWA facility would be PM. PM_{10} and $PM_{2.5}$ levels associated with ACWA facility construction were modeled at off-post locations about 1.2 mi (2 km) east of proposed Area A (closest boundary where residences could potentially be located) (Section 4.5; Table 4.5-8). The incremental PM levels estimated varied between 2% and 16% of the health-based 24-hour or annual NAAQS levels; therefore, adverse health impacts to the off-post public would not be expected from the inhalation of construction-related emissions. However, the background level for $PM_{2.5}$ is already almost equal to the annual NAAQS standard level, so there is a potential for adverse health impacts from the existing environment.

4.7.2.2 Impacts of Operations

Facility Workers

Occupational Hazards. Occupational hazards associated with systemization and operation of an ACWA pilot test facility at ANAD were estimated by using the same method as that discussed for construction (Section 4.7.2.1). The expected number of worker fatalities and injuries was calculated on the basis of rate data from the BLS as reported by the National Safety Council (1999) and estimates of total worker hours required for systemization and operational activities for each option as given in Kimmell et al. (2001). Operation of any of the ACWA technology systems is estimated to require approximately 655 FTE/yr, and systemization testing would require 12 months with a peak work force of 300 FTEs. Annual fatality and injury rates used were as follows: 3.2 fatalities per 100,000 full-time workers and 4.8 injuries per 100 full-time workers. Annual fatality and injury rates for the manufacturing sector were used because that sector was assumed to be the most representative for systemization and operational work at an ACWA facility. The annual fatality and injury rates for systemization and operation of ACWA facilities are shown in Table 4.7-1. The estimated number of injuries is the same for each technology, 14 per year during systemization and 31 per year during operations.

Inhalation Risks. For routine operations, inhalation exposures and risks for facility workers would depend in part on detailed facility designs that are not yet available. In this EIS, facility workers are generally excluded from health risk evaluation for occupational exposure because such exposures are covered by other guidance and regulations (EPA 1998b). Although quantitative estimates of risks to ACWA facility workers from inhalation of substances emitted during facility operations were not generated for this EIS, the workplace environment would be monitored to ensure that airborne chemical concentrations were below applicable occupational exposure limits. Health risks from occupational exposure through all pathways would be minimized because operations would be enclosed as much as possible and because protective equipment would be used if remote handling of munitions was not possible during processing.

Other On-Post Workers

Inhalation of Toxic Air Pollutants. Estimated maximum on-post concentrations of toxic air pollutants from the destruction technologies are discussed in Appendix C. The maximum on-post concentrations were found to occur close to the CLA at ANAD. On-post exposures were modeled on the basis of exposure assumptions typical for the maximum exposed individual (MEI). This person would be a worker assumed to be present at the location of maximum on-post air concentration for eight hours per day and 250 days per year, for the duration of the pilot test operations for each technology. Exposure estimates generated on the basis of these assumptions were compared with cancer and noncancer toxicity values to generate estimates of increased cancer risk and of the potential for noncancer health impacts. A summary of the results of this assessment is shown in Table 4.7-2. Details of the assessment are provided in Appendix C.

As shown in Table 4.7-2, for the four technology systems evaluated, estimated hazard indexes and carcinogenic risks from exposure to toxic air pollutants estimated for the on-post MEI were well below the benchmarks considered representative of negligible risk levels. The typical benchmark indicator for significant noncarcinogenic hazards is a hazard index of greater than 1, and for carcinogenic hazards, it is an increased lifetime carcinogenic risk level of greater than 1×10^{-6}. Hazards for all four technologies were very comparable, generally on the same order of magnitude. Almost all of the estimated noncarcinogenic and carcinogenic risks shown in Table 4.7-2 were associated with boiler emissions and not with destruction facility processes. Note that exposures and risks are slightly higher for the off-post MEI than for the on-post MEI because the annual exposure duration for the off-post MEI is assumed to be longer (see next subsection on off-post public).

TABLE 4.7-2 Toxic Air Pollutant Emissions and Impact on Human Health and Safety during Normal Operations at ANAD[a]

Emissions and Impacts	Neut/Bio[b]	Neut/SCWO	Neut/GPCR/ TW-SCWO	Elchem Oxidation
Hazardous air emissions				
Number of chemicals detected	107	63	183	103
Number of chemicals with quantitative data on toxic, noncarcinogenic effects[c]	79	38	73	42
Number of chemicals with quantitative data on carcinogenic effects[d]	57	23	39	28
Impacts[e]				
Hazard index (*hazard index of <1 means adverse health impacts are unlikely*)				
For MEI[e] in off-post general public, nerve agent processing	NA[f]	2×10^{-3}	3×10^{-3}	5×10^{-3}
For MEI in off-post general public, mustard agent processing	2×10^{-3} (3×10^{-3})	2×10^{-3}	5×10^{-4}	2×10^{-3}
For MEI in on-post population, nerve agent processing	NA	2×10^{-4}	2×10^{-3}	4×10^{-4}
For MEI in on-post population, mustard agent processing	2×10^{-4} (3×10^{-4})	2×10^{-4}	3×10^{-4}	2×10^{-4}
Increased lifetime carcinogenic risk (*risk of 10^{-6} is generally considered negligible*)				
For MEI in off-post general public, nerve agent processing	NA	3×10^{-8}	2.1×10^{-9}	5×10^{-8}
For MEI in off-post general public, mustard agent processing	5×10^{-9} (8×10^{-9})	7×10^{-9}	7×10^{-10}	6×10^{-9}
For MEI in on-post population, nerve agent processing	NA	2×10^{-9}	3×10^{-9}	5×10^{-9}
For MEI in on-post population, mustard agent processing	2×10^{-9} (2×10^{-9})	5×10^{-10}	7×10^{-10}	5×10^{-10}
Increased lifetime carcinogenic risk to population due to worst-case mustard emissions (*risk of 10^{-6} is generally considered negligible*)[g]				
Off post	2×10^{-7}	2×10^{-7}	2×10^{-7}	2×10^{-7}
On post	1×10^{-8}	1×10^{-8}	1×10^{-8}	1×10^{-8}

[a] Based on emission estimates from demonstration testing (Kimmell et al. 2001) and model estimates of maximum on-post and off-post concentrations and adjusted to account for fluctuating operations. ISCST3 model was used. Estimates for general public assumed 24-h/d exposures for the duration of operations. Estimates for the on-post population assumed 8-h/d exposures and 250-d/yr of the duration of operations. See Appendix C for details.

[b] For Neut/Bio, the value in parentheses assumes no further treatment of emissions from the biotreatment vent after they have been processed in the immobilized cell bioreactor (ICB) unit.

[c] Potential noncarcinogenic impacts from some detected chemicals could not be evaluated quantitatively because toxicity data were not available (see text discussion). For Neut/Bio, Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox, 17, 14, 99, and 50 chemicals, respectively, could not be quantitatively evaluated for either noncarcinogenic or carcinogenic effects (see text).

[d] All known carcinogens were evaluated for carcinogenic risk.

[e] Carcinogenic risks are less than 10^{-6} and hazard indexes are less than 0.01 for all technologies; thus, they are in the negligible range. Although calculated cancer risks range from approximately 10^{-10} to 10^{-7}, and calculated hazard indexes range from 10^{-4} to 10^{-2}, there is no significant difference in risk among the technologies. Thus, for all the technologies, increased cancer and noncancer risks from inhalation of emissions are in a range considered to be negligible.

[f] NA = not applicable; MEI = maximum exposed individual.

[g] Although the facility would be designed to operate without mustard releases, these values were estimated as a worst case by assuming continuous emission at the detection limit (Kimmell et al. 2001). The estimated concentrations are all 1% or less of the allowable concentrations for general population exposures.

There are some uncertainties in the demonstration test data used to estimate emissions of toxic air pollutants that should be considered in interpreting the results. Some unit operations were not characterized in demonstration testing, so trace effluents were not estimated for all unit operations that would make up the complete systems. Generally, data were available for unit operations that would be expected to generate the most gaseous emissions during actual operations (Mitretek 2000a–d). However, the emission levels and health risk estimates provided here should be considered only indicative of likely levels. They may need to be revised as technology designs near completion and as estimates of process efficiencies become more reliable (Kimmell et al. 2001). Nevertheless, the values used for the risks from operations presented in this EIS were designed to be very conservative (i.e., potentially resulting in overestimates of risk) and to bound minor variations in the way that the ACWA destruction systems would be engineered.

In general, toxicity benchmark levels were available to allow quantitative risk estimates for the majority of toxic air pollutants detected. For Neut/SCWO operations, 14 of the detected chemicals (22%) did not have established (i.e., peer-reviewed) noncarcinogenic or carcinogenic toxicity benchmark levels (see Appendix C). For Neut/GPCR/TW-SCWO operations, 99 of the detected chemicals (53%) did not have established toxicity benchmark levels. For Elchem Ox operations, 50 of the detected chemicals (49%) did not have established toxicity benchmark levels. For Neut/Bio operations, 17 of the detected chemicals (16%) did not have established toxicity benchmark levels. For most of the substances for which toxicity could not be quantitatively evaluated, emission levels were very low (e.g., less than 10 g/d). Although not quantitatively assessed, toxic effects would be highly unlikely in association with these very low emission levels. For several substances emitted from boilers and diesel generators (aldehydes, propane, butane, pentane, and ethane), emission levels were somewhat higher (up to about 1 kg/d). Although potential health effects from inhalation of these substances could not be quantitatively evaluated because of the lack of toxicity benchmark levels, such data would not distinguish among risks associated with the alternate technologies, because each of the technologies evaluated uses boilers and diesel generators.

Inhalation of Chemical Agent. Maximum potential concentrations from emissions of agent (including consideration of fluctuating operations) were discussed in Section 4.6.3.3. For all three chemical agent types stored at ANAD, modeling dispersion from the estimated maximum emissions resulted in a maximum estimated on-post concentration of less than 1% of the allowable concentration for general public exposures. In practice, the facility stacks would have continuous agent monitoring devices that would sound if any agent were detected in the stacks. By this means, the source could be identified and eliminated quickly; emissions would not be allowed to continue at the detection limit level, as was assumed in the modeling exercise.

Mustard has been classified as a known carcinogen (see Appendix C). The maximum incremental cancer risk for the on-post MEI due to hypothetical mustard emissions was estimated to be 1×10^{-8} (Table 4.7-2). This risk level is 100 times lower than the benchmark risk value of 1×10^{-6}, and, as stated above, emission levels would not be allowed to continue at the detection limit level for more than a short time, so the exposure estimate based on the entire duration of operations is a large overestimate. Therefore, even under hypothetical worst-case emission levels, carcinogenic risks from mustard emissions associated with a pilot facility would be very small.

Exposures from Other Pathways. Other potential exposure pathways to be considered are water (if effluent from the pilot facilities were to be released to nearby waterways) and soil and food (if soil were to become contaminated by releases to air and subsequent deposition). For pilot testing each of the ACWA technologies, plans are to recycle all process water through the system. The facilities are not expected to generate any aqueous effluent except for the sanitary wastewater generated by employees. Also, exposure through soil and food chain pathways from deposition onto soil and/or water is expected to be very low, since the level of air emissions that would result from routine operations is expected to be very low and since the duration of operations would be short. All facility releases would be in conformance with applicable local and state permit requirements. Therefore, exposures through water, soil, or food chain pathways would result in very minimal, if any, additional risk to on-post workers.

Off-Post Public

Inhalation of Toxic Air Pollutants. Maximum off-post concentrations of toxic air pollutants that would result from the ACWA technologies are discussed in Appendix C. Off-post exposures were modeled by using exposure assumptions typical for the MEI in the off-post residential population. This hypothetical person is considered to be an individual who is present at the location of the maximum off-post concentration of a pollutant in air for 24 hours per day and 365 days per year, for the duration of the pilot test operations for each technology. Exposure estimates generated on the basis of these assumptions were compared with cancer and noncancer toxicity values to generate estimates of increased cancer risk and of the potential for noncancer health impacts. A summary of the results of this assessment is shown in Table 4.7-2. Details of the assessment are provided in Appendix C.

This assessment was limited to the estimation of risks associated with inhalation of emitted substances. For some of the emitted substances (e.g., PCBs, dioxins, and furans), exposure to the off-post public through the food-chain pathways could be as large or larger than exposure through inhalation, because these substances are bioaccumulative. Estimates of exposure through these alternate pathways can be highly uncertain and are beyond the scope of this EIS. However, for all the technologies, the emission rates for these substances are quite low (less than 0.00001 lb/yr for all forms of dioxins and furans and less 0.005 lb/yr or less for PCBs). For the purpose of this assessment (i.e., to compare the risks associated with pilot testing the alternate ACWA technology systems), estimation of the risk associated with inhalation should be indicative of the risk from all pathways.

As shown in Table 4.7-2, for the four technology systems evaluated, estimated hazard indexes and carcinogenic risks from exposure to toxic air pollutants estimated for the off-post MEI were well below the benchmarks considered representative of negligible risk levels. The typical benchmark indicator for significant noncarcinogenic risks is a hazard index of greater than 1, and for carcinogenic hazards, it is an increased lifetime carcinogenic risk level of greater than 1×10^{-6}. Hazards for all four technologies were very comparable, generally on the same order of magnitude. Almost all of the estimated noncarcinogenic and carcinogenic risks shown in Table 4.7-2 were associated with boiler emissions and not with destruction facility processes. Note that exposures and risks are slightly higher for the off-post MEI than for the on-post MEI because the annual exposure duration for the off-post MEI is assumed to be longer (see previous discussion for on-post workers).

Per Executive Order 13045 (1997), it is also necessary to consider whether sensitive subpopulations, such as children or the elderly, could be more affected by the estimated exposures to toxic air pollutants than could the general population. The reference concentrations used to evaluate the noncarcinogenic toxicity of the emitted substances already include factors to account for the possible added sensitivity of certain subpopulations. Chemical-specific potency estimates for carcinogens also include conservative uncertainty factors and so can be used to assess risks for sensitive subpopulations. However, the exposure parameters used to estimate intake (i.e., 154 lb [70 kg] body weight; 20 m^3/d inhalation rate) are typical for adults. To consider intake for young children (less than one year old), an inhalation rate of 4.5 m^3/d and a body weight of 20 lb (9 kg) (EPA 1997) could be assumed. Use of these assumptions would result in an estimate of inhalation dose (in mg/kg/d) for a young child that would be 1.7 times greater than the dose assumed for an adult, and overall hazard indices and cancer risks would also increase by a factor of 1.7. Since the hazard indices and cancer risks estimated for toxic air pollutant emissions during normal operations were low (Table 4.7-2), risk levels for sensitive subpopulations, such as children, would still be far less than benchmark levels.

Inhalation of Chemical Agent. Maximum potential off-post concentrations from emissions of agent (including consideration of fluctuating operations) were discussed in Section 4.6.3.3. For all three chemical agent types stored at ANAD, modeling dispersion from the estimated maximum emissions resulted in a maximum estimated off-post concentration of less than 1% of the allowable concentration for general public exposures (CDC 1988). In practice, the facility stacks would have continuous agent monitoring devices that would sound if any agent was detected in the stacks, so that the source would be identified and eliminated quickly.

Mustard has been classified as a known carcinogen (see Appendix C). The maximum incremental cancer risk for the off-post MEI due to hypothetical mustard emissions was estimated to be 2×10^{-7} (Table 4.7-2). This risk level is about 10 times lower than the benchmark risk value of 1×10^{-6}, and, as stated above, emission levels would not be allowed to continue at the detection limit level for more than a short time, so the exposure estimate based on the entire duration of operations is a large overestimate. Therefore, even under hypothetical worst-case emission levels, carcinogenic risks from mustard emissions associated with the destruction facilities would be very small.

Exposures from Other Pathways. Exposures through water, soil, or food chain pathways would result in very minimal, if any, additional risk to the off-post public (see previous discussion of exposure from other pathways for on-post workers).

4.7.3 Impacts of No Action

Activities associated with continued storage (no action) at ANAD would include inspecting and conducting an annual inventory of all munitions, overpacking any leaking munitions discovered during inspections, and transporting the overpacked leakers to a separate storage igloo. Before a worker can enter into any igloo, the air inside is monitored for the presence of agent. Workers are required to wear respiratory protection and protective clothing while in the storage igloos. Therefore, during routine operations under the no action alternative, no worker would be exposed to chemical agent. Routine use of other chemicals would not be required for continued storage operations, so exposure to other chemicals would be limited. A potential hazard would be heat stress associated with the heavy protective clothing and equipment required for the work. However, workers are trained to control this hazard. For the other on-post workers and residents and for the general public, no impacts on human health are expected in association with the no action alternative.

Risk calculations for occupational fatalities and injuries resulting from the no action alternative (i.e., continued storage and maintenance of the ANAD stockpile) are presented in Table 4.7-1. The expected number of worker fatalities and injuries associated with continued maintenance of the munitions stockpile at ANAD was calculated on the basis of rate data from the BLS as reported by the National Safety Council (1999) and an estimate of 90 FTE employees required for munitions maintenance activities each year (Burdell 2000d). Annual fatality and injury rates for the manufacturing sector were used because this sector was assumed to be the most representative for munitions maintenance work. The specific rates were as follows: fatality rate of 3.2 per 100,000 full-time workers and injury rate of 4.8 per 100 full-time workers. Annual fatality and injury risks were calculated as the product of the appropriate incidence rate (given above) and the number of FTE employees. No distinctions were made among categories of workers (e.g., supervisors, inspectors, security personnel), because the available fatality and injury statistics by industry are not refined enough to warrant analysis of worker rates in separate categories. The estimated number of fatalities was less than one; the estimated number of injuries was four.

4.7.4 Impacts from Transportation

Chemical agent would not be transported on or off post for any of the alternative technologies evaluated. However, transportation can have adverse impacts on human health because of the associated emission of toxic air pollutants such as benzene, 1,3-butadiene, and formaldehyde. Emissions consist of engine exhaust from diesel- and gasoline-powered vehicles and fugitive dust raised from the road by transport vehicles. Increased incidence of lung cancer has been associated with prolonged occupational exposure to diesel exhaust (Dawson and Alexeeff 2001); toxic air pollutants are also emitted from gasoline-burning vehicles (EPA 2000e). Also, transportation results in some increased risk of injuries and fatalities from mechanical causes; that is, the transport vehicles may be involved in accidents. This type of risk is termed “vehicle-related.” Both the chronic health hazard from inhalation of emissions from transport vehicles and the injury risk are directly proportional to the number of vehicle miles traveled. For the transportation impacts in this EIS, the annual number of vehicle miles traveled by delivery vehicles (used for delivery of construction materials) and commuter vehicles (used to transport construction and operation workers) was compared for each of the alternative technologies and for the no action alternative. In addition, the annual number of shipments of raw materials and waste required for each alternative was tabulated. It was assumed that the distances for shipping raw materials and waste would be similar for each of the alternatives. This assumption was necessary because actual origination and destination locations had not been determined. Therefore, the data did not support risk calculations using diesel emission factors. The comparison of the number of vehicle miles traveled and the number of shipments by alternative is useful for an overall comparison of the potential transportation impacts to human health from each alternative.

The transportation impacts for ANAD are summarized in Table 4.7-3. The number of miles traveled annually by construction and operations worker commuter vehicles is similar for each technology. For both mustard and nerve agent processing, the Neut/SCWO technology would require the greatest number of shipments annually; approximately 60% more than the other technologies for mustard processing and about 30% more for nerve agent processing. The amount of transportation required for the no action alternative is very small.

4.8 NOISE

The *Noise Control Act* of 1972, along with its subsequent amendments (*Quiet Communities Act* of 1978, *United States Code*, Title 42, Parts 4901–4918 [42 USC 4901–4918), delegates to the states the authority to regulate environmental noise and directs government agencies to comply with local community noise statues and regulations. The State of Alabama and Calhoun County, where ANAD is located, have no quantitative noise-limit regulations.

TABLE 4.7-3 Comparison of Annual Transportation Requirements for Construction and Routine Operations for Alternative Technology Systems at ANAD[a]

Parameter	Neut/Bio[b]	Neut/SCWO	Neut/GPCR/ TW-SCWO	Elchem Ox	No Action[c]
Number of vehicle miles traveled[d]					
Construction delivery vehicle	200,000	200,000	200,000	200,000	NA[e]
Construction worker commuter vehicle	4,000,000	4,900,000	5,000,000	5,300,000	NA
Operations worker commuter vehicle	6,300,000	7,200,000	7,200,000	7,200,000	1,000,000
Number of shipments[f]					
Mustard agent					
Raw materials	88	479	101	191	NA
Waste	384	263	281	258	NA
Total	472	742	382	449	NA
Nerve agent					
Raw materials	NA	479	229	137	NA
Waste	NA	560	590	562	NA
Total	NA	1,039	819	699	<1

[a] Number of vehicle miles traveled and number of shipments are used as indicators of potential transportation-associated health impacts, since emissions and vehicle-related risks increase with increasing transportation.

[b] Neut/Bio totals are for mustard agent processing only.

[c] No action alternative assumes 90 employees would be required for continued storage maintenance.

[d] Annual miles are calculated as the number of workers × 276 work days per yr × 40 mi per round trip.

[e] NA = not applicable.

[f] Raw material and waste shipments for nerve agent are the maximum annual for either GB or VX processing.

Input data sources: Kimmell et al. (2001).

ANAD has developed environmental noise management assessments. Two different sound-level measures of day-night sound level (DNL or L_{dn})[7] are used by the U.S. Army for noise impact assessments in the Army's Environmental Noise Management Program (which incorporates and replaces the Installation Compatible Use Zone Program): A-weighted DNL (ADNL) and C-weighted DNL (CDNL). ADNL is a descriptor used for evaluation of environmental noise-impact on the general population, and CDNL is a descriptor used for evaluation of risk to hearing damage produced by impulsive noise. For the Army's regulatory purposes, these measures are both used to define three land-use classifications. Table 4.8-1 presents these ADNL and CDNL noise-limit criteria for each of three zone classifications

[7] L_{dn} is the time-weighted 24-hour average sound level with a 10 decibel (dB) penalty added to the nighttime levels (2200 to 0700 hours).

TABLE 4.8-1 Noise Criteria for Noise-Sensitive Land Use Classifications

Noise Zone[a]	Noise Limits[b] ADNL (dBA)	Noise Limits[b] CDNL (dBC)	Population Highly Annoyed (%)
Zone I	< 65	< 62	< 15
Zone II	65–75	62–70	15–39
Zone III	> 75	> 70	> 39

[a] Zone I noise levels are acceptable and there is no conflict with noise-sensitive land uses. Zone II noise levels are normally unacceptable for sensitive land uses, such as hospitals, housing, and schools, but are generally acceptable for offices and other work areas. Zone III levels are unacceptable for any residential uses. However, industrial, agricultural, and some commercial business may be compatible.

[b] ADNL and CDNL = A-weighted and C-weighted day-night sound levels. DBA and dBC = A-weighted and C-weighted decibels.

Source: U.S. Army (1997a); ANAD (undated).

(Zones I, II, and III) and corresponding percent of highly annoyed population (U.S. Army 1997a; ANAD undated). Noise-sensitive land uses, such as hospitals, housing, and schools, are considered incompatible with noise environment in Zone III, normally incompatible in Zone II, and compatible in Zone I.

The EPA has recommended a maximum noise level of 70 dB(A)[8] as DNL limit to protect against permanent hearing loss and a maximum noise level of 55 dB(A) as DNL to protect against outdoor activity interference and annoyance (EPA 1974). These levels are not regulatory goals, but are "intentionally conservative to protect the most sensitive portion of the American population" with "an additional margin of safety." For protection against hearing loss in the general population from nonimpulsive noise, the EPA guideline recommends an average L_{eq} limit of 70 dBA over a 40-year period.[9]

---

[8] dBA is a unit of weighted sound-pressure level, measured by the use of the metering characteristics and the A-weighting specified in ANSI S1.4-1983 (the American National Standards Institute specification for sound level meters) and in ANSI S1.4-1985, the Amendment to ANSI S1.4-1983 (Acoustical Society of America 1983, 1985).

[9] L_{eq} is the equivalent steady sound level that, if continuous during a specific time period, would contain the same total energy as the actual time-varying sound. For example, L_{eq} (1-h) is the 1-hour equivalent sound level.

4.8.1 Current Environment

ANAD is situated in rural Calhoun County, about 10 mi (16 km) from the cities of Anniston and Oxford. The small community of Bynum lies on the depot's southern boundary. Land near the remaining three boundaries are sparsely settled. The north boundary is adjacent to Pelham Range, a wooded operational and training area. The east and west boundaries are bordered by sparsely populated rural lands. The major highways serving ANAD are Interstate 20 (I 20) and U.S. Highway 78 (US 78), running east and west, and US 431, running north and south (Figure 4.1-1). The main access to the ANAD is from State Highway 202.

The primary noise-producing activities within ANAD are associated with the operation of the tank firing range, burning ground, demolition pit, and recoilless rifle range, which are located in the depot's restricted area. Other noise sources outside ANAD, which affect the noise levels within, are firing activities from Pelham Range north of the site. The most recent noise assessment at ANAD in 1987 indicated that Zone III is limited to small areas in the northwest within ANAD and that Zone II (normally unacceptable for residential use) does not extend off federal lands, as shown in Figure 4.8-1. The Zone II areas extend onto Pelham Range over about 15 acres (6 ha). All other locations within the depot boundary are classified as Zone I. The location of the preferred site for the proposed facility is in the northern central section of the depot, in the Zone I area, about 0.5 mi (0.8 km) from the nearest part of the Zone II area (Figure 4.8-1).

Ambient sound level measurements at ANAD are not currently available. As indicated above, most areas surrounding ANAD are compatible with noise-sensitive land uses. No sensitive noise receptors (e.g., hospitals, schools) are located near the site. The nearest resident is located about 1.2 mi (2 km) east of the post. There is no off-post noise problem from operation of the ranges and the demolition pit at ANAD. Dense forests within and around the ANAD site are likely to decrease noise levels.

4.8.2 Noise Sources from the ACWA Pilot Test Systems

Noise sources during construction of an ACWA pilot facility would include standard commercial and industrial activities for moving earth and erecting concrete and steel structures. Noise levels generated from these activities would be comparable to those from any construction site of similar size.

Pilot facility operations would involve a variety of equipment that would generate noise. Some equipment, such as fans and pumps for conveying and handling treatment residues (e.g., pollution abatement systems), heating and air conditioning units, electrical transformers, and in-plant public address systems, might be located outside the buildings. However, most of the equipment used in ACWA pilot testing operations would be housed inside buildings designed to

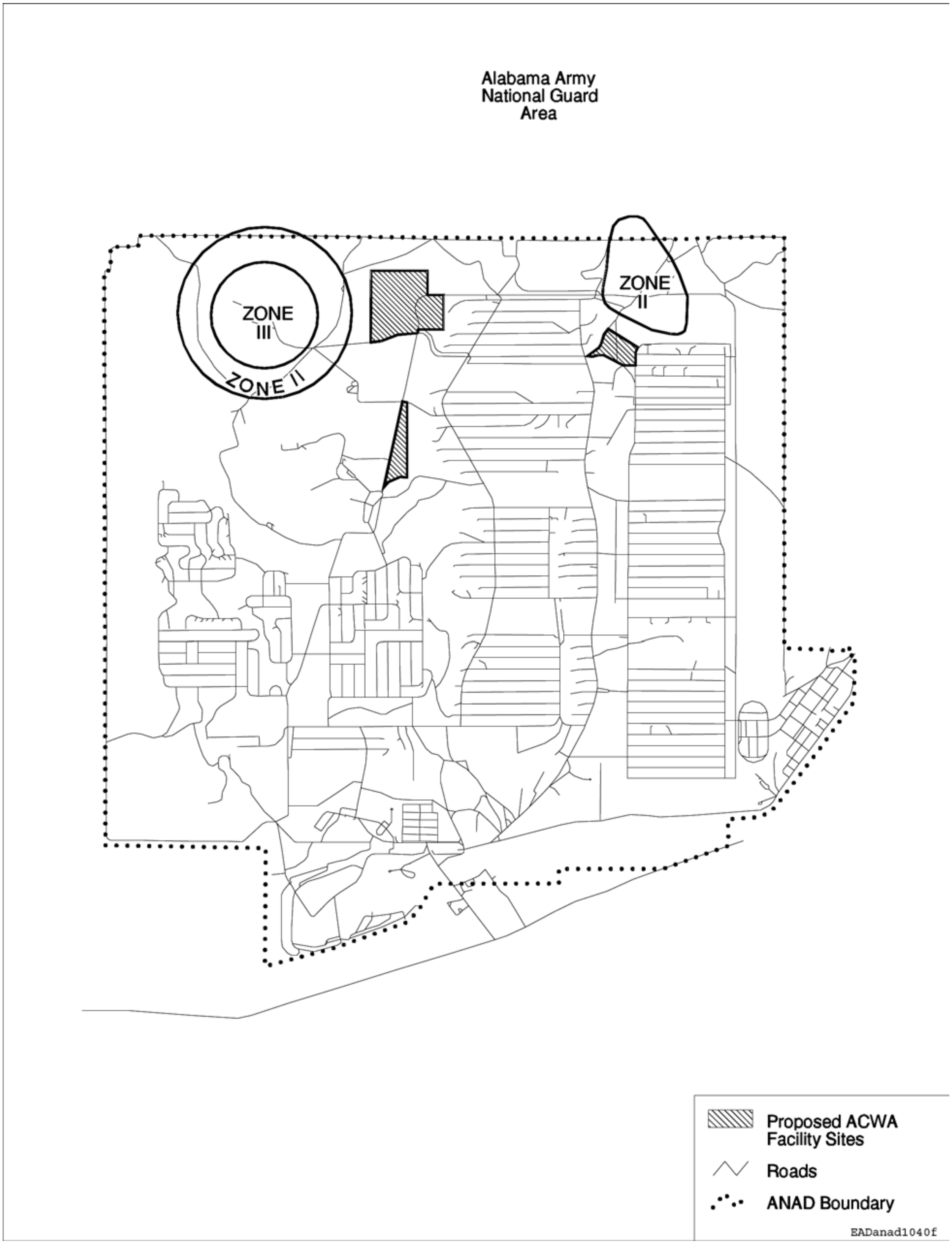

FIGURE 4.8-1 Noise-Sensitive Zones at ANAD

prevent the release of chemical agents and contain potential explosions. The walls, ceiling, and roofing materials used in these buildings would attenuate noise generated by the activities inside the buildings.

During both construction and operation, the commuter and delivery vehicle traffic in and around the ACWA facility would also generate noise. However, the contribution of noise from these intermittent sources would be minor in comparison to that from the continuous noise sources during construction or operation.

As it was in the air quality modeling presented in Section 4.5, Area A, which is located closer to the site boundary in the direction of neighboring residences, was selected as the receptor for the analysis of potential noise impacts. Regardless of the technology selected, it is assumed that noise levels from both construction and operations would be similar, since detailed information on noise from construction and operational activities associated with an ACWA facility is not available.

4.8.3 Impacts of the Proposed Action

4.8.3.1 Impacts of Construction

Operation of equipment and vehicles during construction and associated activities would typically generate noise levels in the 77–90 dBA range at a distance of about 50 ft (15 m) from the source (EPA 1979). Noise levels decrease by about 6 dB for every doubling of distance from the source because sound spreads over an increasing area (geometrical divergence). Thus, construction activities at the pilot test facility location would result in maximum estimated noise levels of about 48 dBA at the ANAD boundary closest to Area A, about 1.2 mi (2.0 km) east of the facility. The noise level would be lower than 48 dBA at residences located further away from the eastern site boundary.

This 48-dBA estimate is likely to be an upper bound because it does not account for other types of attenuation, such as air absorption and ground effects due to terrain and vegetation. This level is below the EPA guideline of 55 dBA for residential zones (see Section 4.8.1) and is in the range found within a typical residential community at night (Corbitt 1990). If other attenuation mechanisms were considered, noise levels at the nearest residence would decrease to near background levels typical of rural environments. In particular, tall vegetation between the proposed facility and the site boundary would contribute to additional attenuation. Thus, potential noise impacts from construction activities at the pilot test facility location are expected to be minor to negligible at the nearest residence. The resulting noise levels would be well within the EPA guidelines, which were established to prevent activity interference and annoyance or hearing impairment.

4.8.3.2 Impacts of Operations

At the baseline incinerator facility in Tooele, Utah, the highest sound levels during operation were measured in the vicinity of the pollution abatement system (Andersen 2000), which is similar in design to pollution abatement systems being considered for use in an ACWA pilot facility. These sound levels were less than 73 dBA within 100 ft (30 m) of the abatement equipment. When the noise attenuation factors discussed in Section 4.8.3.1 are applied, estimated noise levels would be less than 37 dBA at the nearest site boundary. This noise level at the site boundary is comparable to the ambient background level typical of a rural environment and would be hardly distinguishable from the background level, considering other attenuation effects. In conclusion, noise levels generated by plant operation should have negligible impacts on the residence located nearest to the proposed facility and would be well within the EPA guideline limits for residential areas.

4.8.4 Impacts of No Action

The levels of noise generated by current stockpile maintenance activities are part of the current background noise levels, which reflect the operations of the installation. These levels are not expected to change under the no action alternative; therefore, the conditions described in Section 4.8.1 (affected environment) would continue to exist.

4.9 VISUAL RESOURCES

Natural and human-made features give a particular landscape character and aesthetic quality. The character of a landscape is determined by its form, line, color, and texture; each element may influence the character to a varying degree. The stronger the influence of any one or all of these elements, and the more visual variety that can successfully coexist in the landscape, the more aesthetic quality is present in the landscape.

4.9.1 Current Environment

The viewshed within the vicinity of ANAD consists mainly of agricultural and forested land, with some residential and industrial development. The landscape is characterized mainly by woodland or forest on low mountains and hills, with intermittent open land. Vegetation consists of broadleaf deciduous forests in the low-lying areas, pine forests on higher ground, and mixed forests elsewhere.

At ANAD, industrial and administrative development is confined mostly to the southern and southeastern portion of the post. Smaller, more sporadic developments occur in the northwestern parts and along the northern perimeter of the post. Munitions storage facilities are scattered throughout the southwestern, southeastern, and northeastern parts of the post. All of the industrial and administrative areas are brightly lit at night. The munitions storage areas are not visible from off post. The views are limited by the rolling terrain and the relatively dense forests. The industrial and administrative areas of the site can be seen from County Road 109 to the east of the Nichols Industrial Area and State Highway 202 to the south of the site.

The industrial and other developed areas on the installation, including utility corridors, are generally consistent with a BLM Visual Resources Management (VRM) Class IV designation (hosting activities that lead to major modification of the existing character of the landscape). The remainder of the site fits a VRM Class III or IV designation (hosting activities that, at most, only moderately change the existing character of the landscape) (DOI 1986a,b).

Within the CLA, buildings and structures consist mainly of a small number of administrative and vacant buildings and about 155 storage igloos used to house chemical munitions. Buildings in the CLA are located primarily at the western end of the area, the site of the Reconfiguration Facility, and between Areas C and G, the site of Building 88 and other small buildings. Throughout the CLA, structures are generally less than 30 feet (9.1 m) in height, and only the buildings and surrounding parking lots are brightly lit at night. The CLA can be viewed only from the on-post access roads to the north and south and cannot be seen at all from off post. Visual resource conditions in the CLA are consistent with a VRM Class IV designation (DOI 1986a,b).

4.9.2 Site-Specific Factors

The general visual aesthetic character of ANAD could be affected by these factors:

1. Appearance of the ACWA facility itself and its supporting components (other facilities, transmission lines, roads, parking areas),

2. The placement of the ACWA facility (its elevation, adjacent land use, resulting viewshed, etc.) and

3. Visibility impacts due to fugitive dust emissions from construction or due to steam emissions from the operating stacks.

4.9.3 Impacts of the Proposed Action

4.9.3.1 Impacts of Construction

Construction of an ACWA facility would not be expected to affect the visual character of the area because (1) there are no significant visual resources in the area, (2) surrounding areas are primarily forested and not accessible to the public, and (3) the effects would be intermittent and temporary. No change in the BLM VRM class designation would be expected.

4.9.3.2 Impacts of Operations

The presence of ACWA facilities is consistent with the surrounding land uses and would not adversely affect the visual character of the area. Operation of the facilities would not create significant, visible emissions. No change in the BLM VRM class designation would be expected.

4.9.4 Impacts of No Action

Under the no action alternative, there would be no change to the existing visual character of ANAD.

4.10 GEOLOGY AND SOILS

4.10.1 Current Environment

4.10.1.1 Geology

ANAD lies within the Alabama sector of the Appalachian Valley and Ridge Province (Adams et al. 1926). Cambrian to Pennsylvanian-age strata are exposed in long narrow belts of the northeast-trending ridges and valleys. ANAD is located in the Coosa Valley, which is 20 mi (32 km) wide and trends northeast-southwest for approximately 100 mi (162 km).

The sedimentary column in this region has been tilted and thrust-faulted into a series of disharmonic sheets. Most of the thrust faults dip to the southeast, and northwest-directed transport along the thrust faults has resulted in the stacking of large thrust sheets. Local-scale (less than several miles in length) geologic structures range from complex folds and fracture systems near the terminus of a thrust fault, to broader folds within the central regions of the thrust sheets (Thompson et al. 1999).

In the Anniston area, bedrock consists of Cambrian to Ordovician-age clastic and carbonate rocks composed of sandstones, shales (mudstones), cherty limestones, dolomites, and quartzites (Thompson et al. 1999). The carbonate bedrock is overlain by a dolomite-derived residuum that consists of residual clays with chert fragments and rock boulders. Many sinkholes and depressions have formed in the residuum, the result of solution collapse of underlying carbonate bedrock.

A survey of potential economic resources at ANAD has not been conducted. The principal mineral resources in Calhoun County are barite, bauxite, high-alumina clays, limestone, shale, and tripoli (Neathery et al. 1972; Rheams 1992). Tripoli, which is valuable as an abrasive and mineral filler, is the most likely economic mineral in the vicinity of ANAD. Tripoli occurs in association with siliceous limestone and dolomite, which are present at ANAD (Rheams and Richter 1988). A tripoli outcrop was observed by Rheams (1988) approximately 5 mi (8 km) north of ANAD near Brook Mountain.

4.10.1.2 Seismicity

ANAD lies within the Appalachian Tectonic Province (U.S. Army 1991). Other seismic zones in the region include the New Madrid Seismic Zone, located about 267 mi (430 km) from the site; the Piedmont Tectonic Province, located approximately 12.5 mi (20 km) from the site; and a small seismic zone located about 360 mi (580 km) east of the site at the location of the Charleston, South Carolina, earthquake of 1886. Numerous faults occur in the ANAD vicinity, but none of them are considered capable of producing an earthquake. The Pell City Fault, the largest regional fault in the area, is located several miles northwest of the site. The Jacksonville Fault is located on the southeastern boundary of the facility. This fault is not considered to be regional (Yankee Atomic Electric Company 1994). Initial studies indicated the Jacksonville Fault ended near the town of Bynum, southwest of ANAD (Thompson et al. 1999); however, a more recent study indicated the Jacksonville Fault may extend further toward the Jackson Shoals area (Thompson et al. 1999).

The largest known earthquake near ANAD occurred in 1916. It had an epicenter near Fort McClellan, Alabama, about 18.6 mi (30 km) from the facility. This earthquake had a maximum Modified Mercalli Intensity of VII in the epicentral region (Yankee Atomic Electric Company 1994). It was noted by residents in seven states across an area about 100,000 mi^2 (260,000 km^2) in size (USGS 2000). An earthquake of this intensity produces some damage to masonry and causes difficulty in standing. An even larger earthquake, having an intensity equal to a Modified Mercalli Intensity of X, occurred near Charleston, South Carolina, in August 1886 (USGS 2000). Additional Intensity V earthquakes listed for Alabama were centered near Rosemary, Alabama, in June 1917; in the Scottsboro area northeast of Huntsville, Alabama, in June 1927; at Cullman, Alabama, in May 1931; and in the Anniston area in May 1939. There have been no Intensity V earthquakes with epicenters in Alabama since 1939 (USGS 2000).

The estimated peak ground acceleration at ANAD would be generated by an earthquake having an intensity equal to a Modified Mercalli Intensity of X (U.S. Army 1991). This event would be located at the site and would produce an estimated peak ground acceleration of 0.28 G. The duration of this event would be 15 seconds. A distant event at the location of the Charleston earthquake would produce an estimated peak ground acceleration of 0.10 G at the site.

A recent probabilistic analysis was performed for ANAD (Yankee Atomic Electric Company 1994). According to this analysis, a seismic event resulting in a peak horizontal acceleration at ANAD greater than 0.1 G would occur once in 1,000 years. An event resulting in a peak horizontal acceleration greater than 0.3 G would occur once in 10,000 years, and an event resulting in a peak horizontal acceleration greater than 0.6 G would occur once in 100,000 years.

According to the nuclear power station seismic hazard curves for the eastern United States, ANAD is located in Seismic Probability Zone 1 (Staub 1991). Within this zone, minor earthquake damage may be expected to occur at least once in 500 years (or a 10% probability of occurring once in 50 years). The peak ground acceleration exceedance for this event is 0.075 G.

4.10.1.3 Soils

Soil types across ANAD may be grouped into three soil associations on the basis of shared characteristics (Harlin and Perry 1961) (see Table 4.10-1). As shown in Figure 4.10-1, most of the site is dominated by the Clarksville-Fullerton Association. The Anniston-Allen-Decatur-Cumberland and Rarden-Montevallo-Lehew Associations also are present along the southern edge of ANAD. The soils present at each of the three areas being considered for the construction of ACWA pilot facilities (i.e., Areas A, B, and C) are mapped as part of the Clarksville-Fullerton Association. Specifically, the soils at Areas B and C are mainly Clarksville-Fullerton stony loams and the soils at Area A are a combination of stony loams and cherty silt loams belonging to the Clarksville-Fullerton Association. The engineering properties of these soils are variable and must be accounted for in the design of any facilities built in these areas. The soils within Areas A, B, and C are heavily vegetated and largely undisturbed except along the courses of roadways.

4.10.2 Site-Specific Factors

Because the proposed action would entail only shallow excavation and require only standard building materials, it was concluded that there is no potential for impacts on the

TABLE 4.10-1 Soil Associations at ANAD

Association	Soil Type	Characteristics
Clarksville-Fullerton	Stony or cherty soils on ridge tops and steep slopes, and local alluvium	Deep, well-drained to moderately drained Moderate to rapid permeability Moderate water capacity Slight to high erosion hazard
Anniston-Allen-Decatur-Cumberland	Gravelly loam, loam, silt loam, silty clay loam, underlain by limestone	Deep, well-drained Moderate to slow permeability Low to moderately low water capacity Moderate erosion hazard
Rarden-Montevallo-Lehew	Silt loam, shaly silt loam, gravelly silt loam, or fine sandy silt loam on ridge tops	Deep or moderately shallow Moderately well to well-drained Slow to rapid permeability Low water capacity Moderate erosion hazard

Source: Harlin and Perry (1961).

geologic resources at or in the vicinity of ANAD. With respect to the soils at ANAD, potential impacts might result from excavation, erosion, or accidental spills or releases of a variety of hazardous materials, including chemical agents. These potential impacts are discussed in the following sections on impacts from construction, operations, and no action. Potential impacts on soils associated with a major accident resulting in catastrophic releases of agent are discussed in Section 4.21.

4.10.3 Impacts of the Proposed Action

4.10.3.1 Impacts of Construction

Approximately 24 acres (9.7 ha) of ground could be affected to some degree from the construction of a pilot facility at Area A, B, or C (Section 4.1.1). Development of the utilities (e.g., installation of an electric transmission line, gas pipeline, and water pipeline) along the projected utility corridors (Figure 4.10-1) could cause additional soil disturbance. With respect to Area A, the extension of Water Corridor A beyond the existing utility corridor that supports the incinerator could result in the disturbance of approximately 1.2 acres (0.5 ha). For Area B, which is located closest to the existing incinerator, no additional disturbance would occur. For Area C, an additional 1.5 acres (0.6 ha) could be disturbed by the extension of Corridor C from the main existing line (B, C).

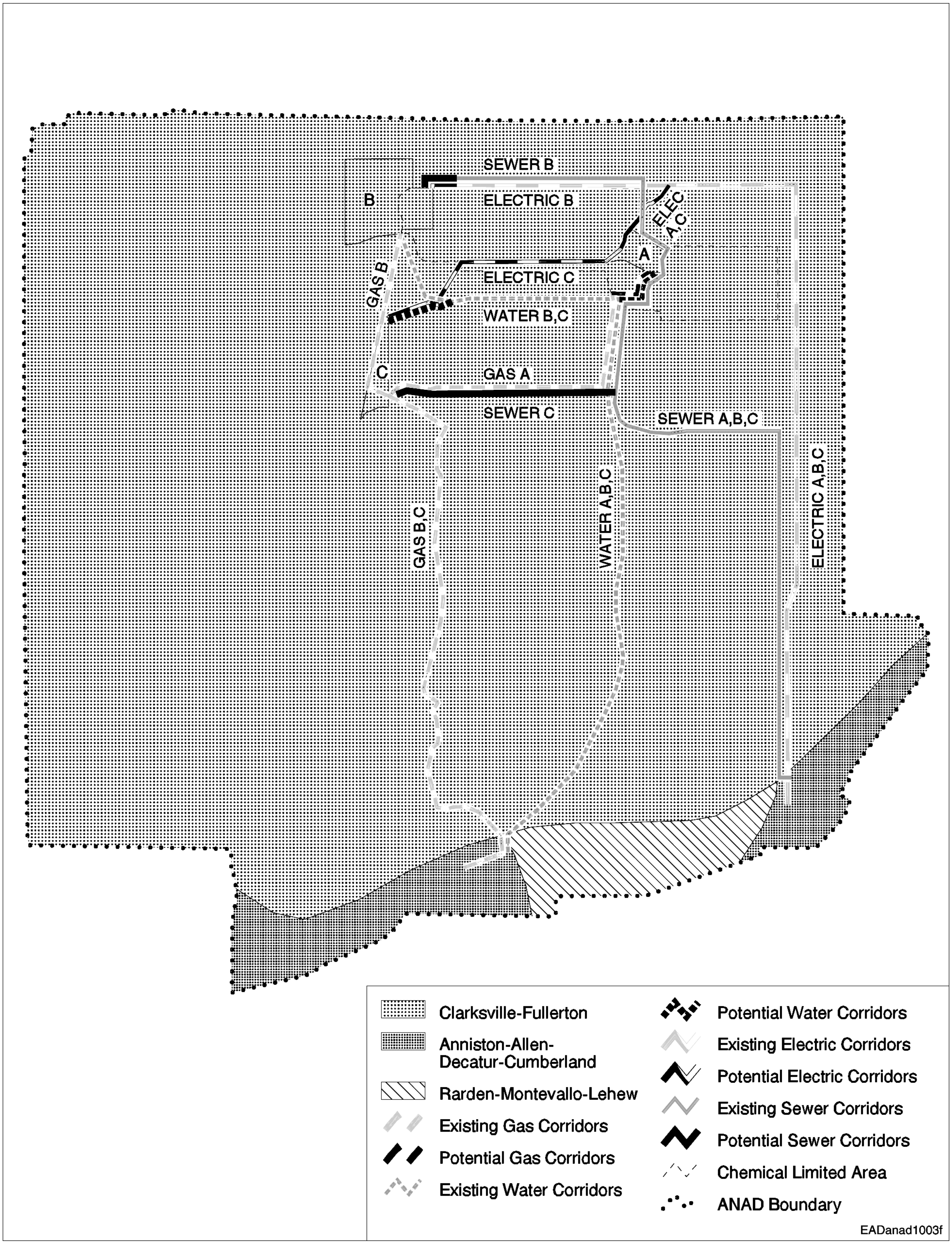

FIGURE 4.10-1 Soil Types at ANAD

Soil disturbance could increase the potential for erosion, which could affect surface water bodies and biological resources. Best management practices (e.g., use of soil fences, berms, and liners; revegetation of disturbed land following construction) would be employed to minimize the potential for soil erosion.

In addition, soils could be affected during construction of a pilot facility if there were an accidental spill or release of a hazardous material. Primarily, effects would be limited to those from spills of hazardous materials (e.g., paints, solvents) transported to the site and used during construction of a pilot facility and leaks of petroleum-based products (e.g., fuel, hydraulic fluid) from construction vehicles. In such an event, actions would be taken to contain and limit the migration of spilled materials. Any contaminated soils would be excavated and disposed of in accordance with applicable requirements.

4.10.3.2 Impacts of Operations

Impacts on soils from the operation of a pilot facility could occur if there were an accidental spill or release of a hazardous material. Such accidents could involve spills of any chemical transported to and used in the ACWA pilot facility, spills of chemical agent during transport of an ACW from the storage bunker to the pilot facility, and leaks of petroleum-based products from vehicles. In such an event, actions would be taken to contain and limit the migration of spilled materials. Any contaminated soils would be excavated and disposed of in accordance with applicable requirements.

Although operations would result in air emissions of a variety of contaminants, the concentrations of these contaminants would be so low (see Sections 4.5 and 4.6) that they would not have a significant impact on surface soils.

4.10.4 Impacts of No Action

Under the no action alternative for ANAD, which is defined as future incineration of the ACWs, potential impacts on soils would be equivalent to those assessed previously in the EIS prepared for the incineration activities (U.S. Army 1991).

4.11 GROUNDWATER

4.11.1 Current Environment

4.11.1.1 Geohydrology

The water-bearing properties of the residuum units at ANAD are summarized in Table 4.10-1. The near-surface alluvium is of Quaternary age and is generally a poor aquifer. Wells completed in this formation generally have a poor yield and the water is high in iron (U.S. Army 1991).

The current conceptual hydrogeological framework of ANAD is a three-layer system, consisting of a thin veneer of overburden capping a layer of dolomite-derived residuum that overlies a dolomite bedrock. In all areas of ANAD, the piezometric surface of shallow bedrock aquifers occurs within the residuum (Science Applications International Corporation [SAIC] 1998). Hydrogeologic data indicate that the residuum serves as a confining (or semiconfining) layer, with transmissivities increasing downward. The weathered zone is extremely heterogeneous, resulting in highly variable permeabilities. In many cases, the shallow groundwater system is not isolated, and leakage of perched water occurs between the residuum and the underlying bedrock.

The unweathered dolomites of the Conasauga and Shady Dolomite are the most transmissive sequences in Calhoun County (Moser and DeJarnette 1992). Large quantities of water can be obtained from the Knox Group, where water-filled solution features are encountered. Fractured areas of the Chilhowee Group clastics yield large quantities of water that may be rich in iron (Moser and DeJarnette 1992). The permeability of the Cambrian rocks is secondary and develops through solution features and joint systems within the carbonate bedrock and fractures within the clastic rocks. Two dominant joint sets, with trendings of N30E and N60W, were reported by Technos (1985). The presence of these fractures provides the interconnection between aquifer systems such as the Chilhowee Group and Knox Group.

4.11.1.2 Groundwater Quantity

Wells completed in the Shady Dolomite and Conasauga Formations have yields that are adequate for domestic, industrial, and municipal uses, with yields in the range of 100 to 500 gal/min (380 to 1,900 L/min) (U.S. Army 1991). There are a number of springs in Calhoun County that discharge groundwater to the surface. These springs are generally located along thrust faults, which tap deep or distant groundwater sources. As a result, the yield from these springs is generally uniform and larger than would be expected if the springs were supplied only from local recharge (U.S. Army 1991).

4.11.1.3 Groundwater Quality

The quality of the groundwater in Calhoun County is generally good. Approximately 90% of the water consumed in the county is supplied by groundwater (U.S. Army 1991). The majority of the municipal water is supplied by Coldwater Spring, which supplies the cities of Anniston, Blue Mountain, several suburban areas, the former Fort McClellan Military Reservation, and ANAD (U.S. Army 1991).

Coldwater Spring is located southwest of Anniston and about 2 mi (3 km) from the southern boundary of ANAD. The spring is fed from the fractured and weathered zones of the Chilhowee Group and from formation cavities and channels in the Shady Dolomite (U.S. Army 1991). The U.S. Army (1991) reviewed a number of studies that address the recharge area for Coldwater Spring. The U.S. Army (1991) concluded that only the southeast corner of ANAD lies within the Coldwater Spring recharge area. It further concluded that groundwater from the area that contains the proposed ACWA sites most likely flows to the northwest, away from Coldwater Spring. Depending on the location of the groundwater divide in the north-central part of ANAD, groundwater from the proposed ACWA sites could potentially flow to the southwest, although this flow direction is unlikely. However, even if the groundwater would flow in a southwesterly direction, the studies reviewed by the U.S. Army (1991) concluded that the flow would not affect Coldwater Spring.

4.11.2 Site-Specific Factors

Annual water resource needs during construction would be essentially the same for all the ACWA technologies being considered. They are estimated to be approximately 7 million gal/yr (26,000 m^3/yr) over approximately three years (see Chapter 3). Construction activities are estimated to generate 4.5 million gal (17,000 m^3) of sanitary waste over the same time period (Kimmell et al. 2001).

Annual water resource needs during operation (which include both process and potable water) would range from 7 million gal/yr (26,000 m^3/yr) for Elchem Ox to 24 million gal/yr (91,000 m^3/yr) for Neut/GPCR/TW-SCWO. Both Neut/SCWO and Neut/Bio would use approximately 14 million gal/yr (53,000 m^3/yr) of water. Potable water needs would be essentially the same for all the ACWA technologies being considered at approximately 6 million gal/yr (23,000 m^3/yr). None of the ACWA technologies would discharge any process wastewater. Wastewater generation is related to the number of workers, which would essentially the same for the all technologies being considered at 7.5 million gal/yr (28,000 m^3/yr).

4.11.3 Impacts of the Proposed Action

4.11.3.1 Impacts of Construction

Construction-related impacts on groundwater from ACWA technologies being considered would be essentially the same. Impacts would be none to negligible, and if impacts did occur, they would exist for only a short period of time. During incident-free construction activities, no contamination of groundwater would be expected. Standard precautions during equipment fueling and maintenance and other activities should be followed to prevent spills or leaks.

Water use during construction is estimated to be 7 million gal (26,500 m^3 or 21.5 acre-ft) over approximately three years (approximately 7 acre-ft/year) (Kimmell et al. 2001). This amount is about 0.02% of the minimum yield of Coldwater Spring and would have a negligible impact on the water supply from the spring. Impacts on the groundwater aquifer from this additional withdrawal over a 36-month period would be negligible. Construction activities would be expected to generate 4.5 million gal (17,000 m^3) of sanitary waste over the same time period (Kimmell et al. 2001). This waste would be treated according to regulations and released. It would have a negligible impact on groundwater .

4.11.3.2 Impacts of Operations

Any impacts on groundwater resources would result from the use of potable water, process water, and fire control water and from the generation of sanitary sewage. Water use of slightly over 7 million gal/yr (26,000 m^3/year) for Elchem Ox would represent an approximate increase of 33% over the annual water use at ANAD for fiscal year (FY) 2000 (Freeman 2000) but only 0.02% of the minimum flow of Coldwater Spring. Water use of 24 million gal/yr (91,000 m^3/year) for Neut/GPCR/TW-SCWO) would approximately double FY 2000 usage on post and be slightly more than 0.2% of the minimum flow of Coldwater Spring. While the percentage increase of water usage on post would be large, it would not be significant when compared with available water resources from Coldwater Spring. This increased withdrawal and usage would have negligible impacts on regional groundwater resources.

4.11.4 Impacts of No Action

Continued storage of chemical weapons at ANAD would not adversely affect groundwater. Controls are in place to minimize soil erosion, although some erosion is expected to occur in areas kept clear of vegetation for security purposes and dirt roadways within the storage block. Facilities exist to handle sanitary waste, and procedures are in place to preclude chemical spills and to address them if they do occur.

4.12 SURFACE WATER

4.12.1 Current Environment

ANAD is located in the Coosa River Basin (U.S. Army 1991). Neely Dam regulates the flow of the Coosa River near ANAD. Water quality in the Coosa River is generally good, although there has been some degradation due to sediment runoff, nutrient loading, and municipal and industrial discharges (U.S. Army 1991). Water quality is satisfactory for domestic, agricultural, and most industrial uses.

The Coosa River is a large perennial stream located approximately 5.3 mi (8.5 km) west of ANAD. Several large reservoirs are associated with dams on the Coosa River, including Logan Martin Lake, west of ANAD, and H. Neely Henry Lake, northwest of ANAD. Two perennial tributaries of the Coosa River in the vicinity of ANAD are Cane Creek, approximately 2.1 mi (3.4 km) to the north, and Choccolocco Creek, approximately 3.4 mi (5.5 km) to the south. Cabin Club Spring, located on the Pelham Range near the northwest boundary of ANAD, supports a shallow pool and stream.

The average flow in the Coosa River is approximately 6,200 million gal/d (270 m^3/s). At Francis Mill, which is northwest of ANAD, Cane Creek has an average flow of 85 million gal/d (4 m^3/s). Near Jenifer, south of ANAD, Choccolocco Creek has an average flow of 1.4 ft^3/s (55 m^3/h) (U.S. Army 1991). The subsurface contribution to Cane Creek is approximately 12% from springs or seeps (base flow). The subsurface contribution to Choccolocco Creek ranges from 33 to 48% (U.S. Army 1991).

ANAD is drained by numerous intermittent streams and one perennial stream. The northern portion of ANAD lies within the Cane Creek watershed, while the southern portion lies within the Choccolocco Creek watershed (U.S. Army 1991). An unnamed perennial stream, a tributary of Cane Creek, flows through the northeast portion of ANAD, including the ammunition storage area and CLA. (Figure 4.12-1 shows the surface water features.) Surface water impoundments on ANAD include Little Lake, which is 5 acres (2 ha) in size, and 25 small ponds, each averaging 0.25 acre (0.1 ha) (U.S. Army 1991).

Except for approximately 12 acres (4.9 ha) of proposed Area A, the proposed ACWA areas are located above the floodplain. Area A is located at the confluence of an unnamed perennial stream flowing from the southwest and an intermittent stream flowing from the south (Figure 4.12-1). Both streams are located within excavated channels. The perennial stream exits ANAD near the northeast corner and passes through the Pelham Range, joining Cane Creek approximately 2.8 mi (4.5 km) north of Area A. An excavated pond lies within the eastern portion of Area A.

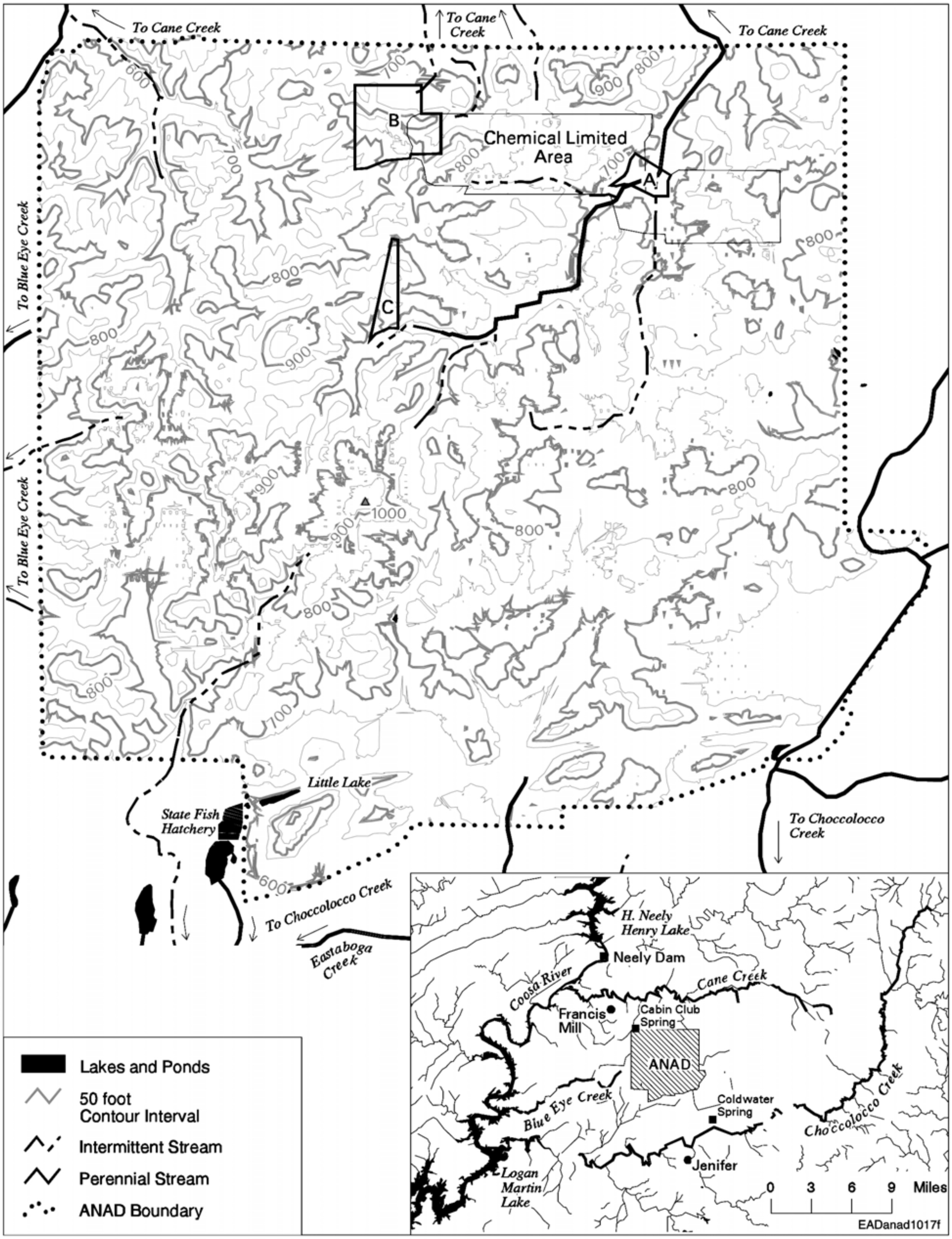

FIGURE 4.12-1 Surface Water Features at ANAD

No permanent surface water features occur in the vicinity of Proposed Area B. The northern portion of ANAD lies within the watershed of an intermittent stream, flowing to the north, which is a tributary to Cane Creek. Perennial flow occurs within this tributary approximately 3 mi (5 km) upstream of its confluence with Cane Creek (U.S. Army 1991). The southern portion of Site B lies within the watershed of an intermittent stream that flows to the northwest. This stream exits ANAD near the northwest corner, and its flow becomes perennial just beyond the ANAD boundary. A number of springs and seeps contribute to this stream, and the quality of the stream is considered relatively good.

Although surface water features do not occur at Proposed Area C, two ponds are located in the vicinity. An excavated pond is located downgradient, approximately 400 ft (120 m) to the southeast of Area C. This pond is more than 20 ft (6.1 m) deep and is permanently flooded. A small impoundment is also located downgradient of Site C, approximately 1,450 ft (442 m) to the east. This pond is semipermanently flooded. In addition, a stream channel also lies downgradient, adjacent to the southeast corner of Area C. Although flow within the stream is intermittent in the vicinity of Area C, perennial flow begins approximately 1,400 ft (430 m) downstream. The stream bed has been modified by excavation within the perennial portion of the stream. This stream passes through Area A and is a tributary of Cane Creek.

4.12.2 Site-Specific Factors

Annual water resource needs during construction would be essentially the same for all the ACWA technologies being considered. They are estimated to be approximately 7 million gal/yr (26,000 m^3/yr) over approximately three years (see Chapter 3). Construction activities would be expected to generate 4.5 million gal (17,000 m^3) of sanitary waste over the same time period (Kimmell et al. 2001).

Annual water resource needs during operation (which include both process and potable water) would range from 7 million gal/yr (26,000 m^3/yr) for Elchem Ox to 24 million gal/yr (91,000 m^3/yr) for Neut/GPCR/TW-SCWO. Both Neut/SCWO and Neut/Bio would use approximately 14 million gal/yr (53,000 m^3/yr) of water. Potable water needs would be essentially the same for all the ACWA technologies being considered at approximately 6 million gal/yr (23,000 m^3/yr). None of the ACWA technologies would discharge any process wastewater. Wastewater generation is related to the number of workers, which would be essentially the same for the all technologies being considered at 7.5 million gal/yr (28,000 m^3/yr). The only outfall to surface waters would be treated domestic sewage.

4.12.3 Impacts of the Proposed Action

4.12.3.1 Impacts of Construction

Construction-related impacts on overland water flow would be none to negligible. If impacts would occur, they would exist for only a short period of time. During incident-free construction activities, no contamination of surface water would be expected. Standard precautions during equipment fueling and maintenance and other activities should be followed to prevent spills or leaks. Berms and other devices should be placed to restrict surface runoff from the construction site. If spills or leaks do occur, procedures should exist to quickly remove contaminants before they could be transported to existing surface or groundwater resources.

There would be no impacts on off-post surface water.

4.12.3.2 Impacts of Operations

Impacts on surface water would be negligible. Sewage would be treated to regulatory required limits and discharged. The estimated sewage discharge of 7.5 million gal/yr (28,000 m^3/yr) or 0.03 ft^3/s would be small when compared with surface water flows and would not significantly change flow conditions in the vicinity of the treatment plant.

There would be negligible impacts on off-post surface water from normal operations. The estimated sewage discharge of 7.5 million gal/yr (28,000 gal/yr) or 0.03 ft^2/s would be small when compared with surface water flows and would not significantly change flow conditions.

The additional withdrawals at Coldwater Spring, which would range from 0.08% to slightly more than 0.2% of the minimum flow, would not be significant and would have only negligible impacts on the surface water environment downstream of the spring.

4.12.4 Impacts of No Action

Continued storage of chemical weapons at ANAD would not adversely affect surface waters. Controls are in place to minimize soil erosion, although some erosion is expected to occur in areas kept clear of vegetation for security purposes and dirt roadways within the storage block. Facilities exist to handle sanitary waste, and procedures are in place to preclude chemical spills and to address them if they do occur.

4.13 TERRESTRIAL HABITATS AND VEGETATION

4.13.1 Current Environment

Located in northeast Alabama, ANAD lies within the Central Appalachian Ridges and Valleys Ecoregion (Omernik 1986). This region is characterized by a mosaic of agricultural land and woodland or forest on low mountains and hills. The Appalachian oak forest type represents the potential natural vegetation of the region. ANAD is located in the southwest portion of Calhoun County. Prior to settlement, Calhoun County had been entirely forested (Harlin and Perry 1961). Broadleaf deciduous forests occurred along low-lying areas and waterways, pine forests occurred on ridgetops and higher ground, and mixed forests occurred elsewhere. Today, the areas surrounding ANAD are predominantly forest and agricultural land. A city (Anniston) lies immediately to the east.

ANAD is predominantly undeveloped. It contains 1,744 acres (706 ha) of improved grounds (representing 11% of the installation's total area), 2,043 acres (827 ha) of semi-improved grounds (representing 13% of the total area), and 11,492 acres (4,653 ha) of unimproved grounds (representing 75% of the total area) (U.S. Army 1995). The topography of ANAD ranges from gently rolling land in the east to hills and steep slopes in the west (U.S. Army 1995).

Terrestrial communities in the vicinity of ANAD consist primarily of broadleaf deciduous forest and pine forest. Within a 30-mi (50-km) radius of ANAD, mixed broadleaf deciduous/pine forest covers approximately 58% of the landscape, while broadleaf deciduous forest covers 7%, and pine forest covers 8% (Pacific Northwest National Laboratory 1999). Within the nearby Talladega National Forest, the predominant forest communities are longleaf pine forest, white oak/red oak/hickory forest, and loblolly pine forest (U.S. Forest Service [USFS] 1994). Table 4.13-1 gives scientific names of plant species found at ANAD. The Pelham Range, located immediately north of ANAD, contains upland hardwood (oak/hickory), bottomland hardwood, and pine communities (U.S. Army 1998b). Pine represents the largest forest type, with large tracts of loblolly pine plantations. Fort McClellan includes a rare remnant mountain longleaf pine community in isolated old-growth stands (U.S. Army 1998b).

Terrestrial communities at ANAD include several types of forest, open grasslands, and landscaped areas. More than 13,000 acres (4,450 ha) of ANAD are covered by forests and woodlands (U.S. Geological Survey [USGS] 1998) (Figure 4.13-1). Approximately 43% of the forests on ANAD are hardwood forests, including red oak/white oak/hickory and sweetgum/yellow poplar (USGS 1998). Red oak/white oak/hickory forest makes up the largest portion, totaling 5,662 acres (2,292 ha) and representing nearly 43% of the forests on ANAD. The understory of these hardwood forests generally has a greater number of species than the other forest types and includes more herbaceous perennials (SAIC 2000). The 10 most common species of the hardwood understory are all native species and include muscadine grape, flowering

TABLE 4.13-1 Plant Species at ANAD

Common Name	Scientific Name
Bermuda grass	*Cynodon dactylon*
Black cherry	*Prunus serotina*
Blackgum	*Nyssa sylvatica*
Blackjack oak	*Quercus marilandica*
Briars	*Smilax sp.*
Broomsedge	*Andropogon virginicus*
Butternut hickory	*Carya cordiformis*
Chinese lespedeza	*Lespedeza cuneata*
Chustnut oak	*Quercus prinus*
Dallis grass	*Paspalum dilatatum*
Flowering dogwood	*Cornus florida*
Green ash	*Fraxinus pensylvanica*
Greenbriar	*Smilax spp.*
Hickory	*Carya sp.*
Japanese honeysuckle	*Lonicera japonica*
Johnson grass	*Sorghum halepense*
Kudzu	*Pueraria montana*
Oak	*Quercus sp.*
Loblolly pine	*Pinus taeda*
Longleaf pine	*Pinus palustris*
Mockernut hickory	*Carya tomentosa*
Muscadine grape	*Vitis rotundifolia*
Nepal grass	*Microstegium vimineum*
Northern red oak	*Quercus rubra*
Pine	*Pinus sp.*
Shortleaf pine	*Pinus echinata*
Southern red oak	*Quercus falcata*
Swamp chestnut oak	*Quercus michauxii*
Sweetgum	*Liquidambar styraciflua*
Sycamore	*Platanus occidentalis*
Water oak	*Quercus nigra*
White oak	*Quercus alba*
Yellow poplar	*Liriodendron tulipifera*

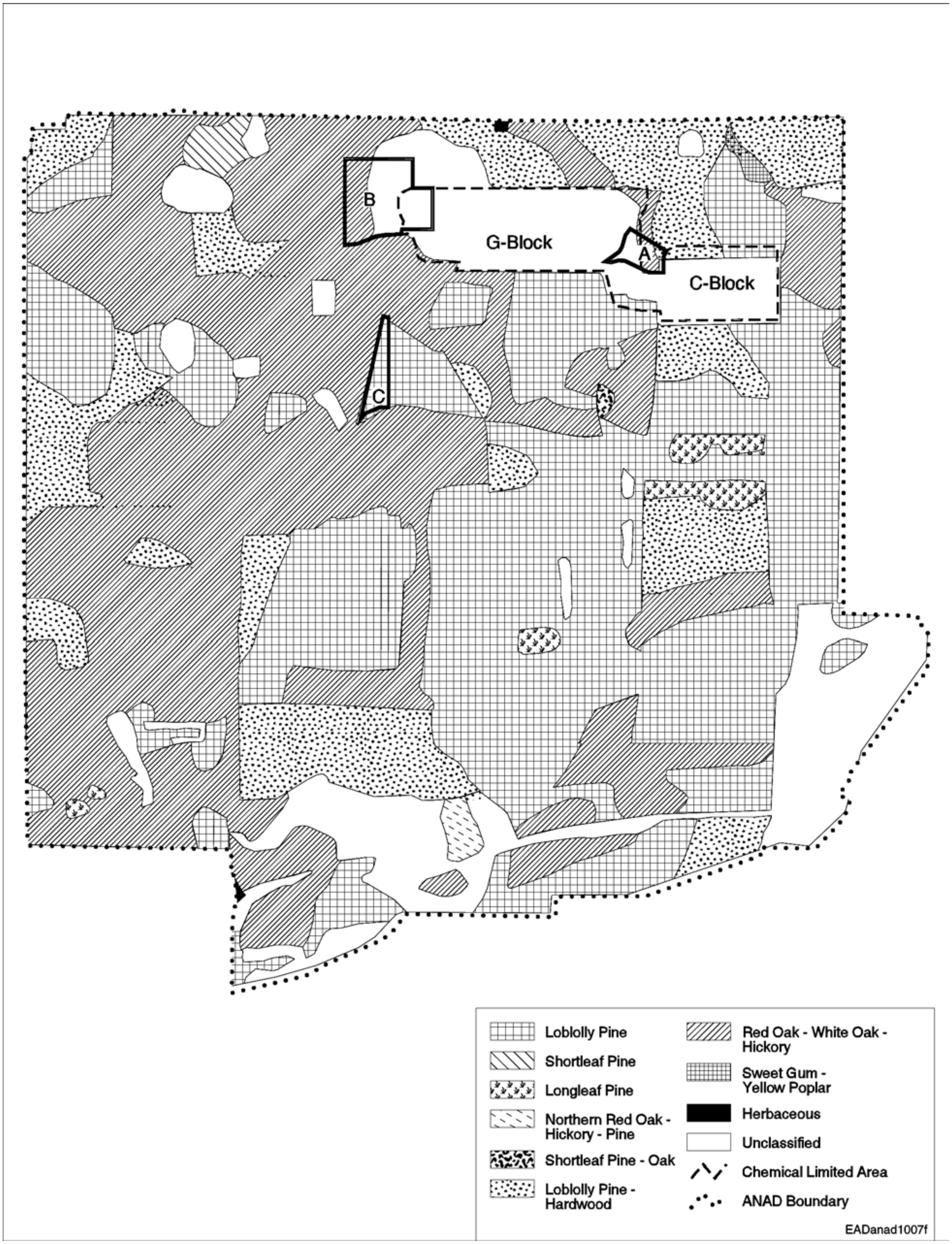

FIGURE 4.13-1 Vegetation at ANAD

dogwood, and blackgum. Pine forests make up approximately 40% of the forests on ANAD and include longleaf pine, loblolly pine, and shortleaf pine forests. Loblolly pine forest makes up the largest portion, totaling 5,158 acres (2,088 ha), representing 39% of the forests on ANAD. The understory of pine forests generally includes muscadine grape, greenbriar, and black cherry. Approximately 17% of ANAD forests are pine/hardwood forest types, including shortleaf pine/oak, loblolly pine/hardwood, and northern red oak/hickory/pine. The understory of pine/hardwood forests generally includes muscadine grape, black cherry, and flowering dogwood. Nonnative invasive species occurring in ANAD forests include Japanese honeysuckle (relatively common in pine and pine/hardwood forest), kudzu, and Nepal grass. Forests on ANAD are managed for multiple uses including timber production, wildlife habitat, and recreation (U.S. Army 1995). Pine and pine/hardwood forests are managed as even/aged stands, while hardwood forests are managed as uneven-aged stands. A 1,000- to 1,200-acre (405- to 486-ha) area of old-growth oak/hickory forest is located in the northwest corner of the restricted area (U.S. Army 1995). The mature hardwood forest in the western portion of ANAD is the least fragmented type of natural terrestrial community present on the installation (Bailey 1997).

In addition to forests, there are approximately 143 acres (57.2 ha) of open land on ANAD that support communities of mostly herbaceous species, including bermuda grass, dallis grass, johnson grass, Chinese lespedeza, broomsedge, and briars (U.S. Army 1995). Open areas are cut once a year between September and March. Some disturbed areas (utility corridors, etc.) have been planted for wildlife use. They include species such as annual rye, winter wheat, grass, and clover. Ammunition storage igloos are typically vegetated with grasses and clover and are mowed (U.S. Army 1995).

Proposed Area A is located within the CLA in the northeast portion of ANAD. This area includes the current location of Building 88. The eastern half of Area A is forested with an immature broadleaf deciduous forest community composed primarily of red oak, white oak, and hickory (USGS 1998). The western half of the site is wooded but is not under forest management because of the chemical storage facilities located there. The area next to the northeast portion is an immature pine-hardwood forest community composed primarily of loblolly pine and broadleaf deciduous species.

Proposed Area B is located directly west of the incinerator facility in the north central portion of ANAD. The western half of Area B lies within a broadleaf deciduous forest community composed primarily of red oak, white oak, and hickory (USGS 1998). Forest management in this area includes selective cutting. The eastern half of the site is wooded but is not under forest management because of the chemical storage facilities located there. Dominant canopy species include chestnut oak, swamp chestnut oak, and southern red oak. The shrub stratum is composed predominantly of flowering dogwood and sapling oaks, while the herbaceous stratum includes numerous oak seedlings. Pines are present in the far western portion of Area B, which is lower in elevation.

Proposed Area C is located near the central portion of ANAD. The entire area is included within an immature loblolly pine forest community (USGS 1998). Additional canopy species include longleaf pine, shortleaf pine, blackjack oak, mockernut hickory, butternut hickory, and sweetgum and include some large individuals. Kudzu vine is very common in this area. The area slopes down to lower elevations in the east and south. Much of the adjacent area to the north, south, and west is red oak/white oak/hickory forest.

4.13.2 Site-Specific Factors

It is expected that impacts on vegetation caused by construction would be the same regardless of the technology evaluated, given the similarity in space requirements, construction activities, and time requirements for constructing any of the pilot test facilities. Routine pilot testing during operations would generate emissions that would be deposited on vegetation downwind of the facility.

Factors associated with an ACWA pilot test facility that would affect vegetation include construction activities, releases and spills, and accidents. These factors could occur during construction of the test facility complex itself and during the installation of utilities, communication cables, and other support areas (such as parking lots and material lay-down areas). The transportation of workers and building materials to the site would also be a factor during both construction and operations.

4.13.3 Impacts of the Proposed Action

The locations of the potential sites and utility corridors are described in Sections 4.1 and 4.3, shown in Figure 4.3-1, and summarized in Table 4.3-2. The construction of an ACWA pilot test facility would disturb about 25 acres (10 ha) for the site complex and up to another 52 acres (21 ha) for the site infrastructure. The total area likely to be disturbed during construction is shown in Table 4.3-2.

4.13.3.1 Impacts of Construction

Impacts on terrestrial habitats might result from disturbances due to construction-related activities or other modifications to the landscape. Landscape modifications generally involve large-scale soil disturbances due to facility construction. Such disturbances may eliminate particular vegetation types or cause the replacement of one type for another. Soil disturbances may also result in the dispersal and deposition of soil particles on surrounding vegetation, potentially reducing photosynthesis and transpiration. Impacts could include mortality of individual organisms, habitat loss, or changes in biotic communities. Erosion of exposed soil at construction sites could reduce the effectiveness of restoration efforts and create downgradient sedimentation.

Impacts on terrestrial habitats might also result from the release to the environment of substances known to cause toxic effects in biota. Construction of a pilot facility might release organic or inorganic compounds, including agent or processing by-products, to the environment. Releases could occur as a single event (a spill, for example) or occur as continual low-level releases. Exposure of biota could result from airborne transmission of materials, surface water contamination, groundwater contamination, or contaminants released to soils. Atmospheric releases of contaminants could result in the widespread dispersal and deposition of contaminants. Exposure routes might include plant root uptake or foliar exposure. Exposures could result in lethal effects, reduced growth or other limiting effects, or no observable effect.

The types of impacts on terrestrial communities from construction were considered to be the same for all of the technologies evaluated, given the similarity in their space requirements, construction activities, and construction durations. The following discussion of construction-related impacts identifies the potential impacts from building a facility within Areas A, B, and C and those from developing the associated infrastructure (e.g., electric power supply, gas and water pipelines, access roads). It also identifies mitigation measures that could minimize or prevent impacts on ecologically sensitive communities in these areas.

The construction of the pilot facility and infrastructure would disturb up to 77 acres (31 ha) of land. Existing vegetation would be destroyed during land clearing activities. The implementation of best management practices for erosion and sedimentation control, fugitive dust emissions, installation of storm-water retention ponds, and immediate replanting of disturbed areas with native species would help minimize impacts on vegetation.

Portions of Area A were previously disturbed during the construction of roads and Building 88. Construction of the pilot facility at Area A would eliminate up to 25 acres (10 ha) of forest community types, including red oak/white oak/hickory and loblolly pine/hardwood. Infrastructure corridors for Area A would require the disturbance of an additional 15 acres (6 ha) of forest types, predominantly red oak/white oak/hickory and loblolly pine. The forest communities occurring on undeveloped land at Area A and along new infrastructure corridors are relatively common and well-represented in the vicinity. Construction at Area A would result in the loss of up to 40 acres (16 ha) of the forest habitat.

Construction of the pilot facility at Area B would eliminate up to 25 acres (10 ha) of forest communities, primarily the red oak/white oak/hickory forest type. Infrastructure corridors for Area B would require the disturbance of an additional 6 acres (2.4 ha) of forest types, predominantly red oak/white oak/hickory. The forest communities occurring on undeveloped land at Area B and along new infrastructure corridors are relatively common and well-represented in the vicinity. Construction at Area B would result in the loss of up to 31 acres (13 ha) of forest habitat.

Construction of the pilot facility at Area C would eliminate up to 25 acres (10 ha) of forest communities, primarily the loblolly pine forest type. Infrastructure corridors for Area C would require the disturbance of an additional 52 acres (21 ha) of forest types, primarily red oak/white oak/hickory. The forest communities occurring on undeveloped land at Area C and along new infrastructure corridors are relatively common and well-represented in the vicinity. Construction at Area C would result in the loss of up to 77 acres (31 ha) of forest habitat.

4.13.3.2 Impacts of Operations

During routine operations, a portion of the materials released from the pilot facility stacks would be deposited on the soils surrounding the site. Deposition from atmospheric emissions would result in very low concentrations of trace metals and organic compounds.

A soil screening-level ecological risk assessment was conducted for each of the four technologies considered for ACWA pilot testing at ANAD to determine potential impacts to biota from routine emissions. This analysis showed that routine emissions would pose negligible ecological risk to terrestrial vegetation (Section 4.14.3.2).

Air concentrations and deposition of emission constituents from a pilot test facility using any of the four technologies being considered would pose negligible ecological risk to terrestrial biota. Consequently, routine operations of a pilot test facility would result in negligible impacts on terrestrial habitats and vegetation.

4.13.4 Impacts of No Action

Under the no action alternative, an ACWA pilot facility would not be constructed. Continued storage of chemical agents at ANAD, including routine maintenance and monitoring operations, would not adversely affect terrestrial habitats or vegetation.

4.14 WILDLIFE

4.14.1 Current Environment

A survey of neotropical migrant birds and resident birds at ANAD was conducted in 1997, and a survey of small mammals and herpetofauna was conducted there in 2000. The ANAD natural resource management plan indicates that forest management is carried out and that plots and strips have been planted to provide food for game and nongame animals. Annual rye, winter wheat, clover, and various grass species are planted in certain open areas at ANAD (U.S. Army 1995).

4.14.1.1 Mammals

Given the geographic location and the different habitats known on the installation, a list of representative mammal species typical of the deciduous forests and southeastern United States was generated (Brown 1997). A survey of small mammals was conducted at ANAD in 1999 and 2000. Species that were observed at ANAD are indicated by an asterisk in the list of representative species below (SAIC 2000):

- Open fields:

Cotton rat	*Sigmodon hispidus**
Eastern cottontail	*Sylvilagus floridanus**
Prairie vole	*Microtus ochrogaster**

- Woodlands (hardwood, mature forests, seedling and sapling, caves):

Eastern pipistrelle	*Pipistrellus subflavu*
White-footed mouse	*Peromyscus leucopus**
Southern flying squirrel	*Glaucomys volans*
Red bat	*Lasiurus borealis*
Gray squirrel	*Sciurus carolinensis**
Northern short-tailed shrew	*Blarina brevicauda*

- General habitats in the southeastern United States:

Coyote	*Canis latrans**
Gray fox	*Urocyon cinereoargenteus*
Raccoon	*Procyon lotor**
Southeastern shrew	*Sorex longirostris*
Striped skunk	*Mephitis mephitis*
Virginia opossum	*Didelphis virginiana**
White-tailed deer	*Odocoileus virginianus**
Wild boar	*Sus scrofa*

Additional species observed at ANAD include eastern chipmunk (*Tamias striatus*), southern short-tailed shrew (*Blarina carolinensis*), woodchuck (*Marmota monax*), beaver (Castor canadensis), and feral cat (*Felis domesticus*) (SAIC 2000).

4.14.1.2 Birds

In 1997, a survey of neotropical birds and resident birds was conducted at ANAD during the spring and summer seasons for a total of nine days. The 15,279 acres (6,112 ha) of land surveyed were found to provide habitat for at least 28 neotropical migrant species and 37 resident species, for a total of 65 different bird species (Bailey 1997).

Although no bird point-count stations were operated in Area A, the species represented in the broadleaf deciduous forest community in other areas are assumed to be represented in Area A. In addition, the burning ground area was not surveyed for safety and security reasons. The blue-winged warbler (*Vermivora pinus*), a rare/uncommon species in Alabama, was spotted once during the survey in the southeast corner of the depot. The Alabama Natural Heritage Program database classifies this species as G5 S3B, meaning its population is secure internationally, but it is a rare breeder in Alabama (Bailey 1997). No additional sitings of this species were made from other observation points during the survey. Birds observed at ANAD include the following:

- These were observed in mature oak/hickory communities:
  Carolina wren — *Thryothorus ludovicianus*
  Blue grosbeak — *Guiráca caerúlea*
  Scarlet tanager — *Piranga olivacea*
  Chimney swift — *Chaetura pelagica*

- These were observed in mixed pine/hardwood communities:
  Wild turkey — *Meleagris gallopavo*
  Red-bellied woodpecker — *Melanerpes carolinus*
  Northern bobwhite — *Colínus virginiánus*
  Red-tailed hawk — *Buteo jamaicensis*

- These were observed in deciduous woods communities:
  Mourning dove — *Zenaida macroura*
  Prairie warbler — *Dendroíca díscolor*
  Northern rough-winged swallow — *Stelgidopteryx serripennis*

- These were observed in loblolly, shortleaf pine communities:
  Indigo bunting — *Passerina cyanea*
  American robin — *Turdus migratorius*

- These were observed in swamps and open water:
  Belted kingfisher — *Ceryle alcyon*
  Green-backed heron — *Butorides virescens*

Because of their habitat and food requirements, green-backed herons, which were generally seen near shorelines and marsh habitats bordering open water, may no longer be present on the depot. The green-backed heron was sighted only once by the Cone Reservoir during the 1997 bird survey. However, the Cone Reservoir has since reverted to dry land because the dam that belonged to the reservoir was breached (Burns 2000a). The belted kingfisher is still likely to be present. There were three confirmed sightings; one was near an unnamed creek, and the other two were located in the mixed pine-hardwood area. None of the sightings were near the reservoir.

4.14.1.3 Amphibians and Reptiles

During a visit to the installation in July 2000, a green anole (*Anolis carolinensis*) was observed near Area C. Surveys of herpetofauna amphibians and reptiles conducted at ANAD in 1999 and 2000 (SAIC 2000) identified 34 species. Herpetofauna were found to be more common in hardwood forest and pine/hardwood forest than in pine forest. Surveys in hardwood forest identified eight species of amphibians and 10 species of reptiles. Nine species occurred only in hardwood forest:

Southern two-lined salamander	*Eurycea cirrigera*
Ocoee salamander	*Desmognathus ocoee*
Marbled salamander	*Ambystoma opacum*
American toad	*Bufo americanus*
Green anole	*Anolis carolinensis*
Black rat snake	*Elaphe obsoleta*
Gray rate snake	*Elaphe obsoleta spiloides*
Corn snake	*Elaphe guttata guttata*
Eastern box turtle	*Terrapene carolina carolina*

Surveys in pine forest identified three species of amphibians and six species of reptiles. Two species occurred only in pine forest:

Midland water snake	*Nerodia spideon pleuralis*
Timber rattlesnake	*Crotalus horridus*

Surveys in pine/hardwood forest identified five amphibian species and four reptile species. One species was found only in pine/hardwood forest:

Northern ringneck snake	*Diadophis punctatus edwardsii*

An additional five species of amphibians and seven species of reptiles were identified from other observations at the ANAD site.

- These were observed throughout the site in general:

Green anole	*Anolis carolinensis*
Three-lined salamander	*Eurycea longicauda guttolineata*

- These were observed in moist forested areas:

Eastern box turtle	*Terrapene carolina carolina*
Three-toed box turtle	*Terrapene carolina triunguis*
Southern ringneck snake	*Diadophis punctatus punctatus*

- These were observed in ponds, wetlands, and streams:

Southern copperhead	*Agkistrodon contortrix contortrix*
Gray treefrog	*Hyla versicolor*
Eastern mud turtle	*Kinosternon subrubrum subrubrum*
Upland chorus frog	*Pseudacris triseriata feriarum*

- These were observed in subterranean burrows:

Eastern narrow-mouthed toad	*Gastrophryne carolinensis*
Eastern spadefoot toad	*Scaphiopus holbrooki holbrooki*
Eastern tiger salamander	*Ambystoma tigrinum tigrinum*

4.14.2 Site-Specific Factors

It is expected that impacts on wildlife caused by construction would be the same regardless of the technology evaluated, given the similarity in space requirements, construction activities, and time requirements for constructing the pilot test facilities. Operational impacts on wildlife would be related to emissions from routine operations, noise, and the presence of the work force.

During construction, impacts on wildlife might result from clearing vegetation for an ACWA pilot test facility and associated infrastructure. Increased activity from the presence of workers and increases in vehicle traffic might also affect wildlife.

4.14.3 Impacts of the Proposed Action

4.14.3.1 Impacts of Construction

Various factors could have environmental impacts on wildlife during the siting, construction, and operation of an ACWA pilot test facility, during an accident, and during no action. Impacts on wildlife might result from habitat loss and land disturbances caused by construction-related activities or other modifications to the landscape. Landscape modifications generally involve large-scale soil disturbances due to facility construction. Such disturbances would eliminate particular habitat types or cause one type to replace another. Landscape modifications might displace or eliminate wildlife that use the area as breeding or foraging habitat or for protection from predators. Impacts could include mortality of individual organisms or habitat loss. Erosion of exposed soil at construction sites could reduce the effectiveness of restoration efforts and create downgradient sedimentation. Wildlife could be affected by land clearing, noise, road kills caused by construction vehicles, and human presence.

Impacts on wildlife might also result from the release to the environment of substances known to cause toxic effects in biota (only with sufficient magnitude and duration of exposure). Construction of a pilot facility could release organic or inorganic compounds, including agent or processing by-products, to the environment. Releases could occur as a single event (a spill, for example) or as continual low-level releases. Exposure of biota could result from airborne transmission of materials, surface water contamination, groundwater contamination, or contaminants released to soils. Atmospheric releases of contaminants could result in the widespread dispersal and deposition of contaminants. Exposure routes might include inhalation, dermal contact with contaminants (including contaminated soil or water), or ingestion (including ingestion of contaminated soil, water, or food). Exposures might result in lethal effects, reduced growth or other limiting effects, or no observable effect.

The general types of impacts on terrestrial communities from construction were considered to be the same for all of the technologies evaluated, given the similarity in their space requirements, construction activities, and construction durations. The following discussion of construction-related impacts identifies the potential impacts from building a facility within Areas A, B, and C and those from developing the associated infrastructure (e.g., electric power supply, gas and water pipelines, access roads). It also identifies mitigation measures that could minimize or prevent impacts on ecologically sensitive communities in these areas.

Construction of the pilot facility and infrastructure would disturb up to 77 acres (31 ha) of land. The implementation of best management practices for erosion and sedimentation control, installation of storm-water retention ponds, and immediate replanting of disturbed areas with native species would help minimize impacts on wildlife.

Portions of Area A were previously disturbed during the construction of roads and Building 88. Construction of the pilot facility at Area A would eliminate up to 25 acres (10 ha) of forest community types, including red oak/white oak/hickory habitat and loblolly pine-hardwood habitat. Infrastructure corridors for Area A would require the disturbance of an additional 15 acres (6.0 ha) of forest types, predominantly red oak/white oak/hickory habitat and loblolly pine habitat. Wildlife associated with these habitats would be eliminated or displaced. Communities occurring on undeveloped land at Area A and along new infrastructure corridors are relatively common and well-represented in the vicinity of the site. Areas of disturbance due to the construction of a pilot test facility and infrastructure are presented in Table 4.13-2.

Construction of the pilot facility at Area B would eliminate up to 25 acres (10 ha) of forest communities, primarily the red oak/white oak/hickory habitat type. Infrastructure corridors for Area B would require the disturbance of an additional 6 acres (2.4 ha) of forest habitat, predominantly red oak/white oak/hickory. Wildlife associated with these habitats would be eliminated or displaced. Communities occurring on undeveloped land at Area B and along new infrastructure corridors are relatively common and well-represented in the vicinity of the site.

Construction of the pilot facility at Area C would eliminate up to 25 acres (10 ha) of forest communities, primarily the loblolly pine habitat type. Infrastructure corridors for Area C would disturb an additional 52 acres (21 ha) of forest habitats, primarily red oak/white oak/hickory. Wildlife associated with these habitats would be eliminated or displaced. Communities occurring on undeveloped land at Area C and along new infrastructure corridors are relatively common and well-represented in the vicinity of the site.

Wildlife with restricted mobility, such as burrowing species or juveniles of nesting species, would be destroyed during land clearing activities. More mobile individuals would relocate to adjacent available areas with suitable habitat. Population densities and competition would increase in these areas, potentially reducing the survival rates or reproductive capacity of displaced individuals. Some wildlife species would be expected to quickly recolonize replanted areas near the facility after completion of construction. The permanent loss of up to 77 acres (31 ha) of habitat would not be expected to threaten local populations of any wildlife species since similar habitat would be available nearby. Losses of forested vegetation would not be expected to include any links between patches of similar habitat; thus, impacts from habitat fragmentation are not anticipated. The losses would not adversely affect the movements of larger mammals such as white-tailed deer, foxes, and squirrels.

4.14.3.2 Impacts of Operations

During routine operations, biota in the vicinity of the pilot test facility would be exposed to atmospheric emissions from the facility stacks. A portion of the materials released from the stacks would become deposited on the vegetation, soils, and surface waters surrounding the site. Deposition from atmospheric emissions would result in very low concentrations of trace metals and organic compounds.

A soil screening-level ecological risk assessment was conducted to assess the risk to terrestrial biota from air emissions expected from each of the four ACWA technologies. None of the chemicals evaluated exceeded the soil benchmark values and thus would not result in a hazard quotient (HQ) of >1 for any of the four technologies. An HQ of <1 indicates concentrations below those that are known to be harmful to biota. The highest HQ was for benzene (HQ = 0.38) from Neut/Bio; this HQ value is almost three times less than the soil benchmark value. Mercury had the next highest HQ of 4.3×10^{-3} (from Neut/GPCR/TW-SCWO), which is 200 times below the benchmark value. For any of the toxic air pollutants emitted from the stacks to achieve an HQ of >1, the deposition radius would have to be limited to 580 yd (530 m), a distance not physically possible given the stack heights and existing wind characteristics, which would result in metals and organic compounds being carried much greater distances. Table 4.14-1 lists the number of chemicals evaluated for the air emissions from each ACWA technology.

TABLE 4.14-1 Chemical Emissions of Potential Concern Based on a Screening-Level Ecological Risk Assessment of Air Emissions from Routine Operation of an ACWA Pilot Facility at ANAD

Technology	No. of Chemicals Evaluated	Chemicals of Potential Concern from Stack Emissions[a]
Neut/Bio	40	None
Neut/SCWO	46	None
Neut/GPCR/TW-SCWO	55	None
Elchem Ox	45	None

[a] Chemical emitted for destruction of GB, VX, and mustard with an HQ of >1 based on 12-h/d operation.

Air concentrations and deposition of emission constituents from a pilot test facility using any of the four technologies being considered would pose negligible ecological risks to species in terrestrial habitats. Consequently, routine operations of a pilot test facility would result in negligible impacts on wildlife.

During the period of operation of the pilot test facility, increased vehicle traffic nearby could result in a higher mortality for wildlife as a result of vehicle-wildlife collisions. Species most affected would include nocturnal mammals, amphibians, and reptiles. The increase in mortality would constitute a negligible to minor adverse impact on local wildlife populations.

Operation of the facility would increase the ambient noise level. A number of wildlife species would tend to avoid otherwise suitable habitats in the vicinity of the facility, resulting in a negligible to minor adverse impact on local wildlife populations. Species that adapt readily to human presence would be less affected by noise impacts.

4.14.4 Impacts of No Action

Under the no action alternative, an ACWA pilot facility would not be constructed. Continued storage of chemical agents at ANAD, including routine maintenance and monitoring operations, would not adversely affect wildlife.

4.15 AQUATIC HABITATS AND FISH

4.15.1 Current Environment

The Coosa River is a large perennial stream, approximately 5.3 mi (8.5 km) west of ANAD. Several large reservoirs are associated with dams on the Coosa River, including Logan Martin Lake, west of ANAD, and H Neely Henry Lake, northwest of ANAD. Logan Martin Lake supports a recreational fishery for bass, bluegill, spotted bass, black crappie, and white crappie. Additional species include threadfin shad, gizzard shad, catfish, suckers, and minnows (U.S. Army 1991).

Two perennial tributaries of the Coosa River in the vicinity of ANAD are Cane Creek, approximately 2.1 mi (3.4 km) to the north, and Choccolocco Creek, approximately 3.4 mi (5.5 km) to the south. Cabin Club Spring, located on the Pelham Range near the northwest boundary of ANAD, supports a shallow pool and stream that are potential habitat for the pygmy sculpin and coldwater darter (U.S. Army 1998b). ANAD contains a portion of the watershed immediately above the spring. Fish species commonly occurring in surface waters on the adjacent Pelham Range include largemouth bass, bluegill, sunfish, channel catfish, blacknose dace, creek chub, and stoneroller (U.S. Army 1998b). Coldwater Spring, approximately 3 mi (5 km) east of ANAD, supports a population of the pygmy sculpin (*Cottus pygmaeus*) and sculpin snail (*Stiobia nana*) (Godwin et al. 1994). A state fish hatchery is located immediately southwest of ANAD.

ANAD is intersected by numerous intermittent streams and one perennial stream. The northern portion of ANAD lies within the Cane Creek watershed, while the southern portion lies within the Choccolocco Creek watershed (U.S. Army 1991). The unnamed perennial stream is a tributary of Cane Creek and flows through the northeast portion of ANAD, including the Ammunition Storage Area and CLA (Figure 4.12-1). Surface water impoundments include Little Lake, 5 acres (2 ha) in size, and 25 small ponds averaging 0.25 acre (0.1 ha) each (U.S. Army 1991). The small lakes on the ANAD are stocked with bluegill and largemouth bass.

Area A is located at the confluence of the unnamed perennial stream flowing from the southwest and an intermittent stream flowing from the south (Figure 4.12-1). Both of these streams are located within excavated channels. The perennial stream exits ANAD near the northeast corner and passes through the Pelham Range, joining Cane Creek approximately 2.8 mi (4.5 km) north of Area A. Fauna within the stream include fish and aquatic gastropods (Godwin et al. 1994). An excavated pond lies within the eastern portion of Area A.

No permanent surface water features occur in the vicinity of Area B. The northern portion of the area lies within the watershed of an intermittent stream flowing to the north, which is a tributary of Cane Creek (Figure 4.12-1). Perennial flow occurs within this tributary approximately 3.1 mi (5 km) upstream of its confluence with Cane Creek (U.S. Army 1991). The southern portion of Area B lies within the watershed of an intermittent stream that flows to the northwest. This stream exits ANAD near the northwest corner, and its flow becomes perennial just beyond the ANAD boundary. A number of springs and seeps contribute to this stream, and the quality of the stream is considered to be fairly good (Godwin et al. 1994). It supports a breeding population of snapping turtle (*Chelydra serpentina*). Fish diversity is limited. The coldwater darter (*Etheostoma ditrema*) occurs within this stream on the Pelham Range. Protection of the watershed has been recommended by the Alabama Natural Heritage Program of the Department of Conservation and Natural Resources (Godwin et al. 1994).

Although aquatic habitats do not occur at Area C, two ponds are located in the vicinity. An excavated pond is located downgradient, approximately 400 ft (120 m) to the southeast of Area C. This pond is more than 20 ft (6.1 m) deep and is permanently flooded. A small impoundment is also located downgradient of Area C, approximately 1,450 ft (442 m) to the east. This pond is semipermanently flooded. In addition, a stream channel also lies down-gradient, adjacent to the southeast corner of Area C. Although flow within the stream is intermittent in the vicinity of Area C, perennial flow begins approximately 1,400 ft (430 m) downstream. The stream bed has been modified by excavation within the perennial portion of the stream. This stream passes through Area A and is a tributary of Cane Creek.

4.15.2 Site-Specific Factors

It is expected that impacts on aquatic habitats and fish caused by construction would be the same regardless of the technology evaluated, given the similarity in space requirements, construction activities, and time requirements for constructing the pilot test facilities. Construction activities that would release sediments to on-post tributaries of streams could affect stream water quality and fish species. Any impacts from routine operations would be a result of emissions deposited in water bodies downwind of the pilot test facility.

4.15.3 Impacts of the Proposed Action

4.15.3.1 Impacts of Construction

The nature of impacts on aquatic habitats and fish from construction were considered to be the same for all the technologies evaluated, given the similarity in their space requirements, construction activities, and construction durations. The following discussion of construction-related impacts identifies the potential impacts from building a facility within Areas A, B, and C (Figure 4.3-1) and those from developing the associated infrastructure (e.g., electric power supply, gas and water pipelines, access roads). It also identifies mitigation measures that could minimize or prevent impacts on ecologically sensitive areas.

Construction of the pilot facility would disturb approximately 25 acres (10 ha) of land at Area A, B, or C. The implementation of best management practices for erosion and sedimentation control, installation of storm-water retention ponds, and immediate replanting of disturbed areas with native species would help minimize impacts on aquatic habitats and fish resulting from construction.

Construction of an ACWA pilot test facility in Area A could affect specific features of the 33-acre (13-ha) Area A, including the two streams that converge there. Rerouting or culverting of the streams in Area A, if necessary, could result in the loss of up to 1,912 linear ft (583 m) of stream habitat, consisting of excavated channels. Approximately 1,238 ft (377 m) of habitat occurs within the perennial stream in Area A, and 674 ft (205 m) occurs within the intermittent stream. Similar habitat, however, occurs along extensive portions of the streams.

Because of the limited diversity of aquatic habitat and the lack of undisturbed habitat within the streams on Area A, disturbances to the streams resulting from construction would constitute a minor adverse impact. Construction at Area A could also eliminate an excavated pond, approximately 0.4 acre (0.2 ha) in size, located in the eastern portion of ANAD. Similar ponds are fairly common on post and in the vicinity of ANAD. The new corridor for the natural gas supply to Area A would cross the perennial stream southwest and upstream of Area A. Approximately 30 ft (9 m) of the stream would be included within the corridor. The implementation of best management practices for erosion control and immediate replanting of disturbed areas with native species would help minimize impacts on streams within the corridors and on downstream aquatic habitats.

Aquatic habitats do not occur on Area B. The implementation of best management practices for erosion control and immediate replanting of disturbed areas with native species would help minimize impacts on streams within the utility corridor and on aquatic habitats downstream of Area B.

No aquatic habitats occur on Area C. However, the new utility corridor would cross an intermittent stream within the chemical agent storage area. This stream is a tributary of the perennial stream intersecting Area A. Approximately 120 ft (37 m) of stream channel would be included within the corridor. A service road currently crosses the stream next to the proposed corridor. In addition, approximately 30 ft (9 m) of the perennial stream would be included within the corridor. The implementation of best management practices for erosion control and immediate replanting of disturbed areas with native species would help minimize impacts on streams within the corridor and on downstream aquatic habitats.

4.15.3.2 Impacts of Operations

Water withdrawal from surface waters for the pilot process, as well as wastewater discharge, would have only negligible impacts on aquatic ecosystems.

A portion of the materials released from the pilot facility stacks would become deposited on the soils and surface waters surrounding ANAD. Deposition from atmospheric emissions would result in very low concentrations of trace metals and organic compounds.

A screening-level ecological risk assessment was conducted to assess the risk to aquatic biota from air emissions generated by ACWA pilot test facilities. Aqueous concentrations from the deposition of airborne emissions during normal operations for each of the four technologies were compared with ecotoxicological benchmark values established to protect aquatic biota, which includes fish, aquatic invertebrates, and aquatic plants (Suter and Tsao 1996). The methodology used for this analysis is similar to that used for soil (Section 4.13.3.2). A total of 38 chemicals were subjected to the screening-level ecological risk assessment. The results of the analysis indicate that none of the metals and organic compounds evaluated exceeded the criteria (Tsao 2001g). For organics, the highest HQ was for hexane (HQ = 0.85), while barium had the highest HQ among the metals (HQ = 3.2×10^{-4}). An HQ of <1 indicates concentrations below levels that are known to be harmful to biota.

Therefore, air concentrations and deposition of emission constituents from a pilot test facility using any of the four technologies being considered would pose negligible ecological risk to aquatic biota. Consequently, routine operations of a pilot test facility would result in negligible impacts to aquatic habitats and fish.

4.15.4 Impacts of No Action

Under the no action alternative, an ACWA pilot facility would not be constructed. Continued storage of chemical agents at ANAD, including routine maintenance and monitoring operations, would not adversely affect aquatic habitats and fish.

4.16 PROTECTED SPECIES

4.16.1 Current Environment

4.16.1.1 Overview

Information from the Alabama Department of Conservation and Natural Resources and USFWS indicates that 39 threatened or endangered species and nine state-protected species occur in the counties within the 30-mi (50-km) radius of the potential impact zone (Lewis 2000a; Goldman 2000). Species documented within the 30-mi (50-km) radius of ANAD are listed in Table 4.16-1. A general overview of threatened and endangered species determined by the USFWS that could potentially be affected by the proposed action is provided in this section.

TABLE 4.16-1 State Protected and Federal Listed Threatened and Endangered Species Occurring within 30 Miles (50 Kilometers) of ANAD[a]

Category, Status, Common Name	Scientific Name	Blount	Calhoun	Cherokee	Clay	Cleburne	Etowah	Jefferson	Randolph	Shelby	St Clair	Talladega
Plants												
Federal endangered												
Alabama leather-flower	*Clematis socialis*			X			X				X	
Green pitcher-plant	*Sarracenia oreophila*			X			X					
Harperella	*Ptilimnium nodosum*			X								
Kral's water-plantain	*Sagittaria secundifolia*			X								
Leafy prairie-clover	*Dalea foliosa*							X				
Piedmont mock bishopweed	*Ptilimnium nodosum*			X								
Tennessee yellow-eyed grass	*Xyris tennesseensis*		X									
Federal threatened												
Eggert's sunflower	*Helianthus eggertii*	X										
Mohr's Barbara's-buttons	*Marshallia mohrii*		X	X			X					
Mammals												
Federal endangered												
Gray bat	*Myotis grisescens*		X							X		
Indiana bat	*Myotis sodalis*	X								X		
State protected												
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	X										
Birds												
Federal endangered												
Red-cockaded woodpecker	*Picoides borealis*		X		X	X						X
Federal threatened												
Bald eagle	*Haliaeetus leucocephalus*			X								
Aquatic biota												
Federal endangered												
Cahaba shiner	*Notropis cahabae*	X						X		X		
Coosa moccasinshell	*Medionidus parvulus*			X								X
Cylindrical lioplax	*Lioplax cyclostomaformis*									X		
Flat pebblesnail	*Lepyrium showalteri*									X		
Ovate clubshell	*Pleurobema perovatum*	X									X	
Plicate rocksnail	*Leptoxis plicata*	X						X				
Southern acornshell mussel	*Epioblasma othcaloogensis*			X						X	X	
Southern clubshell	*Pleurobema decisum*			X			X	X				X
Southern combshell mussel	*Pleurobema penita*						X					
Southern pigtoe (mussel)	*Pleurobema georgianum*		X	X		X	X				X	
Triangular kidneyshell	*Ptychobranchus greeni*	X		X		X	X	X		X	X	
Tulotoma snail	*Tulotoma magnifica*		X							X	X	X
Upland combshell	*Epioblasma metastriata*	X		X				X		X		
Watercress darter	*Etheostoma nuchale*							X				

TABLE 4.16-1 (Cont.)

Category, Status, Common Name	Scientific Name	Blount	Calhoun	Cherokee	Clay	Cleburne	Etowah	Jefferson	Randolph	Shelby	St Clair	Talladega
Federal threatened												
Alabama moccasinshell	*Medionidus acutissimus*			X			X			X		
Blue shiner	*Cyprinella caerulea*		X	X				X		X		X
Fine-lined pocketbook	*Lampsilis altilis*	X	X	X	X	X	X	X		X	X	X
Goldline darter	*Percina aurolineata*									X		
Lacy elimia (snail)	*Elimia crenatella*											X
Little amphianthus	*Amphianthus pusillus*								X			
Orangenacre mucket	*Lampsilis perovalis*							X		X		
Painted rocksnail	*Leptoxis taeniata*		X							X		X
Pygmy sculpin	*Cottus pygmaeus*		X									
Round rocksnail	*Leptoxis ampla*									X		
Slackwater darter	*Etheostoma boschungi*					X						X
State protected												
Coldwater darter	*Etheostoma ditrema*		X				X			X		X
Crystal darter	*Crystallaria asprella*									X		
Holiday darter	*Etheostoma brevirostrum*		X			X						
Vermilion darter	*Etheostoma chermocki*							X				
Amphibians and reptiles												
Federal threatened												
Flattened musk turtle	*Sternotherus depressus*	X					X	X				
State protected												
Alabama map turtle	*Graptemys pulchra*		X	X			X	X				X
Dusky gopher frog	*Rana capito sevosa*									X		
Green salamander	*Aneides aeneus*			X							X	
Southern hognose snake	*Heterodon simus*		X							X		

[a] The bald eagle (*Haliaeetus leucocephalus*) and red-cockaded woodpecker (*Picoides borealis*) may occur in any county, if habitat exists. Bald eagle/wintering birds are possible in areas with reservoirs.

4.16.1.2 Threatened and Endangered Species

Tennessee Yellow-Eyed Grass (Federal Endangered). Tennessee yellow-eyed grass (*Xyris tennesseensis*) is known from only 14 extant populations. Eight of these occur in Alabama; six other colonies occur in Georgia and Tennessee (Reisz Engineers 1999). This perennial occurs in clumps containing few to many bulbous-based individuals with stems from 2.3 to 3.3 ft (0.7 to 1 m) in height. The basal leaf blades are typically pink, red, or purplish and overlap each other one-eighth to one-third of their length. The pale yellow flowers open in late morning and start to close in mid-afternoon, for a total opening time of approximately 4 hours per day from August through September.

Xyris tennesseensis prefers soil that is moist to wet year round and colonizes in open or thinly wooded areas. Unlike other *Xyris*, *X. tennesseensis* are found associated with calcareous rocks; soils near *X. tennesseensis* are generally neutral to alkaline. The plants can be found either in full sun or in partial shade.

Currently, this endangered forb occurs in Franklin, Bibb, and Calhoun Counties in Alabama. Two populations exist on ANAD. One is located near the burning ground in the explosives/energistics handling area in the northwest area of the installation, about 1.4 mi (2.2 km) directly west of Area C. The other population is in the northern part of the installation, on both sides of the fence around the tank firing range, about 2.1 mi (3.4 km) east of Area B. Located close to the unnamed perennial stream, this population is also located 0.9 mi (1.4 km) downstream of Area A (see Figure 4.16-1). The closest populations to Areas A, B, and C are located about 0.9 mi (1.4 km), 1.9 mi (3 km), and 1.4 mi (2.2 km) away, respectively. The population closest to Area A is located near the northern border, directly downstream of Area A (Figure 4.16-1).

Red-Cockaded Woodpecker (Federal Endangered). The red-cockaded woodpecker (*Picoides borealis*) is a small, black-and-white striped species endemic to the southeastern United States. Historically, the red-cockaded woodpecker occurred in pine forests throughout the southeastern United States. However, only a few remain today in some highly isolated areas. The reason is the birds' preference for southern pines infected with red heart fungus. This disease is not common in pine trees until they are about 75 to 100 years old. In addition, the birds typically require at least 100 to 400 acres (41 to 162 ha) of open mature pine woodland and Savannah habitat. Today, the red-cockaded woodpecker breeding group nearest ANAD is in the Talladega National Forest, located about 25 mi (40 km) east of ANAD. Although the 1997 bird survey at ANAD did not cover off-limit secured areas, which contain older tree stands, it can be assumed that because of the fragmented nature of the habitat, these areas are not likely to sustain any cluster of this species.

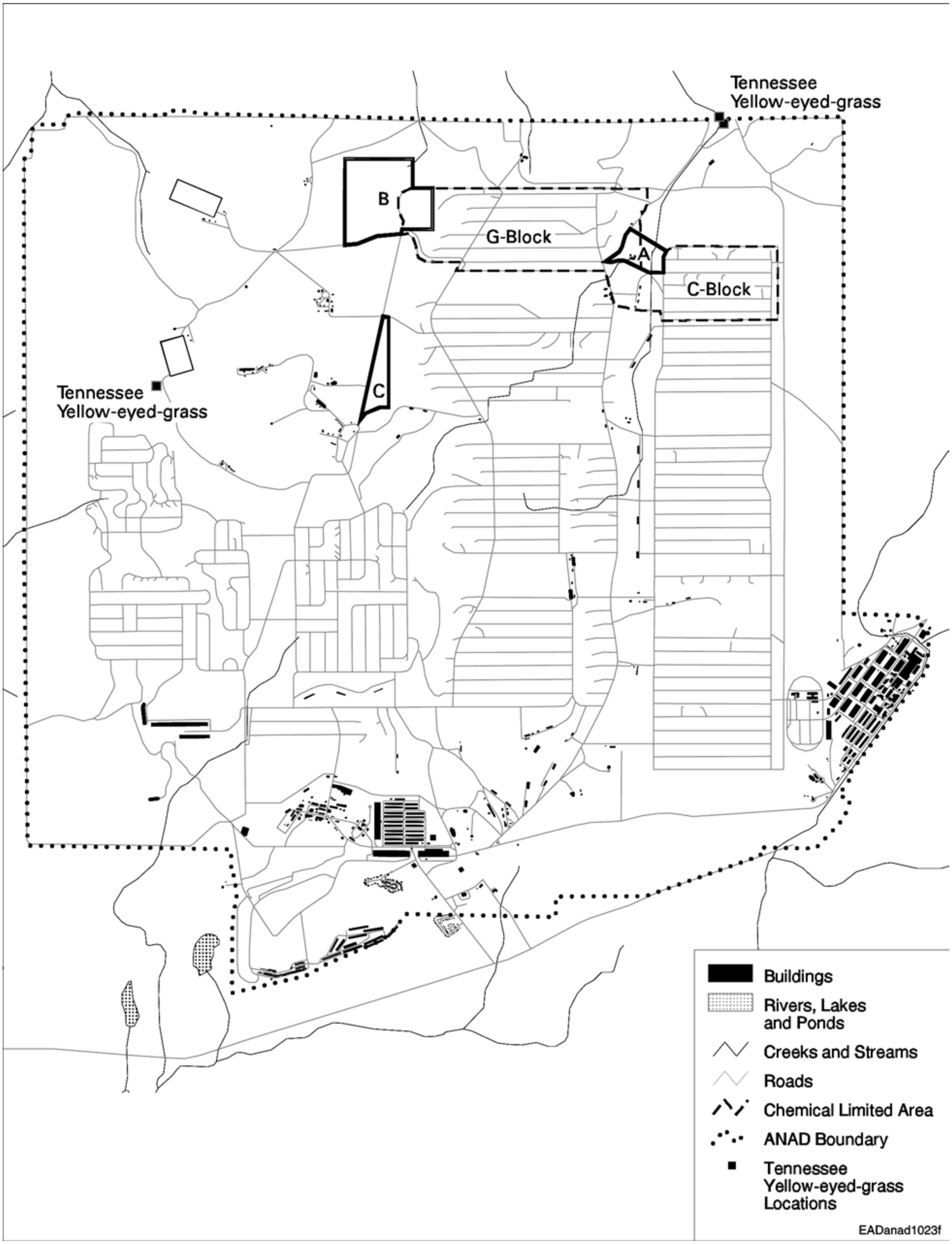

FIGURE 4.16-1 Locations of Tennessee Yellow-Eyed Grass at ANAD

Gray Bat (Federal Endangered). As the largest member of the genus *Myotis* in the eastern United States, the gray bat (*Myotis grisescens*) can be distinguished from other bats by its unicolored dorsal fur. This species is found mostly in Alabama, northern Arkansas, Kentucky, Missouri, and Tennessee. Gray bats also occur in parts of other states, including Georgia, Indiana, Illinois, and Kansas.

Gray bats are restricted almost entirely to habitats like caves or cave-like structures. They are highly selective of caves that provide specific temperature and roosting conditions. In winter, gray bats roost only in deep vertical caves with a temperature range of 6 to 11°C (42–51°F). As a result, only a small number of caves can be used throughout the year. Blowing Wind Cave and Fern Cave National Wildlife Refugees, both of which are located in Decatur, Alabama, are known to be the most important summer and winter caves, respectively, for gray bats. The two caves are about 85 mi (136 km) northwest of ANAD in northern Alabama.

The gray bat has been captured on the Pelham Range next to ANAD, although no roosts have been identified (U.S. Army 1998b). The other closest known occurrence is located southwest of ANAD, approximately 43 mi (69 km) from Area A, 42 mi (67 km) from Area B, and 41 mi (66 km) from Area C.

Mohr's Barbara's Buttons (Federal Threatened). Mohr's Barbara's buttons (*Marshallia mohrii)* is a perennial herb with stems 1 to 2.5 ft (0.3 to 0.8 m) in height. The tubular-shaped flower is white, pale pink, and lavender and blooms from mid-May through June. Fruit is produced in July and August. This herb prefers moist openings in woodlands and is also found along shale-bedded streams. Associations with soils of the Conasauga-Firestone Association are known to occur. These are sandy clays with high organic content. Mohr's Barbara's buttons can be found in either full sun or partial shade.

Once known to span three different physiographic regions in Alabama and Georgia, Mohr's Barbara's buttons are now found only in Alabama in Calhoun, Etowah, Bibb, and central Cherokee Counties. The location of Mohr's Barbara's buttons closest to ANAD is in Calhoun County, approximately 4 mi (6 km) from Area A, 2 mi (3 km) from Area B, and 3 mi (5 km) from Area C.

Pygmy Sculpin (Federal Threatened). Found only in Calhoun County, Alabama, the pygmy sculpin (*Cottus pygmaeus*) is designated a federal threatened species because of its extremely limited distribution. To date, it is found only in Coldwater Spring and Coldwater Spring Run in Calhoun County, Alabama. These two locations represent the entire known range of this species (McCaleb 1973).

Through a cooperative agreement between the City of Anniston and the USFWS, the pygmy sculpin is protected against any action that would be harmful. Currently, the greatest threat to this species is groundwater contamination from ANAD and a proposed highway construction project. Coldwater Spring and Coldwater Spring Run next to each other south of ANAD. They are approximately 5 mi (8 km) from Area A, 6 mi (10 km) from Area B, and 5 mi (8 km) from Area C.

Blue Shiner (Federal Threatened). Blue shiner (*Cyprinella caerulea*), formerly of the Cahaba River, is now found only in the Coosa River drainage in the Little River and Choccolocco Creek. The blue shiner lives in medium to large streams and requires clear waters for its existence. It is located southeast of ANAD, approximately 13 mi (21 km) from Area A, 15 mi (24 km) from Area B, and 15 mi (24 km) from Area C.

Fine-Lined Pocketbook Mussel (Federal Threatened). The fine-lined pocketbook mussel (*Lampsilis altilis*) is a medium-sized mollusk, rarely exceeding 4 in. (10 cm) in length. It is differentiated from the orange-nacre mucket by its white nacre, sharper posterior, and rays on its shells. Historically, the fine-lined pocketbook mussel was found in the Tombigbee River drainage, Black Warrior River and tributaries, Alabama River, and other river systems in Alabama. However, the fine-lined pocketbook mussel seems to limit its habitat mostly to creeks in various counties in Alabama. It is located south of ANAD, approximately 12 mi (19 km) from Area A, 12 mi (19 km) from Area B, and 11 mi (17 km) from Area C.

Tulotoma Snail (Federal Endangered). Tulotoma (*Tulotoma magnifica*) is an operculate gastropod with a globular shell ornamented with knob-like structures. The tulotoma snail is found in cool, clean, free-flowing, well-oxygenated waters. Currently, it is located in the Coosa River tributaries of Weogufka and Hatchet Creeks of Coosa County, Kelly Creek of St. Clair and Shelby Counties, and Ohatchee Creek of Calhoun County. The closest location of Tulotoma snail is northwest of ANAD, approximately 9 mi (15 km) from Area A, 8 mi (13 km) from Area B, and 9 mi (15 km) from Area C.

Painted Rocksnail (Federal Threatened). The painted rocksnail (*Leptoxis taeniata*) is a small to medium-sized gastropod about 0.8 in. (2 cm) in length and oval to globular in shape. It is the only known remaining species of the 15 rocksnail species from the Coosa River drainage. In a survey conducted by the USFWS (Lewis 2000a,b), only three local populations were found in Alabama. They were reported to be in Choccolocco Creek in Talladega County, Buxahatchee Creek in Shelby County, and Ohatchee Creek in Calhoun County. All three counties lie within the 30-mi (50-km) radius of the potential impact zone. The closest reported location of painted rocksnail is southwest of ANAD, approximately 11 mi (17 km) from Area A, 10 mi (16 km) from Area B, and 9 mi (15 km) from Area C.

Southern Pigtoe Mussel (Federal Endangered). The southern pigtoe (*Pleurobema georgiana*) is a small to medium-sized mollusk, typically no longer than 2.4 in (6.1 cm) in length and elliptical to oval in shape. Historically, the southern pigtoe appears to be restricted to the Coosa River drainage, but it has now been found in other drainage systems in Tennessee and Georgia. The USFWS considers *Unio georgianus* to be equivalent to *Pleurobema georgiana*. The closest colony of the southern pigtoe is located east of ANAD, approximately 18 mi (28 km) from Area A, 19 mi (31 km) from Area B, and 20 mi (32 km) from Area C.

4.16.2 Site-Specific Factors

It is expected that impacts on protected species resulting from construction would be the same regardless of the technology evaluated, given the similarity in space requirements, construction activities, and time requirements for constructing the pilot test facilities. Impacts on protected species might result from the clearing of vegetation during construction of an ACWA pilot test facility and associated infrastructure. Increased human activity from the presence of the on-post work force during both construction and operations and increases in vehicle traffic are unlikely to affect federal and state protected or sensitive species.

4.16.3 Impacts of the Proposed Action

4.16.3.1 Impacts of Construction

None of the proposed sites for a pilot test facility or routes for infrastructure corridors are located in the immediate vicinity of the populations of Tennessee yellow-eyed grass at ANAD. Therefore, there would be no direct impacts on these populations as a result of construction. Implementation of storm-water control measures would greatly reduce the potential for indirect impacts on this population. Consequently, impacts on Tennessee yellow-eyed grass are expected to be negligible. Construction of an ACWA facility at Areas B or C would not affect Tennessee yellow-eyed grass. A detailed evaluation of impacts associated with construction and operation of an ACWA facility is provided in the biological assessment for ANAD (see Appendix D).

The red-cockaded woodpecker does not occur at ANAD. The nearest breeding group is approximately 25 mi (40 km) east of ANAD in Talladega National Forest. Facility construction would not affect nesting habitat for the red-cockaded woodpecker, since suitable habitat currently does not exist on ANAD or in the immediate vicinity. Consequently, construction of an ACWA pilot test facility would not result in impacts on the red-cockaded woodpecker.

Although the gray bat (*Myotis grisescens*) is known to occur on the Pelham Range north of ANAD, it does not occur on ANAD. Facility construction would not affect caves used for hibernating, maternity, or roosting since suitable caves do not exist on ANAD or in the immediate vicinity. Foraging habitat, such as large stream corridors, lakes, or adjacent forests, also would not be affected by facility or infrastructure construction. Consequently, construction of an ACWA pilot test facility would not result in impacts on the gray bat.

Mohr's Barbara's buttons (*Marshallia mohrii*) is not known to occur on ANAD, although it is present on Pelham Range to the north. Habitat associated with Mohr's Barbara's buttons on the Pelham range, such as ephemeral streams with an open canopy maintained by frequent wildfires, is not present at or near the proposed facility or infrastructure construction sites. Therefore, facility construction would not result in impacts on Mohr's Barbara's buttons.

Potential impacts on aquatic habitats could occur as a result of the construction of an ACWA pilot test facility. A perennial stream and tributary intersect Area A, while Areas B and C are located next to intermittent streams. However, the implementation of best management practices for control of storm-water runoff and sedimentation and the immediate replanting of disturbed areas with native species would help minimize impacts on streams. Thus, impacts on the blue shiner, tulotoma snail, and painted rocksnail from facility construction would be negligible. The pygmy sculpin, fine-lined pocketbook mussel, and southern pigtoe mussel are not located in watersheds that contain potential construction sites or utility corridors and therefore would not be affected by construction of an ACWA pilot test facility.

Although not located on ANAD, the coldwater darter (*Etheostoma ditrema*), protected by the state of Alabama, is distributed at various places in different watersheds within a 30-mi (50-km) radius of ANAD (Lewis 2000b). However, only one of the tributaries could be potentially affected by construction, because of downstream effects. It is discussed here. The coldwater darter is known to reside in a tributary of Cane Creek, in the western portion of the Pelham Range (Godwin et al. 1994; Lewis 2000b). Because Area B is located within this watershed, upstream of the tributary, there could potentially be effects from construction at this location. However, if proper mitigation techniques were used (i.e., prevention of sediment flowing into the streams), impacts from construction would be negligible. There would be no impacts on the coldwater darter from construction at Areas A or C. The other locations where coldwater darters are found are in a separate tributary of the same watershed or in different watersheds. Thus it is highly unlikely that construction of an ACWA facility would affect their habitat conditions.

4.16.3.2 Impacts of Operations

During routine operations, biota in the vicinity of the pilot test facility would be exposed to atmospheric emissions from the facility stacks. A portion of the materials released from the stacks would be deposited on the vegetation, soils, and surface waters surrounding the site. Deposition from atmospheric emissions would result in very low concentrations of trace metals and organic compounds.

A screening-level ecological risk assessment was conducted to assess the risk to aquatic biota from air emissions generated by ACWA pilot test facilities (Tsao 2001g). The assessment indicated that the deposition of emission constituents from a pilot test facility using any of the four technologies being considered would pose negligible ecological risks to biota in aquatic habitats (see Section 4.15.3.2). A soil screening-level ecological risk assessment was also conducted to assess the risk to terrestrial biota (see Section 4.13.3.2). The deposition of emissions from a facility using any of the four technologies was shown to pose negligible ecological risks to biota in terrestrial habitats.

Therefore, air concentrations and deposition of emission constituents from a pilot test facility using any of the four technologies being considered would pose negligible ecological risk to protected species in terrestrial or aquatic habitats. Consequently, routine operations of a pilot test facility would result in negligible impacts on protected species.

Routine operation of an ACWA pilot test facility would not affect either of the two populations of Tennessee-yellow-eyed grass, the only federal listed species on ANAD.

Although not located at ANAD, coldwater darters are distributed at various places in different watersheds within a 30-mi (50-km) radius of ANAD (Lewis 2000b). The one tributary discussed in the construction section would not be affected by air emissions, since the amount emitted into the air would be so small. It is unlikely that operations would cause any impact, much less deposit all of the combustion materials in the same tributary or watershed. The ACWA facility would be designed so that wastewater released during operations would be fully contained and sent to the wastewater treatment plant for further processing. Thus, there would be no effect on the coldwater darter from the operation of an ACWA facility at Areas A, B, or C.

The other locations inhabited by the coldwater darter are in different watersheds. It is highly unlikely that the operation of an ACWA facility would affect any of these habitat conditions.

4.16.4 Impacts of No Action

No impacts on protected species would occur from continued storage of chemical weapons at ANAD. The two locations where Tennessee yellow-eyed grass is found are fenced in to prevent disturbance by any surface activities.

4.17 WETLANDS

4.17.1 Current Environment

Hardwood bottomland forests occur along the Coosa River and tributaries. They are extensive along Cane Creek to the north of ANAD (U.S. Army 1998b). Hydrologic regimes in these wetland communities are seasonally flooded and temporarily flooded. Forest canopy species include water oak, swamp chestnut oak, sycamore, sweetgum, and green ash, as well as a number of other species. More than 3,400 acres (1,360 ha) of wetlands are found on Fort McClellan (U.S. Army 1998b).

Approximately 112 acres (45.3 ha) of wetlands occur on ANAD (Geonex Corporation 1995). Types of wetlands range from permanently flooded lakes to intermittent streams:

- Forested wetlands supporting broad-leaved deciduous trees (classified as palustrine forested broad-leaved deciduous wetlands) total 28.5 acres (11.5 ha), with an additional 6.5 mi (10.4 km) of wetlands mapped as linear features.

- Unvegetated ponds (palustrine unconsolidated bottom wetlands) cover 15.8 acres (6.4 ha).

- Wetlands supporting shrubby vegetation communities (palastrine scrub-shrub) total 12.6 acres (5.1 ha), with an additional 0.6 mi (1.0 km) of wetlands mapped as linear features.

- Wetlands with predominantly herbaceous vegetation (palustrine emergent wetlands) total 8 acres (3.2 ha), with an additional 0.4 mi (0.6 km) mapped as linear features.

- A total of 10.2 acres (4.1 ha) of perennial streams (riverine lower perennial wetlands) occur on ANAD, with an additional 2.3 mi (3.7 km) mapped as linear features.

- There are 4.3 acres (1.7 ha) of intermittent streams (riverine intermittent wetlands), which are temporarily flooded or seasonally flooded, with an additional 18.7 mi (29.9 km) mapped as linear features.

The most frequently occurring type of wetland is the semipermanently flooded impoundment (unvegetated ponds), at 15 occurrences. The type of wetland represented by the greatest total acreage is the seasonally flooded broad-leaved deciduous forest, with 16.6 acres (6.7 ha).

Area A is located at the confluence of the unnamed perennial stream flowing from the southwest and an intermittent stream flowing from the south (Figure 4.17-1). Both streams are situated within excavated channels. The perennial stream is classified as a riverine lower perennial wetland, with an unconsolidated bottom (Geonex Corporation 1995). This stream passes northward and exits ANAD near the northeast corner. The intermittent stream is classified as an intermittent riverine streambed wetland that is seasonally flooded. Area A includes the 100-year floodplain of these two streams (Figure 4.17-1). The floodplain reaches from slightly upstream of Area A, along both streams, and extends downstream beyond the ANAD northern boundary (U.S. Army 1998a). The 100-year floodplain occupies approximately 12 acres (4.9 ha) of Area A, leaving less than 21 acres (8.3 ha) of the area above the floodplain.

A second intermittent stream flows from the west and joins the perennial stream approximately 350 ft (107 m) south of Area A. This stream is also classified as an intermittent riverine streambed wetland that is seasonally flooded. Two wetlands are located in the western portion of Area A. These wetlands support deciduous shrubby vegetation communities (palustrine scrub-shrub broad-leaved deciduous wetlands) and are seasonally flooded. The eastern portion of Area A contains an excavated pond (palustrine unconsolidated bottom wetlands) that is unvegetated. A small impoundment (palustrine unconsolidated bottom wetlands) is located approximately 0.3 mi (0.5 km) south of Area A, near the intermittent stream. This wetland is semipermanently flooded and is unvegetated.

An intermittent stream flows northward along the eastern margin of the incinerator facility, immediately east of Area B (Figure 4.17-1). This stream is classified as an intermittent riverine streambed wetland that is seasonally flooded. It enters a small impoundment (palustrine unconsolidated bottom wetland) north of the incinerator before continuing to Cane Creek, north of ANAD. The northern portion of Area B lies within the watershed of this stream.

Immediately to the south and downgradient of Area C, an intermittent stream flows along the north side of the road (Figure 4.17-1). This stream, a tributary of Cane Creek, lies within an excavated channel and, becoming perennial, passes through the CLA and Area A. Along most of its length between Areas A and C, the stream is classified as a lower perennial riverine wetland, with an unconsolidated bottom. An excavated pond lies downgradient to the southeast of Area C, immediately beyond the road. This pond (more than 20 ft [6.1 m] in depth) is permanently flooded and does not support wetland vegetation. It is classified as a palustrine wetland with an unconsolidated bottom. A small impoundment lies downgradient and approximately 1,450 ft (442 m) to the east of Area C. This palustrine wetland with an unconsolidated bottom is semipermanently flooded and also does not support wetland vegetation. Approximately 750 ft (229 m) to the northwest of Area C is an impounded forested wetland (palustrine forested broad-leaved deciduous wetland) that is semipermanently flooded. This wetland lies across the north-south road and is not downgradient from Area C.

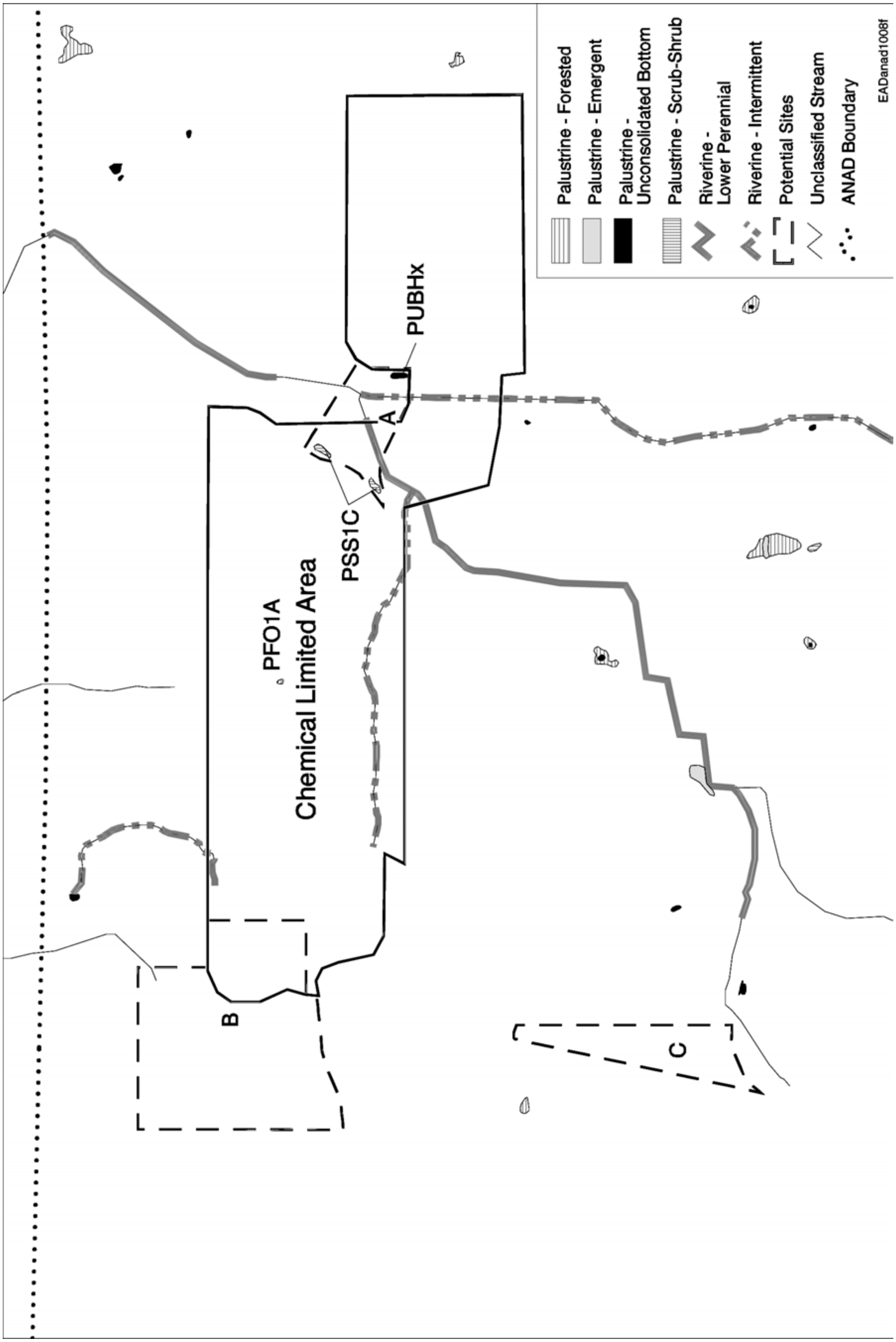

FIGURE 4.17-1 Wetlands in the Vicinity of the Proposed Locations for an ACWA Pilot Test Facility at ANAD

4.17.2 Site-Specific Factors

It is expected that impacts on wetlands resulting from construction would be the same regardless of the technology evaluated, given the similarity in space requirements, construction activities, and time requirements for constructing the pilot test facilities. Factors associated with an ACWA pilot test facility that would affect wetlands include construction activities, releases, and spills. These factors could occur during the construction of the proposed test facility on about 25 acres (10 ha) and during installation of the infrastructure and parking lots. The transportation of workers and building materials to the site and vehicle traffic during facility operations would also be factors.

4.17.3 Impacts of the Proposed Action

4.17.3.1 Impacts of Construction

Construction-related activities might eliminate particular wetlands or cause one type to replace another. Landscape modifications might displace or eliminate the wildlife that use the area as breeding or foraging habitat or for protection from predators. Landscape modifications might also increase the amount of impervious surface within a watershed, resulting in indirect impacts on wetlands. Impacts could include mortality of individual organisms or habitat loss. The implementation of standard erosion control measures, installation of storm-water retention ponds, and immediate replanting of disturbed areas with native species would help minimize impacts on wetlands.

Impacts on wetlands might result from the release to the environment (a spill, for example) of substances known to cause toxic effects in biota. Exposure routes might include dermal contact, ingestion, plant root uptake, or foliar exposure. Exposures might result in lethal effects, reduced growth or other limiting effects, or no observable effect. However, implementation of standard procedures to avoid or respond to releases would minimize the potential for impacts on wetlands.

The following discussion of construction-related impacts identifies the potential impacts from building a facility within Areas A, B, and C (Figure 4.3-1) and those from developing the associated infrastructure (e.g., electric power supply, gas and water pipelines, access roads). It also identifies mitigation measures that could minimize or prevent impacts on ecologically sensitive areas.

The pilot facility would occupy approximately 25 acres (10 ha) of land. The implementation of best management practices for erosion and sedimentation control, installation of storm-water retention ponds, and immediate replanting of disturbed areas with native species would help minimize impacts on wetlands.

Wetlands could be affected by filling or draining during construction. Impacts could include the elimination of entire wetlands or portions of wetlands or the reduction of wetland functions. Impacts on wetlands from soil compaction or alteration of surface water runoff patterns or groundwater flow could occur if the facility were located immediately next to wetland areas. Maintaining a buffer area around wetlands during construction of the facility could minimize impacts on wetlands.

At Area A, grading to prepare for the construction of an ACWA pilot test facility could disturb wetlands and drainage patterns throughout the area. In addition, the physical requirements for a 25-acre (10-ha) facility at Area A might affect specific features of the 33-acre (13-ha) area during construction. Construction of the pilot facility at Area A could potentially eliminate the three palustrine wetlands located in the area and the riverine wetlands within the two streams that converge in the area. Activities that result in impacts on wetlands are regulated by the U.S. Army Corps of Engineers (COE). A permit from the COE would be required for discharges of fill material into these wetlands.

The two palustrine wetlands in the western portion of Area A are seasonally flooded scrub-shrub wetlands. Each one is 0.4 acre (0.2 ha) in size; together, they total approximately 0.8 acre (0.3 ha), which represents about 8% of the scrub-shrub wetland type on ANAD. Although this type of wetland is not rare at ANAD, it accounts for only about 11% of the total wetland area on at ANAD. The palustrine unconsolidated bottom wetland type, represented by the permanently flooded excavated pond in the eastern portion of Area A, accounts for approximately 14% of the wetland area at ANAD. This wetland is approximately 0.4 acre (0.2 ha) in size and accounts for about 3% of the total palustrine unconsolidated bottom wetlands at ANAD. Approximately 1,238 ft (377 m) of perennial riverine unconsolidated bottom wetland is included in the streams on Area A. Although perennial streams are not common at ANAD, this wetland type is well represented along the stream below Area A and in the ANAD vicinity. In addition, approximately 674 ft (205 m) of seasonally flooded riverine streambed wetland occurs in the intermittent stream on Area A. This wetland type is fairly common at ANAD and in the vicinity. The new corridor for the natural gas supply to Area A would cross the perennial stream southwest and upstream of Area A. Approximately 30 ft (9 m) of the stream would be included within the corridor. The implementation of best management practices for erosion control and immediate replanting of disturbed areas with native species would help minimize impacts on this wetland and wetlands in downstream areas.

Sedimentation might occur in riverine wetlands downstream from Area A as a result of grading and stream channel impacts. Construction in close proximity to the stream channels might also result in accidental releases of contaminants into the streams. Construction of the utility corridor north of Area A could result in similar impacts. The new corridor would be located next to the perennial stream intersecting Area A. These impacts could be minimized by the implementation of storm-water runoff control measures and the avoidance of construction activities or the operation of equipment within buffer areas along streams where practicable. Large areas of exposed soil at Area A could result in the deposition of PM, through wind erosion, onto wetlands in the vicinity of Area A. Impacts from deposition could be reduced by limiting the area of land exposed at any time.

Area A also includes the 100-year floodplain of the two streams that converge there. The floodplain occupies approximately 12 acres (4.9 ha) of Area A, leaving less than 21 acres (8.3 ha) of the area above the floodplain available for construction. Therefore, the construction of a pilot facility at Area A could potentially require construction activities within the 100-year floodplain.

The loss of up to 1.2 acres (0.49 ha) of palustrine wetland, up to 1,912 ft (582.9 m) of riverine wetland, and up to 12 acres (4.9 ha) of floodplain as a result of the construction of a pilot test facility at Area A would constitute a moderate to large adverse impact.

Wetlands do not occur on Area B. However, sedimentation might occur in riverine wetlands downstream from the construction site as a result of grading. Construction activities might also result in accidental releases of contaminants into surface waters in downstream portions of the watershed. Wetlands within downgradient streams to the east and west of Area B could be adversely affected by surface water contaminants. Water quality impacts, however, could be minimized by the implementation of storm-water runoff control measures. If both storm-water runoff and soil erosion control measures were implemented, impacts on wetlands from the construction of a pilot facility at Area B would be likely to be minor.

No wetlands occur on Area C. However, sedimentation might occur in riverine wetlands downstream from the construction site as a result of grading. Construction activities might also result in accidental releases of contaminants into surface waters in downstream portions of the watershed. Such impacts could be minimized by the implementation of storm-water runoff control measures. Fugitive dust from construction might be dispersed by wind and deposited on wetlands in the vicinity, such as the ponds east and southeast of Area C, or in nearby streams.

The new utility corridor for Area C might eliminate all or portions of two palustrine wetlands in the western portion of Area A. These are classified as seasonally flooded scrub-shrub wetlands; together, they total approximately 0.8 acre (0.3 ha). The new corridor would also cross an intermittent stream within the chemical agent storage area. This stream is classified as a seasonally flooded riverine streambed wetland and is a tributary of the perennial stream intersecting Area A. Approximately 120 ft (37 m) of riverine wetland would be included within the corridor. A large segment of this stream and a small permanently flooded palustrine wetland would be located next to the new corridor. In addition, approximately 30 ft (9 m) of the perennial stream would be included within the corridor. Wetlands near or downstream of the new utility corridor would be adversely affected by uncontrolled runoff from the corridor. Impacts on water quality, however, could be minimized by the implementation of storm-water runoff control measures. If both storm-water runoff and soil erosion control measures were implemented, impacts on wetlands from the construction of a pilot facility at Area C would be likely to be moderate.

4.17.3.2 Impacts of Operations

Water withdrawal from surface waters for pilot plant processes, as well as wastewater discharge, would result in negligible changes in surface water levels. These changes would, in turn, result in negligible impacts on aquatic ecosystems, including wetlands located along the periphery of these surface water bodies.

A portion of the materials released from the pilot facility stacks would be deposited on the vegetation, soils, and surface waters (including wetlands) surrounding the site. Deposition from atmospheric emissions would result in very low concentrations of trace metals and organic compounds.

A screening-level ecological risk assessment was conducted to assess the risk to aquatic biota from air emissions generated by ACWA pilot test facilities (Tsao 2001g). The assessment indicated that the deposition of emission constituents from a pilot test facility using any of the four technologies being considered would pose negligible ecological risks to biota in aquatic habitats (Section 4.15.3.2). A soil screening-level ecological risk assessment was also conducted to assess the risk to terrestrial biota (see Section 4.13.3.2). The deposition of emissions from a facility using any of the four technologies was shown to pose negligible ecological risks to biota in terrestrial habitats.

Therefore, air concentrations and deposition of emission constituents from a pilot test facility using any of the four technologies being considered would pose negligible ecological risk to wetland biota. Consequently, routine operations of a pilot test facility would result in negligible impacts on wetlands.

4.17.4 Impacts of No Action

Under the no action alternative, an ACWA pilot facility would not be constructed. Continued storage of chemical agents at ANAD, including routine maintenance and monitoring operations, would not adversely affect wetlands.

4.18 CULTURAL RESOURCES

4.18.1 Current Environment

Human occupation in the Coosa Valley may have begun as early as 12,000 B.C. However, in most periods, the land that became ANAD was more suitable as a place to obtain resources rather than a place to live. The temperate forests that cover the site contained an abundance of plant and animal resources that were exploited by both prehistoric and frontier populations (Dye 1984; COE 1997). The earth contained mineral resources, such as chert and iron ore, used by prehistoric and historic populations, respectively, for manufacturing tools. In some cases, the original soils, now much eroded, were suitable for agriculture (Jordan and Whitley 1999). However, most of the well-drained uplands that form the ANAD landscape were not suitable for long-term settlement. Surface water is not readily available within ANAD, and its rolling topography and narrow entrenched valleys make permanent occupation a challenge. Level ridge tops and alluvial floodplains are the most likely locations for settlement (Dye 1984). In short, while the Coosa Valley has a long history of occupation, the uplands that form ANAD were peripheral to the main areas of settlement. This is one of the reasons that it was attractive for the construction of a weapons depot.

4.18.1.1 Archaeological Resources

Because ANAD presented few opportunities for permanent settlement and because there is a significant history of ground disturbance at ANAD, the potential for finding archaeological resources at ANAD is limited. Industrialization of the Anniston area began in the mid-nineteenth century. As industrialization increased, the land that became ANAD was increasingly disturbed. Four mines and numerous gravel pits or quarries now within ANAD's boundaries are indicated on soil survey maps (Harlin and Perry 1961). In the 1940s, when ANAD was established, large sections of the site were disturbed during the construction of the storage igloos and industrial areas (Figure 4.18-1). The main potential for preserved archaeological resources lies in certain favorable locations within the buffer zones surrounding and separating the storage areas. An initial cultural resources reconnaissance of ANAD concluded that because of the restricted public access to ANAD, there was a good possibility of intact cultural resources in these areas (Dye 1984). In 1984, surveys of the less disturbed areas began to be conducted, including the areas under consideration for an ACWA pilot facility.

The COE Mobile District conducted six archeological surveys at ANAD between 1984 and 1997. These included surveys of proposed construction sites, timber sale lots, and areas considered to have a high potential for yielding archaeological remains (COE 1997). In 1997, the Alabama State Historic Preservation Officer (SHPO) concurred that the necessary surveys of "all areas within ANAD considered suitable for archeological survey" have been completed (COE 1997). However, since these surveys were conducted at different levels of intensity, with the broader surveys checking only those areas with the highest potential for yielding sites, the Alabama SHPO may require a more intensive survey of any selected construction site.

Area A is located along an intermittent drainage separating Storage Area G from Storage Area C, partly within the fenced and restricted chemical agent storage area (Figure 4.17-1). Floodplains are one of the areas with a high potential for yielding archaeological remains (Dye 1984). The portion of Area A within the chemical agent storage area has not been surveyed for

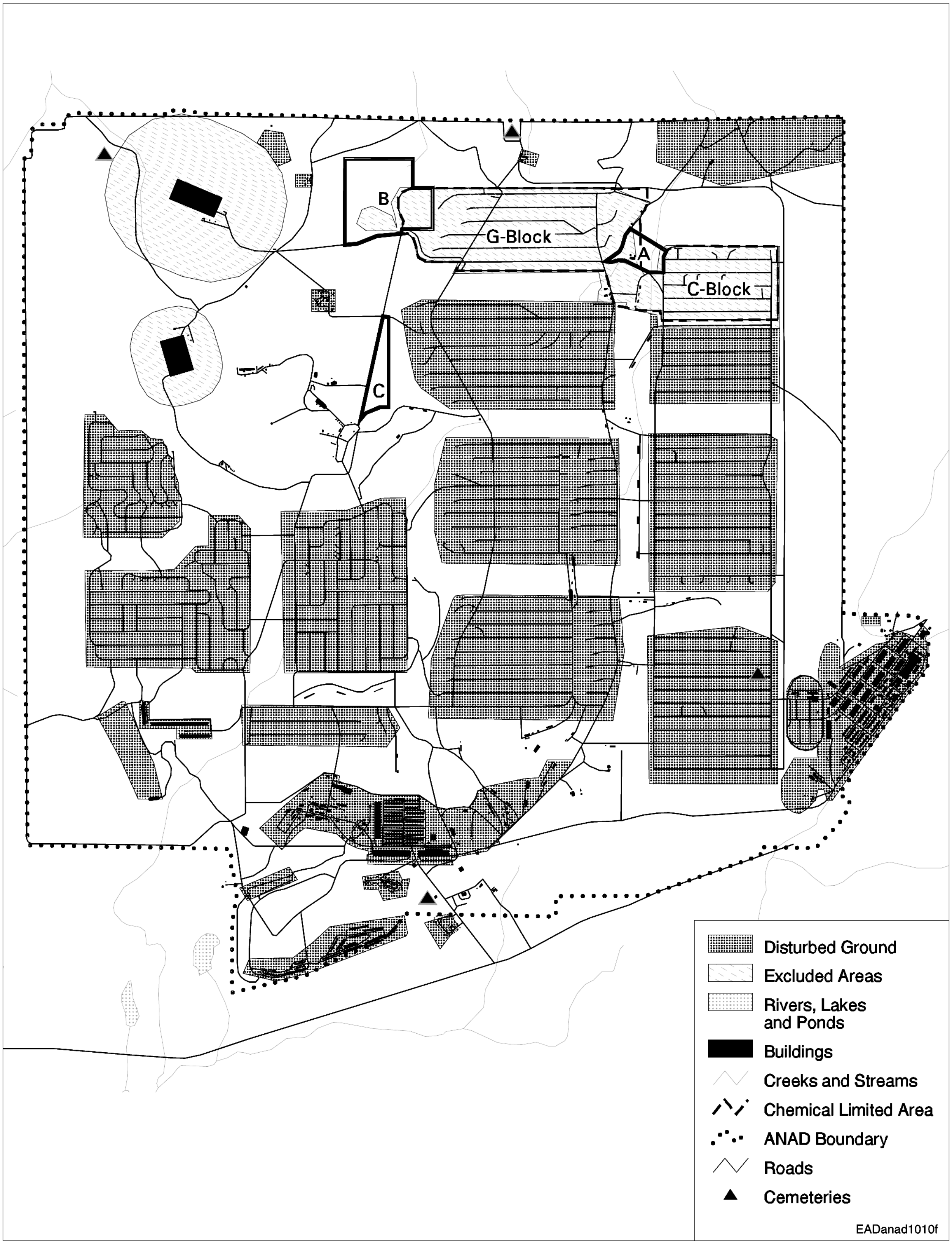

FIGURE 4.18-1 Areas of Disturbance at ANAD (Source: COE 1997)

archaeological resources. However, soils in this part of Area A have been at least partly disturbed by the construction of Building 88 and the roads connecting the building to the storage igloos. It is not clear whether the area outside the fence was investigated in one of the archaeological surveys conducted at ANAD.

Area B is located adjacent to the demilitarization incinerator currently under construction at ANAD. It lies partly within the chemical agent storage area but is mostly outside its fences. Part of the area outside the fence has been surveyed for cultural resources at least twice. In 1984, part of Area B was considered as part of the M55 Rocket Demilitarization Plant Project (COE 1984). Later, in 1991, a survey that included all of Area B was conducted as part of the Demilitarization Project (COE 1991). No cultural resources were recorded in these surveys.

Area C is located east of West Patrol Road near the Lance Missile Facility. This area is relatively undisturbed and has been considered for an archaeological survey. However, it is not clear whether this area was included in any of the timber sale or high probability archaeological surveys. While no archaeological site has been recorded in its vicinity, a more intensive archaeological survey may be required if Area C is chosen for the construction of an ACWA pilot facility.

4.18.1.2 Traditional Cultural Properties

A traditional cultural property is a property that is “eligible for inclusion in the National Register because of its association with the cultural practices or beliefs of a living community that (a) are rooted in that community’s history, and (b) are important in maintaining the continuing cultural identity of the community” (Parker 1995). Such properties are often, although not exclusively, associated with Native American communities. By 1836, Native American populations, mostly Creek and Cherokee, were removed from this part of Alabama and forced to resettle in Oklahoma. There are no known Native American traditional cultural properties at ANAD. In 1996 and 1997, five Creek and three Cherokee tribal groups were contacted regarding artifacts recovered from the Coosa River Storage Annex, formerly a part of ANAD. No response was received at that time (Burns 2000b). Native American groups with a historical interest in the Anniston area have been contacted as part of this analysis.

Properties reflecting traditional rural cultures of Afro-American and Euro-American groups are also potentially present in the area. The historic cemeteries located within ANAD, which are noted in Appendix F, may be considered traditional cultural properties relating to these populations.

4.18.1.3 Historic Structures

Construction of ANAD began in 1941 as part of Phase A of World War II depot construction. This time occurred during the protective mobilization phase of the war. Thus, ANAD played an important role in the logistical support of the Army during the critical early months of World War II (Whelan et al. 1997). Because of ANAD's potential significance with regard to the U.S. arms buildup in preparation for World War II, an evaluation of ANAD architecture constructed before 1946 was conducted in 1984. No structures were found to meet Army criteria for designation as important historical structures or eligibility criteria for the *National Register of Historic Places* (NRHP) at that time (Hightower 1984). However, this part of Alabama does not lack significant historic resources. There are at least 72 properties listed on the NRHP located within 30 mi (50 km) of ANAD.

Of the three possible locations for an ACWA pilot facility at ANAD, only one includes an existing standing structure. Area A includes Building 88, which is now abandoned and in disrepair. The building was formerly used as a maintenance facility for chemical weapons (Burdell 2000a). It is currently scheduled for demolition (Burdell 2000a). Building 88 was built in 1944 but was not considered in the 1984 Historic American Building Survey/Historic American Engineering Record (HABS/HAER) survey (Hightower 1984; Library of Congress 2000). An evaluation of the structure's historical significance may be required if this site is chosen for an ACWA pilot facility. The building is unlikely to be considered eligible for the NRHP since it played no role in the critical early months of the war.

4.18.2 Site-Specific Factors

Factors that need to be considered with regard to significant archaeological sites, traditional cultural properties, and historic structures under the ACWA Program include these:

1. Destruction or disturbance of cultural resources could occur during construction activities.

2. Contamination of cultural resources could occur during an accidental chemical release or spill. This might lead to the establishment of temporary restrictions on access to the property or possibly to the destruction or disturbance of cultural resources if soils would need to be removed during cleanup.

3. Secondary impacts could be associated with the construction or operation of a proposed facility, such as these:

    a. Increased pedestrian or vehicle traffic in the area could increase the potential for inadvertent or intentional damage to cultural resources by casual passerbys or amateur collectors or

    b. Increased erosion potential as a result of construction activities could disturb archaeological sites next to the construction area.

4.18.3 Impacts of the Proposed Action

4.18.3.1 Impacts of Construction

Archaeological Resources. The probability of adverse effects on cultural resources as a result of the construction of any of the proposed facilities is very small. The potential for occurrence of archaeological sites is low in most areas of ANAD. Each of the proposed ACWA areas is a considerable distance from known archeological sites, and each of the three proposed areas has been at least partly subject to some level of archeological survey. Part of Area B has already undergone intensive surveying for other proposed construction projects (COE 1984, 1991). Part of Area A and all of Area C have been considered in less-intensive surveys that focused on areas with archaeological potential (COE 1997). Only the parts of Areas A and B that lie within the CLA have not been surveyed, and the ground in these areas is at least partially disturbed. For the most part, the potential utility and access road corridors would follow existing right-of-ways; therefore, they would be expected to have little impact on archaeological resources. While further intensive survey may be required before the Alabama SHPO concurs on a “no adverse effect” determination for this project, the chances of encountering additional significant archaeological resources in areas of proposed construction appear to be small.

If cultural material were unexpectedly encountered during ground-disturbing activities at previously disturbed or surveyed areas of the depot, construction would cease immediately, and the Alabama SHPO and a qualified archaeologist would be consulted to evaluate the significance of the cultural artifacts.

Traditional Cultural Properties. No traditional cultural properties are known to occur within the proposed construction areas for the ACWA facility; therefore, no impacts on traditional cultural properties are expected. Consultations with interested Native American tribes regarding the proposed action have occurred. Copies of the consultation letters and any responses received are presented in Appendix F.

Historic Structures. Only Area A includes an existing structure, Building 88. This former maintenance facility for chemical weapons is now abandoned, in disrepair, and scheduled for demolition (Burdell 2000a). Building 88 was built in 1944 and should have been considered in the 1984 HABS/HAER survey (Hightower 1984) but was not (Library of Congress 2000). An evaluation of the structure’s historical significance may be required before SHPO concurs on a “no adverse effect” determination for this project. The building is unlikely to be considered eligible for listing on the NRHP because it played no role in the critical early months of the war.

The structures within the CLA at ANAD were recommended as not being eligible for NRHP listing (Hightower 1984). It is unclear whether the Alabama SHPO has concurred with this recommendation. Nonetheless, none of these structures would be demolished or modified during construction of an ACWA facility at ANAD. Therefore, no adverse impacts to structures are anticipated.

4.18.3.2 Impacts of Operations

Archaeological Resources. Routine operation of the pilot facilities would have no impact on eligible archaeological resources at ANAD. No known significant resources that could be affected by increased use of the area are located near the proposed ACWA facility, and no ground-disturbing activities would be involved in operating the facility.

Traditional Cultural Properties. No traditional cultural properties are known to occur within the operations area for an ACWA facility; therefore, no impacts on traditional cultural properties are expected. Consultations with interested Native American tribes regarding the proposed action have occurred. Copies of the consultation letters and any responses received are presented in Appendix F.

Historic Structures. The structures within the chemical storage area used to store the weapons stockpile from which munitions would be removed during operation of the proposed ACWA pilot facility have been recommended as not being eligible for NRHP listing. Regardless of their eligibility status, routine removal of the munitions from these structures would not affect the integrity of the structures; therefore no adverse effect is expected.

4.18.4 Impacts of No Action

4.18.4.1 Archaeological Resources

The no action alternative (i.e., continued storage of chemical weapons that might otherwise be destroyed by pilot testing) would not directly affect archaeological resources. No ground-disturbing activities are currently planned for the area should an ACWA facility not be constructed at ANAD. Archaeological resources might be affected if there were an accident while munitions were in storage (see Section 4.21).

4.18.4.2 Traditional Cultural Properties

No known traditional cultural properties are known to occur within ANAD. Therefore, the no action alternative (i.e., continued storage of chemical weapons that might otherwise be destroyed by pilot testing) would have no impact on properties of this type. Nearby resources might be affected if there were an accident while munitions were in storage (see Section 4.21).

4.18.4.3 Historic Structures

The no action alternative (i.e., continued storage of chemical weapons that might otherwise be destroyed by pilot testing) would not affect historic structures. Building 88 is slated for demolition regardless of the ACWA action taken. Chemical munitions that might otherwise be removed and destroyed during pilot testing would continue to be stored in the designated chemical storage area structures. Such use is compatible with the history and the origin of the bunkers. If the SHPO has concurred with the recommendation that they are not eligible for NRHP listing, these structures also would not be affected if there were an accident while munitions were in storage (see Section 4.21).

4.19 SOCIOECONOMICS

4.19.1 Current Environment

Socioeconomic data for ANAD describe a region of influence (ROI) surrounding the installation that is composed of three counties: Calhoun County, Etowah County, and Talladega County (Figure 4.19-1). The ROI is based on the current residential locations of government workers directly related to ANAD activities and captures the area in which these workers spend their wages and salaries. More than 90% of ANAD workers currently reside in these counties (Whatley 2000). The following sections present data on each of the counties in the ROI. However, since the majority of ANAD government workers live in Calhoun County and in the city of Anniston, and since the majority of impacts from an ACWA facility would be expected to occur in these locations, more emphasis is placed on describing the ROI in these two locations.

4.19.1.1 Population

The population of the ROI in 2000 stood at 296,029 (U.S. Bureau of the Census 2001b), and it was expected to reach 296,676 by 2001 (Table 4.19-1). In 2000, 112,249 people (38% of the ROI total) resided in Calhoun County, with 24,276 living in the city of Anniston itself

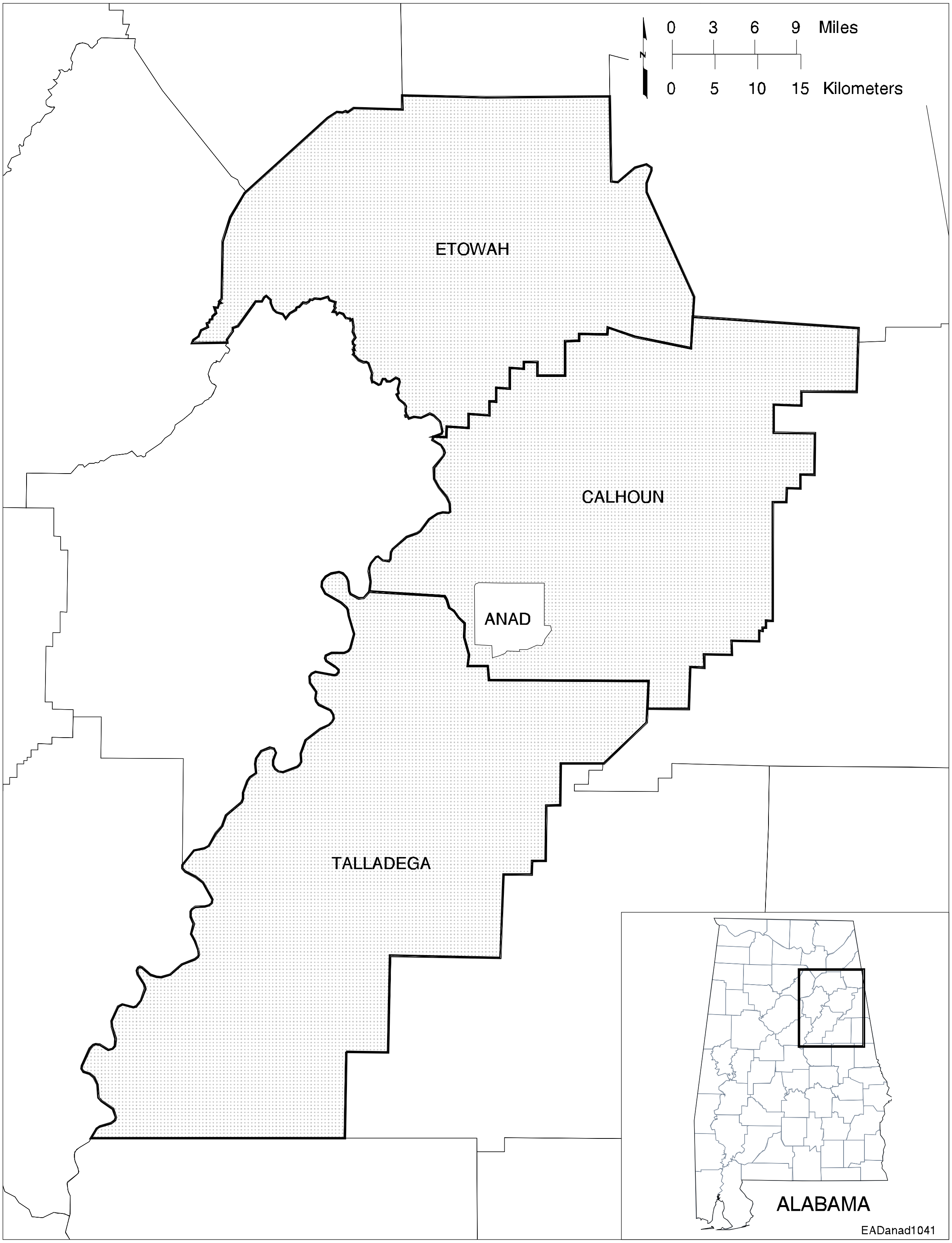

FIGURE 4.19-1 ANAD Region of Influence

TABLE 4.19-1 Population in the ANAD Region of Influence in Selected Years

Location	1980[a]	1990[a]	Annual Average Growth Rate (%) 1980–1990	2000[b]	Annual Average Growth Rate (%) 1990–2000	2001[c] (Projected)
City of Anniston	29,135	26,638	-0.8	24,276	-0.9	24,300
Calhoun County	119,761	116,032	-0.3	112,249	-0.3	112,000
Etowah County	103,057	99,840	-0.3	103,459	0.4	104,000
Talladega County	73,826	74,109	0.0	80,321	0.8	81,000
ROI total	296,644	289,981	-0.2	296,029	0.2	297,000
Alabama	3,894,000	4,048,508	0.4	4,447,100	0.9	4,449,000

[a] U.S. Bureau of the Census (1994).

[b] U.S. Bureau of the Census (2001b).

[c] Allison (2001).

(U.S. Bureau of the Census 2001b). During the 1980s, Calhoun and Etowah Counties experienced small decreases in population, while the population in Talladega County grew slightly. Anniston itself experienced an annual average growth rate of –0.8%. The ROI annual average growth rate during this period was –0.2%. Over the period 1990–2000, population in the ROI as a whole grew slightly, with an annual average growth rate of 0.2%, while population in the city of Anniston continued to fall at an annual rate of –0.9%. Over the same period, population in the state grew at an annual rate of 0.9%. Other incorporated places in Calhoun County in the vicinity of ANAD are Blue Mountain (population 233 in 2000), Hobson City (878), Oxford (14,592), and Weaver (2,619) (U.S. Bureau of the Census 2001b).

4.19.1.2 Employment

In 1999, total employment in Calhoun County stood at 40,906 (U.S. Bureau of the Census 2001a); it was expected to reach 42,600 by 2001 (Allison 2001). The economy of the county is dominated by the trade and service industries, with employment in these activities contributing more than 60% to total employment in the county (see Table 4.19-2). The manufacturing sector is also a significant employer in the county, representing 27% of total county employment in 1999. Annual average employment growth in the county was 2.0% over the period 1990 to 1998 (U.S. Bureau of the Census 1992c, 2001a).

TABLE 4.19-2 Employment in Calhoun County by Industry in 1999

Employment Sector	Number Employed	% of County Total
Agriculture	659[a]	1.6
Mining	85	0.2
Construction	1,782	4.4
Manufacturing	11,024	26.9
Transportation and public utilities	1,128	2.8
Trade	8,209	20.1
Finance, insurance, and real estate	1,445	3.5
Services	16,574	40.5
Total	40,906	

[a] 1997 data.

Sources: U.S. Bureau of the Census (2001a); USDA (1999).

In 1999, total employment in the ROI stood at 96,005 (U.S. Bureau of the Census 2001a); it was expected to reach 98,800 by 2001 (Allison 2001). The economy of the ROI is dominated by the trade and service industries, with employment in these activities contributing almost 60% to total employment in the ROI in 1999 (see Table 4.19-3). Average annual employment growth in the ROI was 3.4% during the period 1990 to 1999 (U.S. Bureau of the Census 1992c, 2001a).

Employment at ANAD currently stands at 3,838 (Burdell 2000c), including 90 employees working at the CLA (Burdell 2000d). A number of commercial and industrial tenants occupy land and buildings currently used by the military, and employment in these activities currently stands at 584 people. There are also 1,117 contractors currently working at the site (Burdell 2000c).

Unemployment in Calhoun County steadily declined during the late 1990s from a peak rate of 9.1% in 1993 to the current rate of 5.1% (Table 4.19-4) (U.S. Bureau of Labor Statistics 2001). Unemployment in the ROI currently stands at 6.7%, compared with 5.0% for the state.

4.19.1.3 Personal Income

Personal income in Calhoun County stood at almost $2.4 billion in 1999 and was expected to reach $2.6 billion in 2001. The annual average rate of growth was 4.6% over the

TABLE 4.19-3 Employment in the ANAD Region of Influence by Industry in 1999

Employment Sector	Number Employed	% of ROI Total
Agriculture	2,057[a]	2.1
Mining	520	0.5
Construction	4,449	4.6
Manufacturing	26,107	27.2
Transportation and public utilities	2,926	3.0
Trade	18,118	18.9
Finance, insurance, and real estate	3,523	3.7
Services	38,305	39.9
Total	96,005	

[a] 1997 data.

Sources: U.S. Bureau of the Census (2001a); USDA (1999).

TABLE 4.19-4 Unemployment Rates in Calhoun County, ANAD Region of Influence, and Alabama

Location and Period	Rate (%)
Calhoun County	
1990–2000 average	6.8
2001 (current rate)	5.1
ROI	
1990–2000 average	7.2
2001 (current rate)	6.7
Alabama	
1990–1999 average	5.9
2001 (current rate)	5.0

Source: U.S. Bureau of Labor Statistics (2001).

period 1990–1999 (Table 4.19-5). County per capita income also rose in the 1990s. It was expected to reach $23,300 in 2001, compared with $13,758 at the beginning of the period.

The annual average growth rate in personal income was slightly higher in the ROI than in Calhoun County. Total personal income in the ROI grew at an annual rate of 5.0% over the period 1990–1999 and was expected to reach $6.6 billion by 2001. ROI per capita income was expected to rise from $13,236 in 1990 to $22,100 in 2001, representing an average annual growth rate of 4.8%.

4.19.1.4 Housing

Housing stock in Calhoun County grew at an annual rate of 0.9% over the period 1990–2000 (Table 4.19-6) (U.S. Bureau of the Census 2001b). The total number of housing units was expected to reach 51,200 in 2001, reflecting the negative annual growth in county population. Average annual growth in the city of Anniston over this period was 0.6%, with 12,700 total housing units expected in 2001. During this period, 4,569 new units were added to the existing housing stock in the county, with 687 additional units present in the city of Anniston at the end of the period. Vacancy rates currently stand at 18.3% in the city and 11.7% in the county as a whole for all types of housing. Based on annual average growth rates between 1990 and 2000, there would be 6,000 vacant housing units in the county in 2001, of which 2,100 would be rental units available to construction workers at the proposed facility.

TABLE 4.19-5 Personal Income in Calhoun County and ANAD Region of Influence

Location and Personal Income	1990[a]	1999[b]	Annual Average Growth Rate (%) 1990–1999	2001[c] (Projected)
Calhoun County				
Total (millions of $)	1,596	2,388	4.6	2,610
Per capita ($)	13,758	21,204	4.9	23,300
Total ROI				
Total (millions of $)	3,838	5,955	5.0	6,570
Per capita ($)	13,236	20,160	4.8	22,100

[a] U.S. Bureau of the Census (1994).

[b] U.S. Department of Commerce (2001).

[c] Allison (2001).

TABLE 4.19-6 Housing Characteristics in Anniston, Calhoun County, and ANAD Region of Influence

Location and Type of Housing	1990[a]	2000[b]	2001[c] (Projected)
City of Anniston			
Owner occupied	6,531	6,215	6,160
Rental	4,276	4,232	4,190
Total unoccupied units	1,293	2,340	2,320
Total units	12,100	12,787	12,700
Calhoun County			
Owner occupied	30,222	32,856	32,700
Rental	12,761	12,451	12,400
Total unoccupied units	3,770	6,015	6,000
Total units	46,753	51,322	51,200
ROI total			
Owner occupied	78,731	87,221	87,400
Rental	29,375	30,375	30,400
Total unoccupied units	10,295	14,154	14,200
Total units	118,401	131,750	132,000

[a] U.S. Bureau of the Census (1994).

[b] U.S. Bureau of the Census (2001b).

[c] Allison (2001).

Housing grew at a faster rate in the ROI as a whole than in Calhoun County or Anniston during the 1990s; the annual growth rate was 1.1%. The total number of housing units was expected to reach 132,000 by 2001, with more than 13,300 housing units to be added in the 1990s. The vacancy rate currently stands at 10.7%, meaning that more than 4,100 rental units would be available to construction workers at the proposed facility.

4.19.1.5 Community Resources

Community Fiscal Conditions. Construction and operation of the proposed facility would result in increased revenues and expenditures for local government jurisdictions, including counties, cities, and school districts. Revenues would come primarily from state and local sales taxes associated with employee spending during construction and operation. The money would be used to support additional local community services currently provided by each jurisdiction.

Appendix G presents information on revenues and expenditures by the various local government jurisdictions in the ROI.

Community Public Services. Construction and operation of the proposed facility would result in increased demand for community services, in the counties, cities, and school districts likely to host relocating construction workers and operations employees. Additional demands would also be placed on local medical facilities and physician services. Table 4.19-7 presents data on employment and levels of service (number of employees per 1,000 population) for public safety and general local government services. Tables 4.19-8 and 4.19-9 provide staffing data for school districts and hospitals. Table 4.19-10 presents data on employment and levels of service for physicians.

4.19.1.6 Traffic

Vehicular access to ANAD is afforded from State Highway 202, which runs southwest from Anniston toward Pell City along the southern perimeter of ANAD (see Figure 4.1-1). The entrance is located approximately 10 mi (16 km) from downtown Anniston. Other roads in the immediate vicinity of ANAD that are used by employees working on post include:

- U.S. Highway (US) 78, which runs east-west within the vicinity of the southern perimeter of ANAD;
- The Bynum Cutoff, which runs north-south between State Route (SR) 202 and US 78;
- County Road (CR) 109, which runs north-south between Coldwater and Eulaton and Blue Mountain, along the southeastern and eastern perimeter of ANAD;
- CR 26, which runs southeast from SR 202 and CR 109;
- SR 21/US 431, which runs north-south through Oxford and Anniston; and
- Interstate (I) 20, which runs east-west between Oxford and Pell City to the west.

TABLE 4.19-7 Public Service Employment in Calhoun County, Various Cities near ANAD, and Alabama in 2000[a]

	Calhoun County[b]		Anniston[b]		Hobson City[b]	
Employment Category	Number Employed	Level of Service	Number Employed	Level of Service	Number Employed	Level of Service
Police protection	31	0.6	98	4.0	4	4.6
Fire protection[c]	0	0	88	3.6	0	0
General services	194	3.5	124	5.1	6	6.8
Total	225	4.1	310	12.8	10	11.4

	Jacksonville[b]		Ohatchee[b]		Oxford[b]	
Employment Category	Number Employed	Level of Service[a]	Number Employed	Level of Service[a]	Number Employed	Level of Service[a]
Police protection	22	2.6	6	4.9	40	2.7
Fire protection[c]	14	1.7	0	0	0	0
General services	84	10.0	6	4.9	100	6.9
Total	120	14.3	12	9.9	140	9.6

	Piedmont[b]		Weaver[b]		Alabama[d]
Employment Category	Number Employed	Level of Service	Number Employed	Level of Service	Level of Service
Police protection	15	2.9	10	3.8	2.5
Fire protection[c]	4	0.8	0	0	1.1
General services	73	14.3	25	9.5	37.0
Total	92	18.0	35	13.4	40.6

[a] Level of service represents the number of employees per 1,000 persons in each jurisdiction. Data on the number of persons employed came from local government sources (Nieves 2000).

[b] Source of population data was U.S. Bureau of the Census (2001b).

[c] Does not include volunteers.

[d] U.S. Bureau of the Census (2000).

TABLE 4.19-8 School District Data for Calhoun County, Various Cities near ANAD, and Alabama in 2000

Location	Number of Teachers Employed	Student to Teacher Ratio[a]
Calhoun County	591	16.3
Anniston	201	14.1
Jacksonville	104	15.6
Oxford	197	15.6
Piedmont	72	15.6
Alabama		15.6

[a] Student to teacher ratio represents the number of students per teacher in each school district.

Source: Crawford (2000).

TABLE 4.19-9 Medical Facility Data for Calhoun County in 1999

Hospital	Number of Staffed Beds	Occupancy Rate (%)[a]
Jacksonville Hospital	62[b]	24[b]
North East Regional Medical Center	253[b]	76[b]
Stringfellow Memorial Hospital	125[b]	31[b]
County total	440	-

[a] Percent of staffed beds occupied.

[b] Data source, by permission: SMG Marketing Group, Inc., © copyright 2001.

Table 4.19-11 shows average annual daily traffic flows over these road segments, together with designations for the congestion levels (level-of-service designations) developed by the Transportation Research Board (1985). The designations range from A to F; A through C represent good traffic operating conditions with some minor delays experienced by motorists, and F represents jammed roadway conditions.

TABLE 4.19-10 Physician Employment in Calhoun County and Alabama in 1997[a]

	Calhoun County		Alabama
Employment Category	Number Employed	Level of Service	Level of Service
Physicians	203	1.7	2.1

[a] Level of service represents the number of employees per 1,000 persons in each jurisdiction.

Sources: American Medical Association (1999) for number employed; U.S. Bureau of the Census (2001b) for population data.

TABLE 4.19-11 Average Annual Daily Traffic (AADT) in the Vicinity of ANAD

Road Segment	Traffic Volume (AADT)	Level of Service[a]
CR 109 in Eulaton	10,370	B
CR 109 at SR 202	7,670	B
CR 109 at US 78	8,840	A
SR 202 west of ANAD Main Gate	5,610	A
SR 202 in Eulaton	13,990	B
US 78 and CR 109 in Coldwater	8,970	A
US 78 east of SR 202/US 78	4,710	A
US 78 and CR 93	9,340	A
I 20 in Oxford	32,340	A

[a] Allison (2001).

Source: Oliver (2000).

4.19.2 Site-Specific Factors

This analysis covers the potential consequences on socioeconomic factors from siting, constructing, and operating an ACWA pilot test facility. It considers effects on population, employment, income, regional growth, housing, community resources, and transportation.

4.19.3 Impacts of the Proposed Action

Impacts from construction and operations are summarized in Table 4.19-12. The impacts of no action are provided as well for comparison.

4.19.3.1 Impacts of Construction

Neutralization/Biotreatment. The potential socioeconomic impacts from constructing a Neut/Bio facility at ANAD would be relatively small. Construction activities would create direct employment of about 640 people in the peak construction year and an additional 540 indirect jobs in the ROI. Construction activities would increase the annual average employment growth rate by 0.1% over the duration of construction. A Neut/Bio facility at ANAD would produce approximately $35 million of income in the peak year of construction.

In the peak year of construction, about 640 people would in-migrate to the ROI. However, in-migration would have only a marginal effect on population growth and would require only about 6% of vacant rental housing in the peak year. No significant impact on public finances would occur as a result of in-migration, and less than 10 additional local public service employees would be required to maintain existing levels of service in the various local public service jurisdictions in Calhoun County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding ANAD.

Neutralization/SCWO. The potential socioeconomic impacts from constructing a Neut/SCWO facility at ANAD would be relatively small. Construction activities would create direct employment of approximately 730 people in the peak construction year and an additional 520 indirect jobs in the ROI. Construction activities would increase the annual average employment growth rate by 0.1% over the duration of construction. Neut/SCWO-related employment and related wages and salaries at ANAD would also produce about $37 million of income in the peak year of construction.

TABLE 4.19-12 Effects of Construction, Operations, and No Action at ANAD on Socioeconomics[a,b]

	Neut/Bio		Neut/SCWO		Neut/GPCR/TW-SCWO		Elchem Ox		
Impact Category	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	No Action
Employment (number of jobs in ROI)									
Direct	640	660	730	660	740	660	790	660	90
Indirect	540	580	520	580	580	590	620	820	60
Total	1,180	1,240	1,250	1,240	1,320	1,250	1,410	1,480	150
Income (millions of $ in ROI)									
Direct	22.1	33.4	24.7	33.4	25.3	33.4	27.1	33.4	5.2
Indirect	13.2	12.4	12.2	12.5	13.8	12.6	14.9	19.5	1.3
Total	35.3	45.8	36.9	45.9	39.1	46.0	42.0	52.9	6.5
Population (number of new residents in ROI)	640	740	890	740	970	740	1,100	930	0
Housing (number of units required in ROI)	240	270	330	270	350	270	400	340	0
Public finances (% impact on fiscal balance)									
Cities in Calhoun County[c]	1	1	1	1	1	1	1	1	0
Calhoun County	<1	<1	<1	<1	<1	<1	<1	<1	0
Schools in Calhoun County[d]	1	1	1	1	1	1	1	1	0
Public service employment (number of new employees in Calhoun County)[c]									
Police officers	1	1	2	1	2	1	2	2	0
Firefighters	1	1	1	1	1	1	1	1	0
General	2	3	3	3	4	3	4	3	0
Physicians	1	1	1	1	1	1	1	1	0
Teachers[d]	3	4	5	4	5	4	6	5	0
Number of new staffed hospital beds in Calhoun County	1	2	2	2	2	2	3	2	0
Traffic (impact on current levels of service in Calhoun County)	None	None	None	None	None	None	None	None	None

[a] Impacts are shown for the peak year of construction (2004) and the first year of operations (2009).

[b] The sum of individual row entries and column totals may not correspond because of independent rounding.

[c] Includes impacts that would occur in the cities of Anniston, Hobson City, Jacksonville, Ohatchee, Oxford, Piedmont, and Weaver and in Calhoun County.

[d] Includes impacts that would occur in Anniston, Jacksonville, Oxford, Piedmont, and Calhoun County school districts.

In the peak year of construction, about 890 people would in-migrate to the ROI, both as a result of SCWO employment at ANAD and as a result of the overall growth in the ROI economy through the local procurement of materials and services and through employee spending. However, in-migration would have only a marginal effect on population growth and would require only about 8% of vacant rental housing during the peak year. No significant impact on public finances would occur as a result of in-migration, and only 12 additional local public service employees would be required to maintain existing levels of service in the various local public service jurisdictions in Calhoun County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding ANAD.

Neutralization/GPCR/TW-SCWO. The potential socioeconomic impacts from constructing a Neut/GPCR/TW-SCWO facility at ANAD would be relatively small. Construction activities would create direct employment of approximately 740 people in the peak construction year and an additional 580 indirect jobs in the ROI. Construction activities would increase the annual average employment growth rate by 0.1% over the duration of construction. Neut/GPCR/TW-SCWO-related employment and related wages and salaries at ANAD would also produce about $39 million of income in the peak year of construction.

In the peak year of construction, about 970 people would in-migrate to the ROI, both as a result of SCWO employment at ANAD and as a result of the overall growth in the ROI economy through the local procurement of materials and services and through employee spending. However, in-migration would have only a marginal effect on population growth and would require only about 9% of vacant rental housing during the peak year. No significant impact on public finances would occur as a result of in-migration, and only 13 additional local public service employees would be required to maintain existing levels of service in the various local public service jurisdictions in Calhoun County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding ANAD.

Electrochemical Oxidation. The potential socioeconomic impacts from constructing an Elchem Ox facility at ANAD would be relatively small. Construction activities would create direct employment of approximately 790 people in the peak construction year and an additional 620 indirect jobs in the ROI. Construction activities would increase the annual average employment growth rate by 0.1% over the duration of construction. Elchem-Ox-related employment and related wages and salaries at ANAD would also produce about $42 million of income in the peak year of construction.

In the peak year of construction, about 1,100 people would in-migrate to the ROI, both as a result of Elchem Ox employment at ANAD and as a result of the overall growth in the ROI economy through the local procurement of materials and services and through employee spending. However, in-migration would have only a marginal effect on population growth and would require only about 10% of vacant rental housing during the peak year. No significant impact on public finances would occur as a result of in-migration, and only 14 additional local public service employees would be required to maintain existing levels of service in the various local public service jurisdictions in Calhoun County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding ANAD.

4.19.3.2 Impacts of Operations

Neutralization/Biotreatment. The potential socioeconomic impacts from operating a Neut/Bio facility at ANAD would be relatively small. Operational activities would create about 660 direct jobs annually and an additional 580 indirect jobs in the ROI. A Neut/Bio facility would produce about $46 million annually during operations.

About 740 people would move to the area at the beginning of operations. However, in-migration would have only a marginal effect on population growth and would require about 14% of vacant owner-occupied housing during facility operations. No significant impact on public finances would occur as a result of in-migration, and 10 new local public service employees would be required to maintain existing levels of service in the various local public service jurisdictions in Calhoun County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding ANAD.

Neutralization/SCWO. The potential socioeconomic impacts from constructing and operating a Neut/SCWO facility at ANAD would be relatively small. Operational activities would create about 660 direct jobs annually, and an additional 580 indirect jobs in the ROI. Direct Neut/SCWO-related employment and related wages and salaries at ANAD would also produce about $46 million annually during operations.

About 740 people would move to the area at the beginning of Neut/SCWO facility operation. However, in-migration would have only a marginal effect on population growth and would require about 14% of vacant owner-occupied housing during facility operations. No significant impact on public finances would occur as a result of in-migration, and 10 new local public service employees would be required to maintain existing levels of service in the various local public service jurisdictions in Calhoun County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding ANAD.

Neutralization/GPCR/TW-SCWO. The potential socioeconomic impacts from operating a Neut/GPCR/TW-SCWO facility at ANAD would be relatively small. Operational activities would create about 660 direct jobs annually, and an additional 590 indirect jobs in the ROI. A Neut/GPCR/TW-SCWO facility would produce $46 million annually during operations.

About 740 people would move to the area at the beginning of operations. However, in-migration would have only a marginal effect on population growth and would require about 14% of vacant owner-occupied housing during facility operations. No significant impact on public finances would occur as a result of in-migration, and 10 new local public service employees would be required to maintain existing levels of service in the various local public service jurisdictions in Calhoun County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding ANAD.

Electrochemical Oxidation. The potential socioeconomic impacts from operating an Elchem Ox facility at ANAD would be relatively small. Operational activities would create about 660 direct jobs annually and an additional 820 indirect jobs in the ROI. An Elchem Ox facility would produce about $53 million annually during operations.

About 930 people would move to the area at the beginning of operations. However, in-migration would have only a marginal effect on population growth and would require about 17% of vacant owner-occupied housing during facility operations. No significant impact on public finances would occur as a result of in-migration, and 12 new local public service employees would be required to maintain existing levels of service in the various local public service jurisdictions in Calhoun County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding ANAD.

4.19.4 Impacts of No Action

The socioeconomic impacts of continuing operations at ANAD would be relatively small. The CLA currently employs 90 workers. Wage and salary expenditures by these employees on goods and services have created an additional 60 indirect jobs in the ROI (Table 4.19-14) and increased the annual average employment growth rate in the ROI by less than 0.01% over the period 1990–2000. CLA-related wage and salary expenditures have also created an estimated $7 million in annual income in the ROI.

4.20 ENVIRONMENTAL JUSTICE

On February 11, 1994, President Clinton issued Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (Volume 59, page 7629 of the *Federal Register* [59 FR 7629]). This order, along with its accompanying cover memo, calls on federal agencies to incorporate environmental justice as part of their missions. It directs them to address, as appropriate, disproportionately high and adverse human health or environmental effects of their actions, programs, or policies on minority and low-income populations.

This EIS used data from the two most recent decennial censuses (1990 and 2000) to evaluate environmental justice issues in the context of the ACWA Program at ANAD. The 2000 census provides detailed data on race and ethnicity necessary for a systematic definition of minority populations. Although more than a decade old, the 1990 census nevertheless provided the most recent data available on income, which enabled the identification of low-income populations. To remain consistent with these data sources, the EIS employs the following definitions for minority and low-income:

- *Minority* — Individuals who classify themselves as belonging to any of the following racial groups: Black (including Black or Negro, African American, Afro-American, Black Puerto Rican, Jamaican, Nigerian, West Indian, or Haitian); American Indian, Eskimo, or Aleut; Asian or Pacific Islander; or "Other Race" (U.S. Bureau of the Census 1991). For present purposes, individuals characterizing themselves as belonging to two or more races also are counted as minorities. This study also includes individuals identifying themselves as Hispanic in origin, technically an ethnic category, under minority. To avoid double-counting, tabulations included only White Hispanics; the above racial groups already account for Nonwhite Hispanics.

- *Low-Income* — Individuals falling below the poverty line. For the 1990 census, the poverty line was defined by a statistical threshold based on a weighted average that considered both family size and the ages of individuals in a family. For example, the 1990 poverty threshold annual income for a family of five with two children younger than 18 years was $15,169, while the poverty threshold for a family of five with three children aged less than 18 years was $14,796 (U.S. Bureau of the Census 1992a). If a family fell below the poverty line for its particular composition, the census considered all individuals in that family to be below the poverty line. Low income figures in the 1990 census reflect incomes in 1989, the most recent year for which entire annual incomes were known at the time of the census.

For this EIS, an analysis of minority and low-income populations was done by using census data for two demographic units: counties and census block groups. A block group is a geographic unit consisting of a cluster of blocks that is used by the Census Bureau to present data (U.S. Bureau of the Census 1991). Block groups contain enough blocks to encompass about 250–550 housing units, with the ideal one containing about 400 housing units. Because housing density varies over space, the geographic sizes of block groups vary; smaller units tend to occur in denser areas, such as urban areas. This dual focus on counties and block groups enables the evaluation of environmental justice issues to remain consistent with the geographical focus of analyses in two issue areas where environmental justice is of particular concern: socioeconomics and human health. To maintain consistency with the socioeconomic analysis, the sections on current conditions and impacts under environmental justice consider Calhoun County to be the core county for ANAD. To maintain consistency with the human health analysis, the environmental justice analysis considers population characteristics in census block groups within a 30-mi (50-km) radius of ANAD. The block groups considered include all of Calhoun and St. Clair Counties and parts of Blount, Cherokee, Clay, Cleburne, Etowah, Randolph, Shelby, and Talladega Counties.

To define disproportionate representations of either minority or low-income populations, this EIS uses values for the United States as a whole as reference points, thereby providing an identical comparison for all four installations considered in this EIS. This choice of a reference point, which is central to environmental justice analyses, is consistent with the environmental justice executive order and also with the need to select a meaningful reference point for any given impact assessment (see Council on Environmental Quality [CEQ] 1997; EPA 1998a). The 2000 census indicates that the United States contains 30.9 % minority persons (U.S. Bureau of the Census 2001c), while the 1990 census indicated that 13.1% of persons for whom poverty status was known were considered low-income population in 1989 (U.S. Bureau of the Census 1992b).

4.20.1 Current Environment

Of the Calhoun County residents recorded in the 2000 census, 22.0% were minority (U.S. Bureau of the Census 2001c). This percentage was less than the percentage of minorities in the United States as a whole. The largest percentage of minority persons in Calhoun County (18.5% of the total population) was Black. The 1990 census recorded that 15.7% of the Calhoun County population were below the poverty level (U.S. Bureau of the Census 1992b); this percentage was slightly higher than the percentage in the United States as a whole.

Of the 294 census block groups defined in the 2000 census partially or totally within a 30-mi (50-km) radius of ANAD, 71 contained minority populations in excess of the percentage of minority representation in the United States (Figure 4.20-1). These 71 block groups contained a total of 43,605 minority persons in 2000. Block groups with disproportionately high minority populations included the scattered farming communities of Ashland, Attalla, Lineville, and Pell City, as well as several block groups in the cities of Anniston, Gadsden, and Talladega. The majority of the block groups containing disproportionately high minority populations lie east, north, and southwest of the installation.

Two hundred thirteen of the 358 census block groups defined in the 1990 census lying partially or totally within a 30-mi (50-km) radius of ANAD contained low-income populations in excess of the 13.1% calculated for the United States as a whole (Figure 4.20-2). These block groups contained 43,977 low-income persons in 1989. Block groups with a disproportionately high representation of low-income populations included the same four farming communities noted in the preceding paragraph, other rural communities close to ANAD (Blue Mountain,

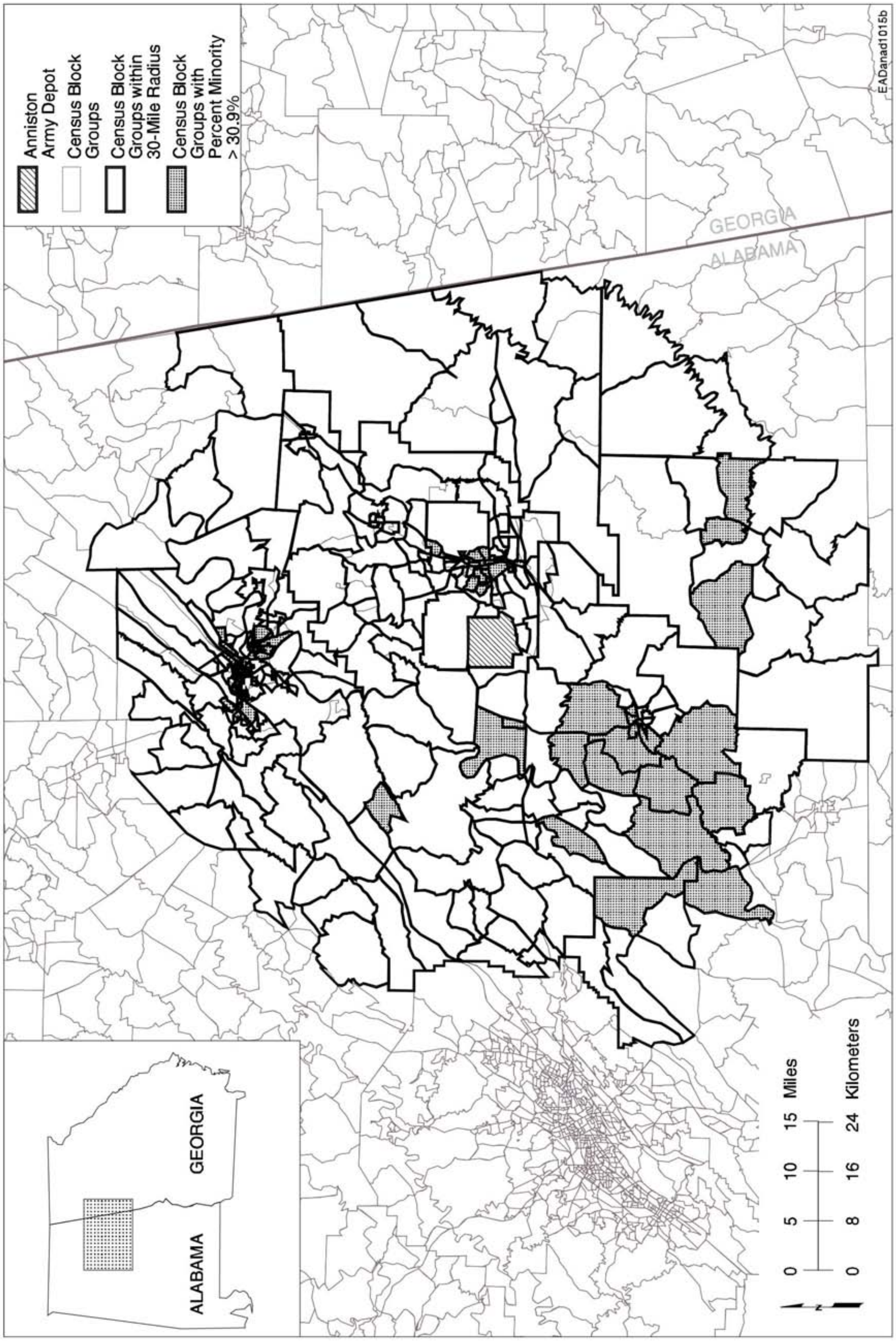

FIGURE 4.20-1 Census Block Groups within a 30-Mile (50-Kilometer) Radius of ANAD with Minority Populations Greater than the National Average in 2000 (Source: U.S. Bureau of the Census 2001d)

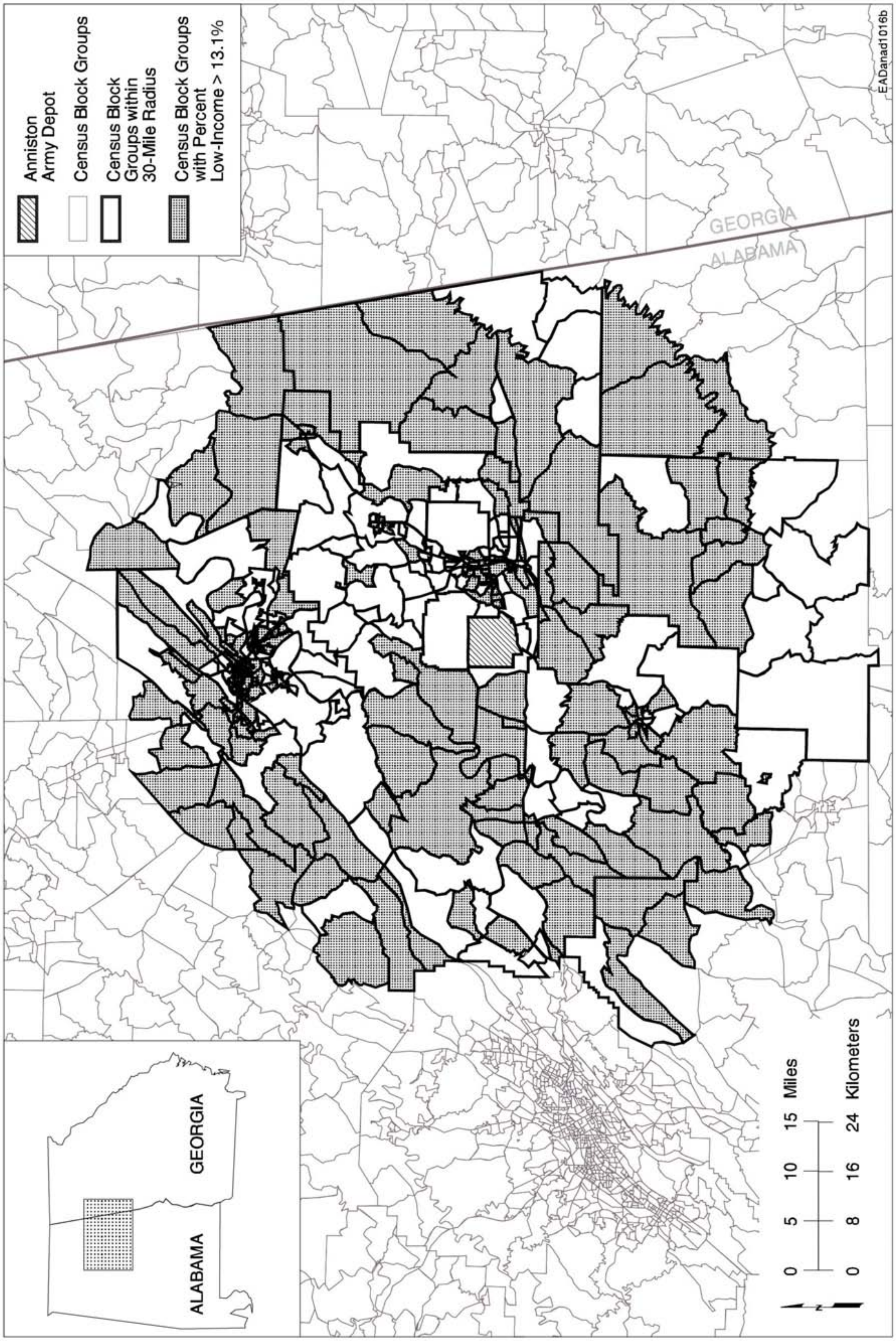

FIGURE 4.20-2 Census Block Groups within a 30-Mile (50-Kilometer) Radius of ANAD with Low-Income Populations Greater than the National Average in 1989 (Source: U.S. Bureau of the Census 1992b)

Edwardsville, Hobson City, Jacksonville, Ohatchee, Ragland, Ridgeville, Riverside, and West End-Cobb Town), and portions of the cities of Anniston, Gadsden, and Talladega.

4.20.2 Site-Specific Factors

Factors considered in this EIS with potential implications for environmental justice are any activities associated with the ACWA Program at ANAD. Included are impacts associated with construction, operations, and accidents. The evaluation of environmental justice consequences focuses on socioeconomic and human health impacts, two categories that directly affect all people, including minority and low-income populations.

To address Executive Order 12898, this analysis focuses on impacts that are both high and adverse and that disproportionately affect minority and low-income populations. Although it seems logical that certain characteristics of many environmental justice populations — such as having limited access to health care and reduced or inadequate nutrition — might make them disproportionately vulnerable to environmental impacts, there do not appear to be any scientific studies that support this contention for the types of impacts considered in this EIS. The absence of such information precludes any analysis that considers increased sensitivity of minority and low-income populations to impacts. To help compensate for this limitation, the analysis of human health impacts includes conservative assumptions and uncertainty factors to accommodate for potentially sensitive subpopulations (see Section 4.7.2.2). The present analysis considers that a disproportionate effect could occur only if the proportion of a population is in excess of the proportion in the United States as a whole, as discussed above under existing conditions. Therefore, significant environmental justice impacts are those that would have a high and adverse impact on the population as a whole and that would affect areas (Calhoun County or census block groups within 30 mi [50 km] of ANAD) containing disproportionately high minority or low-income populations.

4.20.3 Impacts of the Proposed Action

4.20.3.1 Impacts of Construction

The primary socioeconomic impacts from constructing any of the four alternative technologies, discussed in Section 4.19.3.1, would be increases in short-term employment and income. They would also include small increases in the demand for local housing, schools, and public services. None of these impacts would be high or adverse; local governments and the existing housing stock should be able to accommodate increased demands; and the increased employment and income would be a positive consequence of construction. Human health and other impacts similarly are not expected to be high and adverse during construction. As a result, no environmental justice impacts are anticipated from construction.

4.20.3.2 Impacts of Operations

The primary socioeconomic impacts from operating an ACWA facility, discussed in Section 4.19.2.2 for the four technologies, would be increases in employment and income. They would also include small increases in the demand for local housing, schools, and public services. Once again, none of these impacts are high and adverse; local governments and the existing housing stock should be able to accommodate increased demands; and the increased employment and income would be a positive consequence of construction. As a result, no environmental justice impacts are anticipated.

Occupational hazards to workers and releases of agents or other hazardous materials represent the main impacts that could occur during routine operations of the alternative technologies. However, the risk of a noncancer health effect and the risk of cancer from hazardous chemicals released during normal operations would be very low for both workers and the public. These impacts would not be high and adverse; as a consequence, no environmental justice impacts are anticipated from normal operations.

4.20.4 Impacts of No Action

As discussed in Section 4.19.4, socioeconomic impacts of continued operations at ANAD would be small: primarily a continuation of small, positive economic impacts and a slight increase in demands for housing, schooling, and public services. None of these impacts would be considered high and adverse. Similarly, high and adverse human health impacts on either the workers at ANAD or the general public are not anticipated (see Section 4.7.4). As a result, no environmental justice impacts are anticipated under the no action alternative.

4.21 ACCIDENTS INVOLVING ASSEMBLED CHEMICAL WEAPONS

4.21.1 Potential Accidental Releases

This analysis of accidents provides an estimate of the upper range of the potential impacts that might occur as a result of a hypothetical accident related to the proposed action (ACWA pilot testing) or related to the no action alternative (continued storage of the chemical weapons). The accidents selected for analysis were the accidents that were shown to have the highest risk in previous Army analyses (SAIC 1997). The highest-risk accidents are defined as those with the highest combined consequences (in terms of human fatalities) and probability of occurrence. For existing continued storage conditions and for operations, the highest-risk accidents would involve the release of chemical agent; release of other materials would result in lower consequences and risks. In general, the accidents considered in this EIS have a fairly low frequency of occurrence. The accident considered for continued storage (lightning strike into a storage igloo) has an estimated frequency on the order of 7×10^{-4} per year (i.e., one occurrence in 1,400 years). The accident considered for the pilot facilities (handling accident in rocket storage igloo) has a somewhat lower estimated frequency of approximately 2×10^{-4} (i.e., one occurrence in 6,000 years).

4.21.1.1 Scenarios

The hypothetical highest-risk accident for ACWA pilot testing of GB and VX assumes that a handling accident would occur in a rocket igloo, and a fire and the release of agent from all the munitions in the igloo would follow. The hypothetical highest-risk accident for ACWA pilot testing of mustard assumes that an earthquake would cause the part of the unpack area where munitions are located to fall. The hypothetical highest-risk accident for continued storage assumes that lightning would strike a GB- or VX-rocket-containing igloo, and a fire and the release of agent from all the munitions in the igloo would follow. Therefore, for GB and VX processing, the accident consequences under the no action alternative (continued storage) would be the same as those under the proposed action alternative (pilot facility). However, for mustard-only processing (which would be the case if Neut/Bio was chosen as the ACWA technology at ANAD), the accident consequences under the no action alternative and the proposed action alternative would differ.

Impacts from accidents occurring during the transport of agent from the storage igloos to the pilot testing facility were not assessed for this EIS, because the risks from these accidents would be less than those from the accidents already considered. Accident scenarios and probabilities from on-site transportation are discussed in a PEIS support document (GA Technologies 1987). As noted above, potential accidents from handling the munitions inside the igloos were considered and, in fact, were identified as being the highest-risk accidents during facility operations (SAIC 1997).

For the Neut/Bio pilot facility accident scenario for mustard processing, data given in the ANAD Phase I quantitative risk assessment for a baseline incineration facility (SAIC 1997) were used to estimate the maximum amount of mustard agent that could be released during an earthquake. The Neut/Bio process would use a modified baseline process for ACW access (Parsons and Allied Signal 1999); therefore, it was assumed that the configuration of the unpack area would not deviate significantly from that for the baseline. For ANAD, it was assumed that the maximum number of munitions in the unpack area at the time of the earthquake would be the contents of four on-site containers (ONCs) containing mustard-filled 155-mm projectiles. (This assumption results in the largest possible amount of mustard agent being present in the unpack area among the mustard munition types present at ANAD.)

ONCs are used to transport munitions at the Tooele Chemical Agent Disposal Facility, but the Army is investigating the feasibility of using modified ammunition vans. A change in the transport system used might also entail changes in the dimensions and capacity of the unpack area or a similarly functioning building or area. Such changes should not invalidate the impact estimates for pilot facility accidents during mustard processing given here, because the assumption about the number of munitions present in the unpack area was meant to represent a high-end estimate of the amount of mustard that could be released in an earthquake. These accident impact estimates should be representative for either type of transportation system.

For the storage igloo accident scenario, it was assumed that a lightning strike could release the entire contents of a rocket-containing storage igloo. Similarly, a handling accident in a rocket-storage igloo could result in an explosion and propagation by fire, also causing the entire igloo contents to be released. The probability of such accidents occurring is fairly low (on the order of 7×10^{-4}), but it increases slightly with increasing length of continued storage. For these scenarios, the maximum amount of agent at risk was obtained from estimates of the maximum amount of VX or GB agent stored in any single ANAD rocket-containing igloo (Burdell 2000b).

4.21.1.2 Methods of Analysis

Potential accidental releases of chemical agent to the atmosphere and the associated consequences of such releases were assessed by using the D2PC[10] Gaussian dispersion model (Whitacre et al. 1987). Two meteorological conditions were assumed in the modeling to assess accident impacts. E-1 conditions consist of a slightly stable atmosphere (stability class E) with light winds (1 m/s). D-3 conditions consist of a neutral atmosphere (stability class D) with moderate winds (3 m/s). E-1 conditions would produce conservative impacts for the assessed accident scenarios. They represent accidents that would occur during the night or during a relatively short period after sunrise. The D-3 conditions would result in more rapid dilution of an accidentally released agent than would E-1 conditions. D-3 conditions represent accidents that would occur during daytime. When D-3 meteorological conditions are assumed, the size of the estimated plume is smaller. In conducting D2PC modeling, it was assumed that no plume depletion by agent deposition would occur. This is a conservative assumption for estimating the area potentially affected by an accidental release, because assuming that more agent remains in the plume allows farther plume travel before concentrations are diluted below the toxicological endpoint levels. The D2PC model default mixing height assumptions were used for modeling D-3 meteorological conditions, and per EPA guidance (EPA 1995), an unlimited mixing height was assumed for modeling E-1 meteorological conditions. A mixing height of 5,000 m is used as a default in D2PC to represent unlimited mixing. The D2PC model limits its application to accident release scenarios that could produce impacts at distances of less than or equal to about 30 mi (50 km).

For modeling mustard agent instantaneous releases, the "time after functioning" (TAF) parameter was assumed to be 20 hours. (The TAF was applicable only for accident modeling involving mustard agent instantaneous releases; it is defined as the time after detonation required

[10] The Army has completed the development and validation of a new model (D2Puff). However, the new model is not accredited for use at all installations.

to remove the agent source by decontaminating it or by containing it so it would no longer enter the atmosphere [Whitacre et al. 1987]).

4.21.1.3 Exposures and Deposition

For each of the accident scenarios assessed, the impacts of agent release were modeled by using D2PC-generated plumes with dosages estimated to result in adverse impacts for a certain percentage of the human population exposed (i.e., LCt_{50} = dosage corresponding to 50% lethality; LCt_{01} = dosage corresponding to 1% lethality; no deaths = dosage below which no deaths are expected in the human population exposed; no effects = dosage below which no adverse impacts are expected in the human population exposed). The distances to which these various plumes were predicted to extend were used as the starting point for the analyses of impacts to the various resources of concern under the proposed action and no action alternatives, as detailed in Sections 4.21.2 and 4.21.3 below. These distances are summarized in Table 4.21-1. For reference, the minimum distance from the hypothetical accident locations (i.e., CLA or the unpack area within the proposed facility locations) to the ANAD installation boundary is about 0.5 mi (0.8 km), and the distance to the on-site administrative area is about 2 mi (3 km). For all the hypothetical accidents assessed, the no effects plume contour extends into off-post areas (i.e., extending to 30 mi [50 km]). The extent of the no deaths contour varies from 9 to 30 mi (15 to 50 km), depending on the assumed type of chemical agent release and meteorological conditions.

4.21.2 Impacts of Accidents during the Proposed Action

4.21.2.1 Land Use

An accidental agent release during operation of an ACWA pilot test facility could generate serious negative land use impacts outside the installation, including the death and quarantine of livestock, interruption of agricultural productivity, and disruption of local industrial activities (see Sections 4.21.2.9 and 4.23). Although such an accident would be capable of generating serious negative consequences, the likelihood of such an accident is extremely remote; consequently, the overall risk is very low.

4.21.2.2 Waste Management and Facilities

Hazardous Waste. The highest-risk accident scenario for ACWA pilot testing activities is a handling accident in a rocket-containing igloo. Waste generated under this scenario would be

TABLE 4.21-1 Chemical Agent Plume Distances Resulting from Accidents at an ACWA Pilot Test Facility (Proposed Action) or in the Chemical Limited Area (No Action) at ANAD[a]

Effect	Impact Distance, mi (km)[b]	Exposure Dose (mg-min/m^3)[c]	Impact Area km^2	Impact Area acres
GB Accidents				
Proposed action, D-3 (i.e., handling accident in rocket storage igloo)				
1% lethality	6.7 (11)	10	7.4	1,800
No deaths	9.1 (15)	6	13	3,200
No effects	>30 (>50)	0.5	210	52,000
Proposed action, E-1 (i.e., handling accident in rocket storage igloo)				
1% lethality	29 (46)	10	50	1,200
No deaths	>30 (>50)	6	74	18,000
No effects	>30 (>50)	0.5	130	32,000
No action, D-3 (lightning strike on rocket igloo)				
1% lethality	6.7 (11)	10	7.4	1,800
No deaths	9.1 (15)	6	13	3,200
No effects	>30 (>50)	0.5	210	52,000
No action, E-1 (lightning strike on rocket igloo)				
1% lethality	29 (46)	10	50	1,200
No deaths	>30 (>50)	6	74	18,000
No effects	>30 (>50)	0.5	130	32,000
VX Accidents				
Proposed action, D-3 (i.e., handling accident in rocket storage igloo)				
1% lethality	10 (16)	4.3	15	3,700
No deaths	15 (24)	2.5	31	7,700
No effects	>30 (>50)	0.4	210	52,000
Proposed action, E-1 (i.e., handling accident in rocket storage igloo)				
1% lethality	>30 (>50)	4.3	79	20,000
No deaths	>30 (>50)	2.5	95	23,000
No effects	>30 (>50)	0.4	130	32,000
No action, D-3 (lightning strike on rocket igloo)				
1% lethality	10 (16)	4.3	15	3,700
No deaths	15 (24)	2.5	31	7,700
No effects	>30 (>50)	0.4	210	52,000

TABLE 4.21-1 (Cont.)

Effect	Impact Distance, mi (km)[b]	Exposure Dose ($mg\text{-}min/m^3$)[c]	Impact Area km^2	Impact Area acres
No action, E-1 (lightning strike on rocket igloo)				
1% lethality	>30 (>50)	4.3	79	20,000
No deaths	>30 (>50)	2.5	95	23,000
No effects	>30 (>50)	0.4	130	32,000
Mustard Accidents				
Proposed action, D-3 (earthquake impacts; unpack area)				
1% lethality	0.31 (0.50)	150	0.03	7.4
No deaths	0.38 (0.62)	100	0.04	10
No effects	3.7 (6.0)	2	2.3	570
Proposed action, E-1 (earthquake impacts; unpack area)				
1% lethality	1.2 (1.9)	150	0.18	44
No deaths	1.5 (2.4)	100	0.27	67
No effects	14 (23)	2	15	3,700
No action, D-3 (lightning strike on rocket igloo) – Not applicable[d]				
No action, E-1 (lightning strike on rocket igloo) – Not applicable[d]				

[a] Distances and plume areas in table are from D2PC output. Meteorological conditions of either D stability and 3-m/s wind speed or E stability and 1-m/s wind speed, and a “time after functioning” of 20 hours (for instantaneous mustard releases) are assumed.

[b] Impact distances downwind of accident that would have 1% lethality, no deaths, or no effects on humans (see Table 4.21-2).

[c] Dosage for duration of accident at specific impact distance. The dosages correspond to default values used in the D2PC code (Whitacre et al. 1997).

[d] Highest-risk accidents for continued storage (no action) are limited to rocket-containing igloos, which do not contain mustard agent.

primarily contaminated soil and debris from dispersion of agent. An undeterminable amount of contaminated wastes could be produced by cleanup of a spill or accident involving dispersion of agent. Spill and emergency response plans and resources would be in place to contain, clean up, decontaminate, and dispose of wastes according to existing standards and regulations.

Chemical agents are not listed in the Alabama hazardous waste regulations. If an accident that would involve the release of a chemical agent, such as mustard agent, were to occur, any contaminated residue, soil, water, or other debris resulting from the cleanup of that agent would be characterized to determine if it was a hazardous waste (*Alabama Administrative Code Revised* [Admin. Code R.] 335-14-2). Debris and soil contaminated with agent could be considered hazardous waste if they demonstrated a hazardous characteristic. In this case, the hazardous waste could have a serious impact on hazardous waste management capabilities in the area.

Nonhazardous Waste. Depending on the particular accident conditions, if the cleanup material did not demonstrate a hazardous waste characteristic, the Army might be able to dispose of some of it or most of it as nonhazardous waste in a local landfill.

4.21.2.3 Air Quality

Depending on the amount, an accidental release of GB, VX, or mustard at ANAD during operation of an ACWA pilot test facility could have short-term but very significant adverse impacts on air quality, in terms of human injuries and fatalities (see Section 4.21.2.4). However, the deposition of agent from the air onto the ground surface and/or its degradation in the environment would occur within a relatively short period of time. Mustard decomposes in air relatively quickly; its half-life is about 1.4 days (see Appendix A). GB is considered nonpersistent because it is volatile, soluble in water, and subject to acid-base hydrolysis. Although data on the fate of GB in the atmosphere are lacking, GB is likely to be subject to photolysis, radical oxidation, or hydrolysis upon contact with water vapor (Munro et al. 1999). Therefore, it is unlikely to persist in air. VX is nonvolatile and persistent; however, after an accidental release, VX aerosols would be subject to rapid deposition onto ground surfaces. Therefore, long-term (e.g., more than a few days after release) adverse air quality impacts would not be expected from an accidental release of mustard, GB, or VX.

4.21.2.4 Human Health and Safety

For each of the accident scenarios assessed, the impacts of agent release were modeled by using plumes with dosages estimated to result in death for a certain percentage of the population exposed (i.e., LCt_{50} = dosage corresponding to 50% lethality; LCt_{01} = dosage corresponding to 1% lethality; no deaths = dosage corresponding to 0% lethality). The assumption was made that for any accident, the wind direction would be toward the direction where the largest number of people live. By using site-specific population data, the potential numbers of fatalities for each accident were estimated. Further details on the methods used to estimate number of fatalities are given in Appendix H. This evaluation did not specifically estimate the numbers of nonfatal injuries that would occur for each accident scenario, because there would be great variation in the number and severity of nonfatal injuries, depending on the exposure concentration and duration and on variations in the populations exposed.

The population at risk at ANAD (i.e., persons residing within a 30-mi [50-km] radius of the post) is about 370,000 people. A handling accident in a VX rocket storage igloo could result in an explosion and propagation by fire, causing the entire igloo contents to explode and/or burn (SAIC 1997). For this igloo scenario, the maximum amount of agent at risk was obtained from estimates of the maximum amount of GB stored in any single ANAD igloo (Burdell 2000b). If this handling accident scenario occurred under E-1 meteorological conditions, 1% lethality distances and no deaths distances of more than 30 mi (50 km) would result (Table 4.21-2). The corresponding estimated number of fatalities among the general public would be about 4,400. The estimated number of fatalities for the on-post population would be about 710. If such an accident occurred under D-3 meteorological conditions, the 1% lethality distance would decrease to 10 mi (16 km). The corresponding estimated number of fatalities among the general public would be about 1,500. The estimated number of fatalities for the on-post population would increase somewhat, to about 860 fatalities. This on-post fatality estimate would increase because the D-3 plume would be wider but not extend as far downwind as the E-1 plume.

Since the Neut/Bio technology is applicable only to mustard agent destruction and not to nerve agent destruction, a handling accident in a VX or GB rocket igloo is not an applicable scenario for mustard processing. The highest-risk accident for mustard processing would be an earthquake impacting the unpack area. The impact distances for this accident were found to be much lower. The 1% lethality distance under E-1 meteorological conditions would be 1.2 mi (1.3 km) (see Table 4.21-2). The corresponding estimated number of fatalities among the off-post general public would be 0. The estimated number of fatalities for the on-post population would be about 670 under E-1 meteorological conditions and 230 under D-3 meteorological conditions. This scenario would apply to each of the technologies during mustard processing.

The above estimates are conservative with respect to several modeling assumptions, such as the number of munitions and amount of agent released, unvarying meteorology, no fire-induced plume buoyancy, and the size of the population exposed (e.g., wind assumed to be in direction of most populous area for an extended period of time). However, the toxicity levels used to estimate fatalities were originally developed for healthy adult males. If it is assumed that children and/or the elderly are substantially more susceptible to the effects of agent exposure than healthy adult males and if all other conservative assumptions remain the same, then the estimated number of fatalities could increase. When a previously developed method for incorporating sensitive subpopulation risk assumptions is used (U.S. Army 1991) and when it is assumed that about 35% of the general population in the ANAD ROI (see Section 4.19) falls into the sensitive subgroup, the fatality estimates for the accident scenarios addressed here for alternative

TABLE 4.21-2 Fatality Estimates for Potential Accidents Involving Agent Release at ANAD[a]

Accident Scenario[b]	Distance (mi) To LCt_{50} Dose	Distance (mi) To LCt_{01} Dose	Distance (mi) To No Deaths Dose	On-Post Population at Risk (no. of persons)[c] Source to LCt_{50}	On-Post Population at Risk (no. of persons)[c] LCt_{50} to LCt_{01}	On-Post Population at Risk (no. of persons)[c] LCt_{01} to No Deaths	Maximum Estimated Fatalities for On-Post Population[d]
Continued storage highest-risk accident (applicable to no action and proposed action, all ACWA technologies)							
Lightning strike into VX rocket storage area with fire: D-3	4.3	10	15	986	468	109	857
Lightning strike into VX rocket storage area with fire: E-1	18	>30	>30	883	179	55	707
Facility highest-risk accident (applicable to all ACWA technologies except Neut/Bio)							
Handling accident in VX rocket storage igloo: D-3	4.3	10	15	986	468	109	857
Handling accident in VX rocket storage igloo: E-1	18	>30	>30	883	179	55	707
Highest-risk accident involving mustard (applicable to all ACWA technologies during mustard processing)							
Earthquake impacting UPA: D-3	0.016	0.31	0.38	0	918	0	230
Earthquake impacting UPA: E-1	0.54	1.2	1.5	873	45	0	666

Accident Scenario[b]	Off-Post Public Population at Risk (no. of persons)[c] Source to LCt_{50}	Off-Post Public Population at Risk (no. of persons)[c] LCT_{50} to LCt_{01}	Off-Post Public Population at Risk (no. of persons)[c] LCT_{01} to No Deaths	Maximum Estimated Fatalities for Off-Post Population[d]
Continued storage highest-risk accident (applicable to no action and proposed action, all ACWA technologies)				
Lightning strike into VX rocket storage area with fire: D-3	444	4,689	3,439	1,523
Lightning strike into VX rocket storage area with fire: E-1	4,795	3,063	848	4,366
Facility highest-risk accident (applicable to all ACWA technologies except Neut/Bio)				
Handling accident in VX rocket storage igloo: D-3	444	4,689	3,439	1,523
Handling accident in VX rocket storage igloo: E-1	4,795	3,063	848	4,366
Highest-risk accident involving mustard (applicable to all ACWA technologies during mustard processing)				
Earthquake impacting UPA: D-3	NA	NA	NA	NA
Earthquake impacting UPA: E-1	0	0	6	0

Footnotes appear on next page.

TABLE 4.21-2 (Cont.)

---

[a] Scenarios are highest-risk accidents for pilot facilities and for continued storage.

[b] D-3 corresponds to meteorological conditions of D stability with 3-m/s wind speed, and E-1 corresponds to conditions of E stability with 1-m/s wind speed. All accidents are assumed to occur with the wind blowing toward the location of maximum public or on-post population density. UPA = unpack area.

[c] Population at risk indicates the number of individuals working (for on-post populations) or residing (for off-post populations) within the area encompassed by the plume. LCt_{50} values used were 18, 42, and 600 for VX, GB, and mustard, respectively, assuming a 25-L/min breathing rate (SAIC 1997; Goodheer 1994; Burton 2001). LCt_{01} and no deaths values were defaults from D2PC code (Whitacre et al. 1987), as given in Table 7.21-1. LCt_{50} values proposed by National Research Council (1997b) of <15, <35, and 900 for VX, GB, and HD, respectively (for 15-L/min breathing rate) were not used in this assessment; these values have not been formally approved for use by the Army.

[d] Total fatalities were calculated by assuming (1) a fatality rate of 75% in the area between the point of agent release and the 50% lethality dosage contour, (2) a fatality rate of 25% in the area between the 50% lethality dosage contour and 1% lethality dosage contour, and (3) a fatality rate of 0.5% in the area between the 1% lethality dosage contour and no deaths dosage contour.

technologies would increase by a factor of 1.3 to 1.9. (Details of this assessment are provided in Appendix H.) For example, if children and the elderly are up to 10 times more sensitive to the lethal effects than are healthy male adults, and if a handling accident in a VX rocket storage igloo occurred under E-1 meteorological conditions, up to about 5,700 fatalities (4,400 $\times$ 1.3) would be expected in the general population. It must be emphasized that this is a very conservative estimate of the maximum number of fatalities that would be expected from a highly improbable accident; sufficient data are not available to determine whether children or the elderly are actually more sensitive to the toxic effects of an acute chemical agent exposure than the rest of the population.

For the human health impacts assessment, an internally initiated accident was also modeled (i.e., an accident caused by equipment failure or human error at the pilot facility). The internally initiated accident that was modeled involved a rupture in the 500-gal (1,900-L) agent holding tank or the connecting piping in the MDB that could result in the release of the tank's entire contents. Such an accident could result in the release of a small quantity of GB from the filter farm stack. Air concentrations would be too low to cause fatalities. If this accident occurred while mustard or VX agent was being processed, the amount released from the facility stacks would be negligible, because these agents are relatively nonvolatile and because the room in which the leak would occur is relatively small and would contain the agent, providing only a limited surface area for agent evaporation. In addition, the facility's pollution abatement system would be expected to capture most of the agent that might evaporate from the spill.

Except for biotreatment, the assessment did not find any difference between the technology systems with respect to accident impacts during pilot facility operations. This finding is attributable to the fact that acute health risks are mainly determined by the quantity of agent released in an accident (the source term). Once neutralization has taken place inside the pilot facility, the acute health risks associated with an accidental release of process by-products (e.g., hydrolysate solution) would be negligible in comparison with the risks associated with the release of an agent. Because the alternative technologies would operate at similar throughput rates, with similar total amounts of agent present at the front end of the process (in the unpack area and during munitions disassembly), the maximum agent release amounts in the pilot facilities would be similar for all technologies and less than the amount released in a rocket igloo handling accident. Biotreatment looks at a different scenario because no rockets contain mustard, so that accident is not applicable.

The main potential differences in accidents involving releases of agent for the different technology systems being tested would be related to the method used to access agent and explosives in the munitions. Cryofracture would be used to separate energetics in some processes, while a reverse assembly process with some modifications would be used for other processes. Assessments of the consequences of accidents involving these separation processes are not presented here because the impacts would be substantially smaller than those of the other externally and internally initiated events considered. Also, the currently available design data do not indicate any major differences in the disassembly processes with respect to potential amounts of agent released.

The Neut/Bio process would use seven major process chemicals: sodium hydroxide, sulfuric acid, hydrogen peroxide, ferrous sulfate, liquid nitrogen, aqueous ammonia, and dextrose (PMACWA 1999). The Neut/SCWO process would use five: sodium hydroxide, phosphoric acid, kerosene, liquid oxygen, and liquid nitrogen (PMACWA 1999). The Neut/GPCR/TW-SCWO process would use several hazardous chemicals, including sodium hydroxide, liquid oxygen, hydrogen, and kerosene. Finally, the Elchem Ox process would use sodium hydroxide, nitric acid, sodium hypochlorite, hydrochloric acid, calcium oxide, silver nitrate, and liquid oxygen (PMACWA 2001). Several of these chemicals are flammable or reactive (e.g., sodium hydroxide, sulfuric acid, kerosene) and exhibit irritant properties when inhaled or touched. However, all are common industrial chemicals with well-established handling procedures and safety standards. According to PMACWA (1999), “the risk from gaseous emissions of these chemicals is minimal, but more work is needed to demonstrate the effectiveness of the containment design in the event of an accidental ignition of energetics during processing.” The effectiveness of the containment design is being further addressed in engineering design studies.

4.21.2.5 Soils

Under the accident scenarios considered for ACWA pilot testing activities at ANAD, contamination of surface soils could extend over an area beyond the installation boundaries. Given the nature of the accidents, it is assumed that chemical agent would be widely deposited downwind on surface soils as fine particles or droplets. Degradation rates for fine particles of agent typically are rapid, with rates being slightly faster for nerve agents than for mustard agent (see Appendix A). Therefore, any impacts on soils resulting from the deposition of fine particles of agent would be of limited duration — on the order of several days to two weeks — depending on ambient temperatures.

Pools or larger pieces of chemical agent might be deposited near the location of the agent release. Although larger pieces of chemical agent would degrade more slowly than fine particles, any agent released during such an accident would be removed during cleanup operations and would not have a long-term impact on surface soils. Contaminated soils excavated during cleanup would be disposed of in accordance with applicable requirements.

4.21.2.6 Water Resources

Impacting Factors. The agent deposited on the soil after the rocket igloo handling accident or earthquake accident (for mustard) would be deposited as fine particles, aerosols, or vapor. No large masses (drops, pools, etc.) of agent would be deposited downwind of the accident site. Near the accident site, large drops or pools of agent might occur on the ground surface. This agent near the accident would be removed during cleanup operations and would not pose a long-term threat or be a source of water contamination. However, any agent deposited on the soil downwind of the accident as fine particles could be a potential source of surface or groundwater contamination.

The fine mustard particles on the soil surface downwind of the accident would degrade quickly. Under cold conditions, mustard might be present for as long as 2,000 hours (three months). However, even under cold conditions, within two weeks, the amounts present would be negligible: less than 0.0001% of the original deposition amount (see Appendix A). Under warmer conditions, the mustard would be degraded within a few hours to a few days of deposition. These estimates were based on tests of mustard droplets on the surface. Because the mustard particles deposited downwind of the accident would be very small, it is expected that the mustard would actually degrade in less time than predicted by these estimates.

GB deposited on the soil surface would degrade rapidly. GB has a volatilization half-life of 7.7 hours and a hydrolysis half-life of 46 to 460 hours, depending on the soil's pH (Appendix A). Within two to three days, surface concentrations of GB would be negligible. Only 0.1% of the original deposition would remain after about 10 half-lives; thus, within about three days, surface concentrations of GB would be below 0.01%, and within 15 half-lives (about five days), only 0.003% would remain.

VX deposited on the soil surface would be moderately persistent and could remain in significant concentrations for 15 to 20 days (Appendix A). The degradation half-life of VX in soil is estimated to be about 4.5 days, while the hydrolysis half-life ranges from 17 to 42 days, depending on temperature and pH. Within approximately 1.5 months, less than 0.1% of the VX would remain, and within about two months, less than 0.001% of the deposited VX would remain.

Once agent reached either surface water or groundwater, it would dissolve and begin to hydrolyze and undergo dilution as it mixed with the water. None of the agents would be persistent in water resources; however, some of the agent breakdown products would be persistent in the environment.

Mustard has two breakdown products that are relatively persistent in groundwater: 1,4-oxathiane and 1,4-dithiane. These two products are not toxic at the levels that would be expected to be found in water resources after an accident, but their presence could be used to indicate that past contamination had occurred. GB has one breakdown product that is persistent in the environment: isopropyl methyl phosphonic acid (IMPA), (Appendix A). It is considered an eye and skin irritant with low to moderate toxicity. VX has two relatively stable degradation products: EA2192 and methyl phosphonic acid (MPA) (Appendix A). EA2192 retains some anticholinesterase properties and has the potential to affect human health through the oral pathway. However, at concentrations estimated in the environment, EA2192 would not be expected to pose a significant threat.

Groundwater. Transportation of agent by subsurface flow would be minimal. Surface sources would not last for significant periods, and degradation would occur as the agents moved through the vadose zone to the groundwater. Once in the groundwater, degradation would continue, and significant dilution would occur.

In addition to the fact that the agent source would be present on the surface to contaminate groundwater for only a relatively short length of time, once the agents were dissolved and mobile, they would hydrolyze. Both mustard and GB hydrolyze rapidly, and they would break down before being transported any significant distance in the subsurface. VX hydrolysis takes a slightly longer time, but it still occurs rapidly when compared with groundwater travel times.

It is very unlikely that after an accident, conditions that would allow significant impacts on groundwater resources would exist. Trace amounts of agent breakdown products might be detected, but these contaminants would be present at low concentrations and would not pose significant threats to the environment.

Surface Water. Small ponds and other nonmoving surface water features would be affected after an accident for a short time. Agent concentrations would rapidly decrease as a result of agent degradation and dilution as the agent mixed with the water column.

Surface runoff might mobilize the agent present on the soil surface. If mobilization occurred, the turbulent water would dissolve the agent rapidly. Once dissolved, the mustard and GB would hydrolize rapidly and not persist in the water. VX would be present for a slightly longer period but would also break down rapidly.

It is unlikely that agent transported by runoff would reach surface water bodies in appreciable concentrations because of agent dilution and degradation. Even if it did, impacts would be short-lived. Surface runoff might contain some agent when it reached various surface water bodies, but within a short time, depending on the agent and environmental conditions, these concentrations would be negligible. Dilution from both the overland flow and mixing in the water body would also reduce the concentration of agent reaching the water bodies. In addition, in order for any appreciable amount of agent to reach surface water bodies from overland flow, a rainfall event large enough to produce surface runoff, but small enough to not significantly dilute the dissolved agent, would have to occur shortly after an accident.

Because of the relatively low toxicity of the breakdown products and the low agent concentrations (because of dilution and low initial concentrations of agent or breakdown products), the impacts from degradation products on surface water resources would be none to negligible.

4.21.2.7 Biological Resources

Accident analyses were conducted for a scenario that involved a handling accident in a rocket storage igloo for VX or GB or an earthquake accident for mustard. Ecological impacts from a major accident associated with operation of an ACWA pilot test facility were assessed on the basis of atmospheric concentration estimates made by using the D2PC model (Whitacre et al. 1987). Model output was used to conduct impact analyses for vegetation, wildlife, aquatic habitats and fish, protected species, and wetlands.

Terrestrial Habitats and Vegetation. On the basis of the limited number and qualitative nature of reports on mustard phytotoxicity studies, it was not possible to estimate an area of impacts for acute exposure of terrestrial plants due to an accidental release of mustard. In all likelihood, an accidental release of mustard would cause a certain degree of defoliation and retarded germination downwind from the accident location (Opresko et al. 1998). However, hydrolysis of mustard and GB would probably occur quickly after deposition on plant surfaces and soils (see Appendix A). VX and GB mainly interfere with neurotransmission in animals and would not likely affect vegetation; however, VX is known to be phytotoxic to some plants at 10 ppm (soil and solution). The toxicity of GB to terrestrial plants is unknown but is probably similar in magnitude to the toxicity of VX, since both agents are organophosphates (Opresko et al. 1998). Model runs for an earthquake involving the unpack area during mustard processing under D-3 (daytime) meteorological conditions showed an average mustard deposition area of 2.8 ha (7.4 acres) in the 1% human lethality area that extends to 0.3 mi (0.5 km) downwind from the accident location (see Table 4.21-1). The maximum deposition after an accident would occur during daytime conditions. The downwind distance from the accident location to the 1% human lethality location would be greater for accidents involving VX and GB. Distances and deposition areas for daytime (D-3) conditions would be 10 mi (16 km) and 1,500 ha (3,700 acres) for VX and 6.8 mi (11 km) and 740 ha (1,800 acres) for GB.

Wildlife. The deposition plume areas projected by the D2PC model are elliptical in shape and would occur mostly downwind of the accident. The location and geometry of the plume areas would vary, depending on the atmospheric stability and wind direction at the time of an accident. At ANAD, the prevailing winds that would result in the greatest consequences from an accident would be from the south or southeast. A release of mustard or nerve agents would thus have a higher probability of affecting ecosystems located north or northwest of the CHB. However, the release could presumably affect ecosystems in any direction, depending on the direction and speed of the wind at the time of the accident. Because of the limitations of the D2PC model, the size of habitat potentially exposed to agents cannot be reasonably approximated.

A screening-level ecological risk assessment was conducted to determine impacts of the bounding accident on four common mammalian wildlife species observed in the vicinity of ANAD: white-tailed deer (*Odocoileus virginianus*), red fox (*Vulpes fulva*), meadow vole (*Microtus pennsylvanicus*), and white-footed mouse (*Peromyscus leucopus*). No benchmark values were found for exposure of birds, reptiles, or amphibians to VX, GB, and mustard. Risks to the four species from the accident were characterized by using the hazard quotient (HQ) approach for exposure to mustard, VX, and GB. The HQ is the ratio between the concentration of a contaminant (mustard, GB, VX) in a medium (air, water) and a contaminant-specific benchmark concentration representing a “no observed adverse effects level” (NOAEL) and “lowest observed adverse effects level” (LOAEL) on the basis of results from laboratory studies. HQs for air impacts were calculated on the basis of inhalation benchmark values developed for use in ecological risk assessments of wildlife from exposure to combustion products at ANAD (U.S. Army Center for Health Promotion and Preventive Medicine [USACHPPM] 1999a). The HQ values could vary from zero to infinity. HQ values greater than one show a potential risk to the ecological receptor from the exposure. It is important to note that HQ values greater than one indicate only the potential for adverse risks (or effects) to individual animals and not actual impacts on them. Actual impacts would depend on many factors, such as the length of time of exposure to the plume, concentration of the chemical agent in air, and species sensitivities to various atmospheric concentration levels. HQ values were based on air concentrations estimated by the D2PC model under the air stability expected during typical nighttime conditions (wind speed of 1 m/s) and during typical daytime conditions (wind speed of 3 m/s). Benchmark values were adjusted for differences in inhalation rates due to the different body masses of the four species examined. Distances that were affected by an earthquake or a handling accident at an igloo followed by a fire were determined for HQ values of less than one on the basis of D2PC model output for both the NOAEL and LOAEL exposures. Details on the derivation of contaminant-specific inhalation benchmarks and the HQ calculations for mustard, VX, and GB are provided in Tsao (2001a–f).

Exposure to mustard for wildlife within 5.6 mi (9.0 km) downwind from the accident location and exposure to VX or GB out to 30 mi (50 km) downwind of the accident location would result in mortality, particularly to species with small home ranges, such as small mammals, reptiles, and amphibians. These species would remain in a mustard exposure plume during the accident (see Table 4.21-3). Mammals that did survive within this distance would suffer from blistering skin, respiratory system irritation, eye irritation, and other chronic effects known to occur to humans and laboratory animals (Appendix B in Army 1988).

No data could be found on the uptake of mustard through ingestion under field conditions. Some uptake of mustard deposited on vegetation, particularly in areas downwind of the release, could occur by herbivores during the first few days after the accident. Hydrolysis of mustard would likely occur during the first one to two days after the accident, resulting in various degradation products. No data could be found on exposures of wildlife to mustard degradation products under field conditions. An article that reviews the toxicity of CWA degradation products suggested that a major hydrolysis by-product of mustard, thiodiglycol (TDG), could persist in soils following an accidental release (Munro et al. 1999). Laboratory exposures of rats for 90 days to various levels of TDG resulted in a NOAEL of 500 mg/kg/d. Even if all mustard degraded to TDG (low likelihood of occurrence) within the deposition area, it would be highly unlikely that a herbivore would receive a dose through the food pathway that would be above the NOAEL reported for laboratory rats (Munro et al. 1999).

Exposure of wildlife to VX and GB following an accident might have effects similar to those known to occur to humans. VX and GB are strong inhibitors of enzymes and effect neurotransmission by interfering with the enzyme cholinesterase, in particular. Nausea, vomiting, skeletal muscle twitching, seizures, and death typify the normal progression of effects from brief human exposures to high concentrations (see Appendix A). VX is not expected to be harmful to plants because of their low sensitivity, but it might be harmful to herbivores that consume contaminated vegetation downwind of the accident site over an extended period (Appendix O in U.S. Army 1988).

VX is not very volatile, is moderately persistent in the environment, and may occur in the environment for about 15 to 20 days following deposition on soil. The half-life of VX is about 4.5 days, and an estimated 90% of VX applied to soils would be lost in less than 15 days (Appendix A). No data were available to model wildlife uptake of VX or GB through ingestion. The nerve agent GB is considered nonpersistent in the environment and quickly breaks down in water. Impacts of GB through bioaccumulation in the food chain would not be likely to occur, given its tendency to volatilize quickly. The degradation products of GB have low toxicities (see Appendix A) and also would not be likely to pose a threat to wildlife through biomagnification in the food chain.

Aquatic Habitats and Fish. The impacts on aquatic habitats and fish from the deposition of mustard, GB, and VX would be very similar to the impacts on protected aquatic vertebrate and

TABLE 4.21-3 Distance from Accident Location That Would Result in No or Lowest Adverse Effects on Wildlife at ANAD[a]

	Distance (mi) with Hazard Quotient of <1[b]											
	Mustard				VX				GB			
	Daytime Conditions		Nighttime Conditions		Daytime Conditions		Nighttime Conditions		Daytime Conditions		Nighttime Conditions	
Species	LOAEL[c]	NOAEL[d]	LOAEL[c]	NOAEL[d]	LOAEL[c]	NOAEL[d]	LOAEL[c]	NOAEL[d]	LOAEL[c]	NOAEL[d]	LOAEL[c]	NOAEL[d]
White-tailed deer	0.56	1.2	1.9	3.1	>30	>30	>30	>30	>24	>30	>30	>30
Red fox	1.2	1.2	2.4	3.7	>30	>30	>30	>30	>30	>30	>30	>30
Meadow vole	1.2	1.9	4.4	5.6	>30	>30	>30	>30	>30	>30	>30	>30
White-footed mouse	1.2	1.9	3.7	4.4	>30	>30	>30	>30	>30	>30	>30	>30

[a] Scenarios are a VX release or a GB release that results from a handling accident or lightning strike at a rocket storage igloo or a mustard release that results from an earthquake impacting the unpack area.

[b] Hazard quotient = (dose at a given distance from the source) divided by (benchmark value for receptor species). The air concentration used to determine dose was obtained by using the D2PC model and assuming a wind speed of 3 m/s during daytime and 1 m/s during nighttime.

[c] LOAEL = lowest observed adverse effects level; the maximum distance from the site at which an adverse effect would be expected to occur.

[d] NOAEL = no observed adverse effects level; the distance from the site beyond which no adverse effects would be expected to occur.

invertebrate species. All three chemical agents could have significant short-term impacts. No data on the effects of mustard and GB on aquatic invertebrates could be found. However, the LCt_{50} for VX on aquatic fish is 0.28 μg/L (Appendix O in U.S. Army 1988), indicating that the impact from VX could be severe. Except for VX, long-term impacts of chemical agents on aquatic vertebrates would not be expected because of the quick hydrolysis of mustard and GB.

Protected Species. The impacts on protected mammalian species would be very similar to the impacts on mammals (i.e., wildlife). Because of the scarcity of federal protected species and their distance from the source, impacts on them would be less than impacts on other terrestrial wildlife. On the other hand, state protected species would be more likely to be affected since they would be much closer to the potential source areas. The concentration distances projected by the D2PC model and used for analyzing short-term impacts from accidents on mammals were also used for protected species (i.e., the plume area would be elliptical in shape and would occur mostly downwind of the accident). The location and geometry of the plume areas would vary, depending on the atmospheric stability and wind direction at the time of an accident. At ANAD, the prevailing winds (which would result in the greatest consequences from an accident) are from the south or southeast. A release of mustard or nerve agents would thus have a higher probability of affecting ecosystems located north or northwest of the storage igloo. Yet they could presumably affect ecosystems in any direction, depending on the wind direction and speed at the time of an accident.

A screening-level ecological risk assessment was conducted to determine impacts of the bounding accident to threatened and endangered species in the vicinity of ANAD. The species studied was the gray bat (*Myotis grisescens*). The threatened and endangered aquatic invertebrate species and terrestrial plants and the red-cockaded woodpecker (*Picoides borealis*) are discussed qualitatively, since plume deposition amounts and adequate toxicological data on the effects of chemical agents on these aquatic and terrestrial biota were not available. Risks to threatened and endangered species from the accident were characterized by using the HQ approach for exposure to mustard, VX, and GB, as discussed under wildlife above.

Gray Bat and Red-Cockaded Woodpecker. Gray bats are known to occur outside the 30-mi (50-km) radius of ANAD. The nearest red-cockaded woodpeckers are located 28 mi (49 km) east of ANAD in the Talladega National Forest (Lewis 2000a). Individual bats or red-cockaded woodpeckers occupying roosting and nursery habitat downwind of the accident site would be most susceptible to a handling accident that would release GB or VX. HQ calculations indicate that gray bats could die from inhaling airborne GB or VX while they were congregated in maternity clusters out to or beyond 30 mi (50 km) downwind from the accident site (see Table 4.21-4). An accidental release of mustard might affect the woodpeckers if the plume were to travel far enough to reach their foraging area.

The nearest gray bats are located 41 mi (66 km) southwest of the installation (Lewis 2000a). Other bats are located in the Blowing Wind Cave and Fern Cave National Wildlife

TABLE 4.21-4 Distance from Accident Location That Would Result in No or Lowest Adverse Effects on Protected Species at ANAD[a]

	Distance (mi) with Hazard Quotient of <1[b]											
	Mustard				VX				GB			
	Daytime Conditions		Nighttime Conditions		Daytime Conditions		Nighttime Conditions		Daytime Conditions		Nighttime Conditions	
Species Name	LOAEL[c]	NOAEL[d]	LOAEL[c]	NOAEL[d]	LOAEL[c]	NOAEL[d]	LOAEL[c]	NOAEL[d]	LOAEL[c]	NOAEL[d]	LOAEL[c]	NOAEL[d]
Gray bat	1.9	2.5	4.9	6.2	>30	>30	>30	>30	>30	>30	>30	>30

[a] Scenarios are a VX release or a GB release that results from a handling accident or lightning strike at a rocket storage igloo or a mustard release that results from an earthquake impacting the unpack area.

[b] Hazard quotient = (dose at a given distance from the source) divided by (benchmark value of agent for receptor species). The air concentration used to determine dose was obtained by using the D2PC model and assuming a wind speed of 3 m/s during daytime and 1 m/s during nighttime.

[c] LOAEL = lowest observed adverse effects level; the maximum distance from the site at which an adverse effect would be expected to occur.

[d] NOAEL = no observed adverse effects level; the distance beyond which no adverse effects would be expected to occur; at this distance or farther, the air concentration would not result in adverse effects to receptor species as indicated by results for laboratory animals.

Refuges in Decatur, Alabama, which are 85 mi (136 km) northwest of ANAD. Gray bats are restricted almost entirely to caves or cavelike habitats. The accidental release of mustard would probably not affect gray bats, given that their home range would not overlap the plume that would cause adverse effects. The affected area for a mustard release could extend to 14 mi (23 km) from the source (Table 4.21-1). The home range of the gray bat does not extend closer than 12 mi^2 (20 km^2) southwest of ANAD. The affected area for VX and GB extends for more than 30 mi (50 km) (HQ values of greater than one). Bats would be less likely to be affected from exposure to chemical agents during the day (when they roost in caves) than at night (when they are outside and more susceptible).

Pygmy Sculpin, Blue Shiner, Coldwater Darter. Two federal threatened species, pygmy sculpin and blue shiner, are located within a 30-mi (50-km) radius of ANAD (Lewis 2000a). Coldwater darter (*Etheostoma ditrema*), a state protected species, is also within the 30-mi (50-km) radius (Lewis 2000a). Located south of ANAD, the pygmy sculpin is extremely limited in its distribution and is found only in Calhoun County. Blue shiners have been sited at different locations in Talladega National Forest, approximately 17 mi (27 km) east of ANAD, and in Talladega County, southwest of ANAD. Coldwater darters are located along the western tributary in the Pelham Range (north of ANAD), downstream from Area B. The long-term impact of a mustard, VX, or GB release on aquatic biota would not be significant, since all three chemical agents are broken down by hydrolysis rather quickly, especially GB and mustard, and their potential to bioaccumulate is low. The bioaccumulation potential of VX is sufficiently low that its release would not result in a significant long-term impact on the three aquatic vertebrates.

The short-term impacts of these agents on the pygmy scuplin, blue shiner, and coldwater darter could be considerable. They could be affected by the subsequent deposition of mustard, GB, or VX onto water bodies after their accidental release into the air. Because Area B is located upstream of the tributary, accidentally released chemical agent could potentially be deposited in the stream and subsequently migrate downstream to the coldwater habitat. No studies on the effects of VX on aquatic organisms were found except for one study on striped bass (cited in U.S. Army 1998b). VX is more environmentally persistent than GB. VX is moderately to highly soluble in water, with a solubility of 30 g/L at 25°C (Munro et al. 1999). Its half-life ranges from 17 to 42 days at a temperature of 25°C and a pH of 7 (Appendix A). Impacts on aquatic species would be likely to be most severe in small, shallow streams or water bodies such as Coldwater Spring or the Coldwater Spring Run, where pygmy sculpin are located. Exposure to VX would also increase after the first rainfall event occurred, resulting in runoff of VX into surface waters.

The nerve agent GB is considered nonpersistent in the environment. It quickly breaks down in water. Impacts from GB through aquatic bioaccumulation would not be likely to occur given the agent's tendency to volatilize quickly. GB degradation products have low toxicities (see Appendix A) and also are not likely to pose a threat to wildlife through biomagnification in the food chain.

Mustard can be hydrolyzed quickly, and it has a half-life of a few minutes. Although mustard has limited solubility in water, some mustard could sink to the bottom of the water body and remain there for some time. However, since the hydrolysis-rate-limiting step is essentially the rate of solution, mustard deposited on a surface water body after an accidental release would most likely form a surface film on the water that would quickly be hydrolyzed by the agitation and turbulence in the water body (Opresko et al. 1998; Munro et al. 1999). No adequate aquatic toxicity test of mustard was available for aquatic vertebrates or invertebrates. The major by-product from mustard hydrolysis is TDG. TDG is low in toxicity and is used commercially as a solvent in antifreeze. Small bluegill sunfish were exposed to 1,000 mg/L for 42 days without toxic effects (Munro et al. 1999). The presence of hydrolysis products in surface water would not have a significant impact on the three aquatic vertebrates.

Fine-Lined Pocketbook Mussel, Tulotoma Snail, Painted Rocksnail, and Southern Pigtoe Mussel. Four federal threatened and endangered aquatic invertebrates, the fine-lined pocketbook mussel (*Lampsilis altilis*), southern pigtoe mussel (*Pleurobema georgianum*), Tulotoma snail (*Tulotoma magnifica*), and painted rocksnail (*Leptoxis taeniata*), are known to occur within the 30-mi (50-km) radius of ANAD (Lewis 2000a). If these aquatic invertebrates were located in shallow perennial or intermittent streams downwind from the accident site, they could be exposed to relatively high concentrations of VX from air deposition from the source. VX is known to persist in water for 17 to 42 days at a temperature of 25°C and a pH of 7 (Appendix A). Given the sedentary nature of these aquatic invertebrates, individuals would be exposed to the entire aliquot of water containing agent deposited from the vapor plume following the accident, and the initial impact would be considerably severe.

The nerve agent GB is considered nonpersistent in the environment and quickly breaks down in water. Impacts of GB through aquatic bioaccumulation would not be likely to occur, given the agent's tendency to volatilize quickly. GB degradation products have low toxicities (see Appendix A) and also are not likely to pose a threat to wildlife through biomagnification in the food chain. Potential effects of mustard on these aquatic invertebrates would be as previously discussed for the aquatic vertebrates.

Tennessee Yellow-Eyed Grass and Mohr's Barbara's Button. Two Tennessee yellow-eyed grass colonies are located on ANAD. One is located by the toxic burning ground, and the other is located close to Area A, near the border of Pelham Range (Burns 2000a). A third colony is on the other side of the border in Pelham Range, next to the colony on ANAD. Two other colonies are located elsewhere on Pelham Range (Reisz Engineers 1998). There is only one colony of Mohr's Barbara's button within the 30-mi (50-km) radius (Lewis 2000a), and it is located on Pelham Range, north of ANAD. Mustard might cause some adverse effects on Tennessee yellow-eyed grass and Mohr's barbara's button. It has been demonstrated that liquid mustard is phytotoxic in several species of terrestrial plants (Opresko et al. 1998), although its hydrolysis by-product, TDG, seems to have no effects on several species (Opresko et al. 1998).

On the other hand, VX and GB deposits after the accident are expected to be negligible (Opresko et al. 1998).

Wetlands. Wetlands would be exposed to mustard under the scenario involving an earthquake impacting the unpack area. The limited amount of data available on known impacts on plants suggests that some absorption of VX would occur if VX were released as the result of a handling accident in a rocket storage igloo. (Appendix O in U.S. Army 1988). VX and its breakdown products would be harmful and potentially lethal to animals that ingested contaminated plant material. Plant species exposed to mustard and GB downwind of the accident site would unlikely to become contaminated because of the tendency for both compounds to break down relatively quickly by hydrolysis.

4.21.2.8 Cultural Resources

The occurrence of an accident, either during the proposed action or no action, could result in impacts on cultural resources within the area exposed to agent. The building materials used in historic structures or the exposed surfaces of archaeological sites could become contaminated during an accident. At a minimum, public access to these historic properties would be temporarily denied until contamination was degraded by exposure to light and moisture or by active decontamination.

For the hypothetical accident assessed here, only temporary impacts (i.e., access restrictions) would be expected on cultural resources located outside the maximum radial no effects distance of 30 mi (50 km) (see Table 4.21-1). Access restrictions could last for a few days or longer, depending on the degree of contamination and the length of time required to certify that access to these properties could again be permitted. It is expected that low levels of agent contamination would degrade in a few hours under certain conditions, while larger quantities might take several weeks to degrade (see Appendix A).

Significant historic properties located within 30 mi (50 km) of the accident (listed in Appendix F) could be affected by temporary but extended restriction periods until the contaminant was degraded by light and moisture. If the contaminant was deposited as a liquid, the Army might require that the properties of concern undergo various decontamination procedures before being released for access by the public. These decontamination procedures could potentially damage the property. However, deposition of liquid agent in quantities that would require decontamination procedures that could damage or destroy cultural resources would most likely be confined to the pilot test facility or storage site. Extended public access restrictions, lasting until the contaminant dissipated, would be the most likely measure for preserving significant properties.

4.21.2.9 Socioeconomics

The accidental release of chemical agent at ANAD during ACWA pilot testing would have the potential to affect the socioeconomic environment in two ways. The demand for crops and livestock produced within the 30-mi (50-km) radius around the facility might change, and employees might need to be evacuated from work places.

Agriculture. The most significant impact of an accident on agriculture would be if all the crops and livestock produced in a single season were interdicted (either by federal or state authorities) and removed from the marketplace. Although the impacts from losses in agricultural output on the economy of the counties within the 30-mi (50-km) radius surrounding ANAD would be significant (Table 4.21-5), it is unlikely that the severity of these losses would be any different under the no action and the proposed action alternatives.

Businesses and Housing. Although the evacuation of businesses as a result of an accident at ANAD would likely be only on a temporary basis, disruption to the economy in the area likely to be evacuated (the CSEPP Protective Action Zone [PAZ] surrounding ANAD, consisting of Calhoun, Clay, Cleburne, Etowah, Talladega, and St. Clair Counties) could be significant. In the worst-case scenario, all business sales and employee income in the PAZ would be lost as a result of the evacuation. An evacuation that might be required after an accident could last for many days. Since the exact duration of an evacuation cannot be determined, the consequent overall effect on local economic activity could not be determined. The impacts from a temporary, single-day evacuation of businesses in the PAZ are shown in Table 4.21-5. The data in the table may be used to estimate the impact of an evacuation over a multiple-day period.

Since it is likely that the presence of chemical agent and the risk of accidents at ANAD are already captured in housing values nearby, an accident would probably not create significant additional impacts on the housing market, unless residents were prevented from quickly returning to their homes.

4.21.2.10 Environmental Justice

Within 30 mi (50 km) of ANAD, the analysis of human health impacts anticipates that highly unlikely accident scenarios causing the widespread release of an agent would indeed result in high and adverse impacts (see Section 4.21.2.4). In such a situation, minority and low-income populations could suffer fatalities and serious injuries disproportional to their representation in the United States as a whole, if the wind direction at the time of the accident put the agent plume in the direction of census tracts with high numbers of minority or low-income populations (see Section 4.20.1 for identification of these census tracts). Such severe human health impacts would

TABLE 4.21-5 Socioeconomic Impacts of Accidents at ANAD Associated with the Proposed Action and No Action[a]

Parameter	Neut/Bio	Neut/ SCWO	Neut/ GPCR/ TW-SCWO	Elchem Ox	No Action
Impacts from a one-year loss of agricultural output					
100% loss of agricultural output					
Employment (no. of jobs)	47,000	47,000	47,000	47,000	47,000
Income (millions of $)	1,360	1,360	1,360	1,360	1,360
75% loss of agricultural output					
Employment (no. of jobs)	35,200	35,200	35,200	35,200	35,200
Income (millions of $)	1,020	1,020	1,020	1,020	1,020
50% loss of agricultural output					
Employment (no. of jobs)	23,500	23,500	23,500	23,500	23,500
Income (millions of $)	680	680	680	680	680
Impacts from a single-day evacuation of businesses					
100% of economic activity affected					
Sales (millions of $)	62	62	62	62	62
Employment (no. of jobs)	142,000	142,000	142,000	142,000	142,000
Income (millions of $)	37	37	37	37	37
75% of economic activity affected					
Sales (millions of $)	46	46	46	46	46
Employment (no. of jobs)	107,000	107,000	107,000	107,000	107,000
Income (millions of $)	28	28	28	28	28
50% of economic activity affected					
Sales (millions of $)	31	31	31	31	31
Employment (no. of jobs)	71,000	71,000	71,000	71,000	71,000
Income (millions of $)	18	18	18	18	18

[a] Impacts for no action and the proposed action are presented for the first year of operation of an ACWA facility (2009).

have similarly high and adverse socioeconomic consequences in the counties that make up the ROI (see Section 4.19), including the removal of some of the work force and the interruption of agricultural activity (see Section 4.21.2.9). However, such accidents have a low frequency of occurrence, on the order of 7×10^{-4} per year (i.e., one occurrence in 1,400 years), so the risk of the resultant disproportionate impacts would be low. Such impacts are not anticipated.

4.21.3 Impacts of Accidents during No Action (Continued Storage)

4.21.3.1 Land Use

Land use impacts from accidents under the no action alternative would be the same as those discussed under the proposed action (Section 4.21.2.1).

4.21.3.2 Waste Management and Facilities

Waste management impacts from accidents under the no action alternative would be the same as those discussed under the proposed action (Section 4.21.2.2).

4.21.3.3 Air Quality

After an accidental release of agent from a storage igloo at ANAD, deposition of agent from the air onto the ground surface and/or degradation in the environment would occur within a relatively short period of time (see Section 4.21.2.3). Therefore, long-term (e.g., more than a few days after release) adverse air quality impacts would not be expected from an accidental release of mustard, GB, or VX.

4.21.3.4 Human Health and Safety

The U.S. Army and Federal Emergency Management Agency (FEMA) routinely conduct CSEPP exercises, in coordination with the communities surrounding ANAD and with their participation. These exercises are required under a 1988 memorandum of understanding (MOU) between FEMA and the Army. Because chemical agent is currently stored at ANAD, some risk from accidents is already present. For example, agent could be released if a pallet were accidentally dropped during daily operations (i.e., maintenance and inspection). The most probable event would be that the pallet would be dropped from 4 ft (1 m), the average height that a pallet could be dropped during normal operations. This would involve three rounds of munitions spilling their contents on the igloo floor. Emergency response preparation for potential accidents of this type during normal ANAD operations (e.g., maximum credible events [MCEs] for daily operations) is routinely evaluated under CSEPP (Freil 1997).

For this EIS, the hypothetical accident for continued storage is assumed to be an event that could release the entire contents of a storage igloo containing GB or VX rockets (e.g., a lightning strike). The probability of such an event occurring is low (on the order of 7×10^{-4}), but it increases slightly with increasing length of continued storage. A lightning strike could result in an explosion and propagation by fire, causing the entire igloo contents to explode and/or burn (SAIC 1997). Thus, the impacts from a lightning strike would be identical to those from a handling accident (Section 4.21.2.4) because the estimated amount of nerve agent that would be released is identical. The consequences from a lightning strike on a VX storage igloo have been estimated in terms of the number of fatalities and are given in Table 4.21-2. A discussion of the impacts is provided in Section 4.21.2.4.

4.21.3.5 Soils

Potential impacts on soils associated with the accident scenarios considered under the no action alternative would be the same as those discussed under the proposed action (Section 4.21.2.5).

4.21.3.6 Water Resources

The factors that would affect water resources under the accident scenario would be the same for the no action and proposed action alternatives (Section 4.21.2.6). Impacts on surface water resources would be short-lived, although agent breakdown products might persist for some time. Impacts on groundwater resources would be unlikely and, if they did occur, would be negligible. Breakdown products might be detected, but their occurrence would be unlikely.

4.21.3.7 Biological Resources

The impact from an accident involving a lightning strike on a GB or VX rocket storage igloo, followed by a fire in the CLA, was evaluated for the no action alternative. The methodology used for assessing impacts to biological receptors under the no action accident scenario was the same as that used under the proposed action accident scenario (see Section 4.21.2.7). Table 4.21-1 presents the agent exposures and deposition areas that could result from this accident scenario for the 1% lethality, no deaths, and no effects distances to humans.

Terrestrial Habitats and Vegetation. Impacts on vegetation from VX and GB deposited after the lightning strike accident would be the same as those for a handling accident at a storage igloo (4.21.2.7). VX and its breakdown products could accumulate in plant tissues, but they would not be likely to cause adverse impacts because of the relatively low sensitivity of plants to nerve agents. Mustard release is not considered under the no action alternative because the hypothetical highest-risk scenario is a lightning strike on a GB or VX rocket-containing igloo followed by a fire.

Wildlife. The impacts to wildlife under the no action accident scenario would be the same as those discussed under the proposed action scenario (see Section 4.21.2.7).

Aquatic Habitats and Fish. The amount of GB or VX that would be deposited into aquatic habitats as the result of a lightning strike at a storage igloo would be the same as the deposition amounts that would result from a handling accident at a storage igloo (see Table 4.21-1). Aquatic habitats and fish would experience impacts similar to those discussed under the proposed action (Section 4.21.2.7).

Protected Species. The impacts on protected species from exposure to chemical agents released following an accident during continued storage would be the same as impacts from an accident under the proposed action (Section 4.21.2.7).

Wetlands. The impacts on wetland vegetation from a lightning strike during continued storage would be the same as impacts from a handling accident at a storage igloo under the proposed action (Section 4.21.2.7).

4.21.3.8 Cultural Resources

Potential impacts on cultural resources associated with accident scenarios under the no action alternative would be as those discussed under the proposed action (Section 4.21.2.8). Appendix F discusses historic properties that could be affected by the modeled accidents under the no action alternative.

4.21.3.9 Socioeconomics

Potential impacts on socioeconomics associated with the accident scenarios under the no action alternative would be the same as those discussed under the proposed action (Section 4.21.2.9).

4.21.3.10 Environmental Justice

Potential impacts on environmental justice associated with the accident scenarios considered under the no action alternative would be the same as those discussed under the proposed action (Section 4.21.2.10).

4.22 CUMULATIVE IMPACTS

Cumulative impacts would result from adding the incremental impacts of the proposed action to other past, present, and reasonably foreseeable future actions. "Reasonably foreseeable future actions" are considered to be (1) actions that are covered in an environmental impact document that was either published or in preparation, (2) formal actions such as initiating an application for zoning approval or a permit, or (3) actions for which some funding has already been secured. Cumulative impacts could result from actions occurring at the same time or from actions occurring over a period of time.

This cumulative impact analysis does not cover areas in which the proposed action and other reasonably foreseeable future actions would have no impacts or only localized impacts. Thus, the following areas were not analyzed for cumulative impacts:

- Geological resources,
- Cultural resources, and
- Communications infrastructure.

In addition, cumulative impacts were not assessed for accidents. Accidents are low-probability events whose exact nature and time of occurrence cannot reasonably be foreseen. Although their impacts may be large, these impacts cannot be added in a reasonably predictable manner to the impacts of other reasonably foreseeable future actions.

Finally, the analyses in this EIS were based on the assumption that a single, full-scale ACWA pilot test facility would be built. If two or more ACWA pilot test facilities would be built, they would share common facilities, and each one would be smaller than the full-scale pilot facility. Collectively, they would be similar in size to a full-scale pilot test facility, and their impacts together would reasonably be bounded by the impacts of the full-scale pilot. The cumulative impacts of two ACWA pilot test facilities and/or an increase in weapons throughput would be reasonably bounded by the impacts of the full-scale pilot and the impacts of a baseline incinerator. Thus, this cumulative impact analysis should represent the impacts from either one or two ACWA pilot test facilities.

Government and private organizations were contacted to identify reasonably foreseeable on-post and off-post actions for inclusion in this cumulative impact analysis. Organizations contacted included the following:

- Anniston Army Depot;
- Alabama Department of Environmental Management, Air Division;
- Division 4, Alabama Highway Department;
- Calhoun County Economic Development Council;
- Talladega County Economic Development Council;
- Calhoun County Highway Department; and
- Talladega County Road Department.

4.22.1 Other Reasonably Foreseeable Future Actions

The impacts of past and present actions are included in the discussions of the affected environment. They are summarized here, when needed, in the corresponding discussions of cumulative impacts.

4.22.1.1 On-Post Actions

Some on-post actions have already been included in the proposed action as defined and analyzed in this document. These include building an access road to the ACWA site and building required infrastructure. Other reasonably foreseeable on-post actions included here in Section 4.22 in this cumulative impact analysis include:

- Constructing and operating new facilities, including a DRMO electric induction furnace, the plasma energy pyrolysis system (PEPS), the PTFMC, the blast chamber facility, and

- Clear-cutting to control Southern pine beetle infestation.

The impacts of these actions were assessed on the basis of information from discussions with post personnel (Smith 2001).

The only other on-post Chem Demil action would be the operation of the baseline incinerator. An EIS for the baseline incinerator at ANAD has been prepared (U.S. Army 1991). The construction of a baseline incinerator is complete. Cumulative impacts in each impact area are assessed on the basis of the assumption that the baseline incinerator would be operating.

4.22.1.2 Off-Post Actions

The reasonably foreseeable off-post actions have been identified broadly as highway construction; housing development; industrial expansion, including the Honda plant currently under construction; light industrial expansion; and some commercial development.

4.22.2 Land Use

ANAD lies in a predominantly rural area with land cover dominated by forest. Areas of residential use and agriculture are interspersed among the forested tracts. Of the 18,000 acres (7,000 ha) of land at the post, 13% is semiimproved and 75% is unimproved. The Fort McClellan Military Reservation's Pelham Range abuts ANAD to the north. Private land ownership predominates in other nearby area. Past and present land use on ANAD has been primarily for industrial and related purposes, including administrative, residential, and recreational uses. The dominant feature of the facility is more than 11,000 acres (4,400 ha) of woodland (U.S. Army 1991). Use of the northeastern portion of the installation for an ACWA pilot test facility is consistent with other past, current, and planned future land use at ANAD.

An ACWA pilot test facility would have negligible effects on land use both on and off the post (Section 9.2). The baseline incinerator is located on the northern border of Proposed Area B, a location consistent with current land use. U.S. Army (1991) found no significant land use impacts from the baseline incinerator. The baseline incinerator and an ACWA pilot test facility together would disturb about 150 acres (59 ha) or 0.81% of the total area of ANAD, some of it in previously disturbed areas. Other reasonably foreseeable on-post actions would disturb additional land and follow current land use patterns.

Housing development is occurring south and west of Oxford and east of Anniston. Jacksonville is experiencing a housing boom (Smith 2001). A new Honda plant is under construction about 8.5 mi (14 km) west of ANAD, and a concrete pole plant is being built in Anniston. These and other anticipated activities in the vicinity of ANAD would not contribute to significant adverse land use impacts when aggregated with impacts from on-post activities.

4.22.3 Infrastructure

Table 4.22-1 presents the expected utility demands for a baseline incinerator at ANAD.

4.22.3.1 Electric Power Supply

ANAD purchases electric power from Alabama Power Company. It used 62 GWh of electric power in 2000. A new transmission line and substation have been built to supply the baseline incinerator. Additional power distribution infrastructure beyond that built for the baseline incinerator would be needed to meet the electric power needs of an ACWA pilot test facility (Section 4.3) and other reasonably foreseeable on-post actions. Depending on the ACWA technology chosen, more than 105 GWh/yr of electric power in addition to the 33 GWh/yr required for the baseline incinerator might be needed while other on-post uses were still being supplied (Tables 4.3-1 and 4.22-1). Other reasonably foreseeable on-post actions would add to the amount of additional electric power needed. This need would represent an increase of about 220% over year 2000 consumption levels. Discussions with local planners indicated no current or foreseen problems in supplying electric power in the Calhoun County area (Smith 2001).

TABLE 4.22-1 Estimated Annual Utility Demands for a Baseline Incinerator at ANAD

Utility	Annual Demand
Electric power (GWh)	33
Natural gas (scf)	1,300,000,000
Process water (gal)	88,000,000
Potable water (gal)	6,400,000
Sewage produced (gal)	7,500,000

Source: Folga (2001b).

4.22.3.2 Natural Gas Supply

ANAD purchases its natural gas from Algasco. It used 310 million ft^3 (8.8 million m^3) in 2000. Additional gas distribution infrastructure beyond that built for the baseline incinerator would be needed to supply the natural gas needs of an ACWA pilot test facility (Section 4.3) and other reasonably foreseeable on-post actions. Depending on the ACWA technology chosen, more than 130 million scf/yr (3.7 million m^3/yr) of natural gas in addition to the 1,300 million scf/yr (37 million m^3/yr) required by the baseline incinerator might be needed while other on-post uses were still being supplied (Tables 4.3-1 and 4.22-1). Other reasonably foreseeable on-post actions would add to the amount of additional natural gas needed. This need would represent an increase of about 460% over year 2000 consumption levels. It could not be determined whether the post could be supplied with this amount of natural gas through existing lines. Discussions with local planners indicated no current or foreseen problems in supplying natural gas in the Calhoun County area (Smith 2001).

4.22.3.3 Water (Supply and Sewage Treatment)

The water supply system is currently being upgraded to support the baseline incinerator, and a water tower has been built to supply emergency needs. Normal operations of an ACWA pilot test facility would result in minor impacts on groundwater (Section 4.11). Depending on the technology chosen, an ACWA pilot test facility's potable and process water use of, at most, 24 million gal/yr (92,000 m^3/yr) would exceed the water use during construction (Table 4.3-1). The baseline incinerator could use up to 94 million gal/yr (356,000 m^3/yr) of water when 365 days per year of operation are assumed (Table 4.22-1). The total use of 120 million gal/yr (450,000 m^3/yr) is about 14% of the minimum reserve of Coldwater Spring but only 1.4% of the spring's minimum flow. Although quantitative water use figures were not available, water use by other reasonably foreseeable on-post actions would be smaller and cumulatively would not exceed the water available from Coldwater Spring. Additional water distribution pipelines and a supply system to provide for peak water demands for emergency response would be needed for an ACWA pilot test facility (Section 4.3). Other reasonably foreseeable on-post actions would increase the required overall emergency capacity beyond that required for an ACWA pilot test facility alone and would also require additional pipelines.

Sanitary sewage production during operation of an ACWA pilot test facility would exceed sewage production during construction. Operating an ACWA pilot test facility and a baseline incinerator could produce up to 15 million gal/yr (57,000 m^3/yr) of sewage, an increase of more than 960% over the volume treated in 1999. Other reasonably foreseeable on-post actions would generate additional, but smaller, amounts of sanitary sewage. A new sewage treatment plant is being built to handle sewage from the baseline incinerator. An additional increase in capacity might be needed to handle the additional load from an ACWA pilot test facility.

4.22.4 Waste Management

Cumulative impacts from the construction and operation of an ACWA pilot test facility with the baseline incinerator and other reasonably foreseeable facilities should be minimal. Discussions with local planners indicated that current off-post hazardous and nonhazardous waste disposal capacities appear adequate (Smith 2001; U.S. Army 1991).

Hazardous wastes are transferred to and stored at hazardous waste storage facilities on post. Most are packaged and transported off post to permitted treatment and disposal facilities. In 1999, ANAD generated about 3.6 million lb (1.7 million kg) of hazardous wastes. Nonhazardous wastes are disposed of off post or recycled. Sanitary wastewater is treated in the on-post sewage treatment plant. In 1999, ANAD treated 1.6 million gal (5,900 m^3) of sewage.

The quantities of wastes generated by construction of an ACWA pilot test facility (Table 4.4-2) and other on-post actions would be small and have minimal impacts on waste management systems. Operating any of the ACWA pilot test facilities and a baseline incinerator would produce an amount of hazardous and nonhazardous wastes that, while representing a substantial increase in the amount of waste generated by ANAD, would be minimal in the vicinity of ANAD (Tables 4.4-3, 4.4-4, and 4.4-5). U.S. Army (1991) found no significant impacts on waste management systems from operation of the baseline incinerator. The total stockpile to be demilitarized is fixed, so the amounts and types of wastes produced would depend on the distribution of the stockpile among the technologies. Any of the technologies alone would produce minimal amounts of hazardous wastes. Amounts of wastes from other reasonably foreseeable on-post facilities including PEPS and the DRMO induction furnace could not be quantified but would be expected to be minimal. Overall, hazardous wastes from these facilities would have a minimal impact on waste management systems. A baseline incinerator would also produce brine salts, for which the ultimate disposal requirements are currently unclear (Section 4.4.3).

Sanitary sewage production during operation of an ACWA pilot test facility would exceed sewage production during construction. Operating an ACWA pilot test facility and a baseline incinerator could produce up to 15 million gal/yr (57,000 m^3/yr) of sewage, an increase of more than 960% over the volume treated in 1999. Other reasonably foreseeable on-post actions would generate additional, but smaller, amounts of sanitary sewage. A new sewage treatment plant is being built to handle sewage from the baseline incinerator. An additional increase in capacity might be needed to handle the additional load from an ACWA pilot test facility.

4.22.5 Air Quality

Emissions of toxic and hazardous air pollutants are of interest primarily because of their potential impacts on human health or biological resources. Sections 4.22.6 and 4.22.12 discuss potential cumulative impacts in these impact areas. This analysis assumes that a baseline incinerator would be operating during the construction and operation of an ACWA pilot test facility.

4.22.5.1 Impacts of Construction

PM_{10} and $PM_{2.5}$ from fugitive emissions would be the pollutants of principal concern during construction. Emissions of pollutants from worker and delivery vehicles, construction equipment, fuel storage, and refueling operations would be small, and off-post concentrations from these sources would not exceed NAAQS levels (Section 4.5).

Table 4.22-2 summarizes the maximum ambient total particulate concentrations, including the background concentration, from construction of an ACWA pilot test facility and operation of a baseline incinerator. Except for the annual $PM_{2.5}$ concentration, these concentrations are, at most, 90% of the NAAQS levels. The annual $PM_{2.5}$ level — when the particulate concentrations from the background level (96% of the NAAQS level), from the operation of the baseline incinerator (0.53% of the NAAQS level), and from the construction of an ACWA pilot test facility (2.8% of the NAAQS level) are taken into account — would exceed 99% of the NAAQS level. (Background levels in Alabama tend to be near or above the annual $PM_{2.5}$ NAAQS level.) Other reasonably foreseeable on-post and off-post actions that emit particulates would contribute small or temporary concentrations to this level and raise the cumulative annual $PM_{2.5}$ concentrations during the temporary period of ACWA construction activities.

4.22.5.2 Impacts of Operations

Table 4.22-3 summarizes the maximum ambient concentrations, including the background concentration, from concurrent operation of an ACWA pilot test facility and a baseline incinerator. Except for the annual $PM_{2.5}$ concentration, these concentrations would be, at most, 83% of the NAAQS levels. The annual $PM_{2.5}$ level — when the concentrations from the background level (96% of the NAAQS level), from the operation of the baseline incinerator (0.53% of the NAAQS level), and from the operation of any ACWA facility (0.33% of the NAAQS level) are taken into consideration — would be almost 97% of the NAAQS level. (Background levels in Alabama tend to be near or above the annual $PM_{2.5}$ NAAQS level.) Other reasonably foreseeable on-post and off-post actions that would emit particulates would contribute small or temporary concentrations to this level and raise the cumulative annual $PM_{2.5}$ concentration during operation of an ACWA pilot test facility.

TABLE 4.22-2 Air Quality Impacts from Construction of an ACWA Pilot Test Facility and Operation of a Baseline Incinerator at ANAD and Other Nearby Actions[a]

		Concentration ($\mu g/m^3$)				
Pollutant	Averaging Time	Maximum Increment[b]	Background	Total	NAAQS	Percentage of NAAQS[c]
PM_{10}	24 hours	22	68	90	150	60 (15)
	Annual	0.92	26	27	50	55 (1.8)
$PM_{2.5}$	24 hours	12	46	58	65	90 (19)
	Annual	0.50	14.4	14.9	15	99.4 (3.3)

[a] See Section 4.5 for details on background and modeling.

[b] The maximum increment is the sum of the increment for the ACWA pilot test facility plus the increment for a baseline incinerator. The ACWA pilot test facility increment is based on Table 4.5-8. Baseline incinerator PM_{10} impacts are based on U.S. Army (1991). Baseline incinerator $PM_{2.5}$ impacts are assumed to be 100% of PM_{10} impacts during operation.

[c] Values are based on total concentration, including the background concentration and maximum increment, from simultaneous construction of an ACWA pilot test facility and a baseline incinerator. Values in parentheses are based on the increment due to the two facilities alone and ignore the background concentration.

4.22.6 Human Health and Safety — Routine Operations

4.22.6.1 Impacts of Construction

PM_{10} and $PM_{2.5}$ from fugitive emissions are the pollutants of principal concern during construction. Emissions of pollutants from worker and delivery vehicles, construction equipment, fuel storage, and refueling operations would be small, and off-post concentrations from these sources would not exceed NAAQS levels (Section 4.5).

Particulate NAAQS levels would not be exceeded off post during construction of an ACWA pilot test facility with concurrent operation of the baseline incinerator (Section 4.22.5). However, even without any new actions, the current background annual $PM_{2.5}$ level is at 96% of the NAAQS level. (Background levels in Alabama tend to be near or above the annual $PM_{2.5}$ NAAQS level.) Concurrent construction of an ACWA pilot test facility and operation of a baseline incinerator would raise the maximum level to more than 99% of the NAAQS level (Table 4.22-2). Other reasonably foreseeable future actions would contribute small concentrations to this level and raise the cumulative annual $PM_{2.5}$ concentrations during the temporary period of ACWA pilot test facility construction activities. With the preexisting high background level almost equal to the NAAQS level, there is a potential for adverse health impacts off post from the existing environment during construction of an ACWA pilot test facility.

4.22.6.2 Impacts of Operations

The EIS for ANAD (U.S. Army 1991) does not discuss post-specific risks from the baseline incinerator. However, risks associated with the Johnston Atoll Chemical Agent Disposal System (JACADS) incinerator were estimated on the basis of measured stack concentrations. Risk estimates based on representative conditions at ANAD would differ from those derived for JACADS. However, the methodology used in assessing risks from JACADS emissions was very conservative (i.e., it overestimated risks). Thus, the JACADS risks can be taken as reasonable indicators of the expected risks from the baseline incinerator at ANAD.

Noncarcinogenic risks from operation of an ACWA pilot facility would be 0.5% or less of the levels considered to present hazards (Table 4.7-2). The maximum carcinogenic risk to on-post and off-post populations from agent processing and worst-case agent emissions associated with any ACWA technology would be 2×10^{-7}, or 20% of the 1×10^{-6} benchmark level generally considered representative of negligible risk. As summarized in the EIS for PBA (Appendix H of U.S. Army [1997b]), the maximum risk from the JACADS incinerator would be 6.2×10^{-7}, or 62% of the 1×10^{-6} level generally considered representative of negligible risk. When additivity for the carcinogens is assumed (a common assumption in risk assessments), a baseline incinerator and an ACWA pilot test facility operating simultaneously would represent an increased carcinogenic risk of approximately 8.2×10^{-7}, 82% of the benchmark level. This risk would generally be considered negligible.

Risks from the maximum possible release of agent from an ACWA pilot test facility were estimated by assuming that agent could be emitted continuously from the filter farm stack at the agent detection limit of the in-stack monitor (Section 4.6). The detection limit is about 20% of the concentration allowed in the stack. Operations would be shut down if the detection limit were reached. Thus, the estimate of risk is conservative (i.e., it overestimates risk). The maximum estimated risk from ACWA pilot test facility emissions would be 0.34% of maximum allowable level recommended by the CDC (Table 4.6-6). U.S. Army (1991) estimates the maximum risk from the baseline incinerator conservatively and assumes that emissions are at the allowable level. This EIS assumes lower emissions are at the detection limit. By adjusting the Army’s results for lower emissions to put them at the detection limit, the maximum risk from the baseline incinerator would be 4% of the maximum allowable level recommended by the CDC. If an ACWA pilot test facility and a baseline incinerator were operating concurrently, the worst case would have agent levels equal to 4.34% of the allowable level. However, it is unlikely that such levels would be reached under routine operating conditions, because the two plant stacks would be at different locations, which would lead to lower maximum air concentrations than would occur if all emissions were from one stack. Also, the assumption of continuous agent release at the detection limit (Section 4.6) is very conservative and results in overestimates of possible agent releases.

Only annual $PM_{2.5}$ concentrations would exceed 83% of the corresponding NAAQS levels during concurrent operation of an ACWA pilot test facility and a baseline incinerator (Table 4.22-3). Even without any new actions, the current background annual $PM_{2.5}$ level is 96% of the NAAQS level. (Background levels in Alabama tend to be near or above the annual $PM_{2.5}$ NAAQS level.) Concurrent operation of an ACWA pilot test facility and the baseline incinerator would raise the maximum level to about 97% of the NAAQS level. Other reasonably foreseeable future actions would contribute small concentrations to this level and raise the cumulative annual $PM_{2.5}$ concentrations during operation of the ACWA pilot test facility. With the preexisting high background level almost equal to the NAAQS level, there is a potential for adverse health impacts off post from the existing environment during operation of an ACWA pilot test facility.

4.22.7 Noise

No sensitive noise receptors are located near ANAD. Currently, noise-producing activities at ANAD are associated with the operation of the tank firing range, burning ground, demolition pit, and recoilless rifle range. Off-post noise sources include firing activities on Pelham Range. There is no off-post noise problem from operation of the ranges and demolition pit at ANAD.

Construction and operation of an ACWA pilot test facility would result in maximum noise levels that would not exceed 48 dBA at the eastern boundary if the facility were located in Area A (Section 4.8). If it were located in Area B nearer to the baseline incinerator, the maximum noise level at the western boundary would be less. Operation of the baseline incinerator would add less than 3 dBA, a barely perceptible increase, to the maximum level, regardless of which site was chosen for the ACWA pilot test facility. The cumulative noise level from both facilities would be less than the EPA's 55-dBA guideline. Noise from the blast chamber facility could have an impact on areas affected by an ACWA pilot test facility in Area B. Its impact would be intermittent, and no significant cumulative noise impact would be expected. Other reasonably foreseeable on-post actions would be located far enough away from locations affected by noise from an ACWA pilot test facility to preclude significant cumulative impacts. The widening of Route 109 east of the post would add temporarily to overall noise levels, but the cumulative impact would not be significant.

TABLE 4.22-3 Air Quality Impacts from Operation of an ACWA Pilot Test Facility and a Baseline Incinerator at ANAD and Other Nearby Actions

		Concentration ($\mu g/m^3$)				
Pollutant	Averaging Time	Maximum Increment[a]	Background	Total	NAAQS	Percentage of NAAQS[b]
SO_2	3 hour	22	346	368	1300	28 (1.7)
	24 hours	7.4	149	156	365	43 (2.0)
	Annual	0.17	32	32	80	40 (0.21)
NO_2	Annual	1.36	21	22	100	22 (1.4)
CO	1 hour	100	14,171	14,271	40,000	36 (0.25)
	8 hours	52	8,000	8,052	10,000	81 (0.52)
PM_{10}	24 hours	7.5	68	76	150	50 (5.0)
	Annual	0.13	26	27	50	53 (0.26)
$PM_{2.5}$	24 hours	7.5	46	54	65	83 (12)
	Annual	0.13	14.4	14.5	15	97 (0.87)

[a] The maximum increment is the sum of the increment for the ACWA pilot test facility plus the increment for a baseline incinerator. The ACWA pilot test facility increment is based on the largest modeled value for any technology (Tables 4.5-9 through 4.5-12). Baseline incinerator impacts are based on U.S. Army (1991). Baseline incinerator $PM_{2.5}$ impacts are assumed to be 100% of PM_{10} impacts during operation.

[b] Values are based on total concentration, including background concentration and maximum increment, from simultaneous operation of an ACWA pilot test facility and a baseline incinerator. Values in parentheses are based on operation of the two facilities alone and ignore the background level.

4.22.8 Visual Resources

The PEPS, PTFMC, and the DRMO induction furnace would be in keeping with the industrial and administrative nature of the southeastern portion of the post. The detonation chamber would be located in the northwestern portion of the site, and any view of it would be limited by rolling terrain and forest. Increased traffic and dust during construction of an ACWA pilot test facility would be temporary and intermittent. During operations, an ACWA pilot test facility could produce a small steam plume. When present, this plume would add to the visual impact of the large steam plume from the baseline incinerator. Any plumes associated with other reasonably foreseeable on-post facilities would be small. Overall, the visual impacts in the vicinity of ANAD should not be significant.

4.22.9 Soils

With the exception of soil contamination resulting from air emissions during operations, the analysis area for cumulative impacts to soils was limited to the immediate on-post vicinity of the proposed sites. Activities that would disturb soils would have very localized impacts and hence little chance of creating cumulative impacts.

The baseline incinerator and an ACWA pilot test facility, along with its supporting infrastructure, could disturb up to 150 acres (59 ha) of soils, some of them previously undisturbed.

Future construction actions not associated with an ACWA pilot test facility would be located at least 0.6 mi (1 km) away from all alternative ACWA pilot test facility locations. These activities could contribute to soil erosion and accidental spills and releases, which are the same types of impacts as those associated with construction of an ACWA pilot test facility. These impacts would be temporary and would be minor if the best management practices mentioned in Section 4.10 were followed.

There would be no significant cumulative impacts on surface soils from the routine operation of an ACWA pilot test facility and other on-post and off-post actions, including the routine operation of the baseline incinerator. On the basis of its low emissions, the ACWA pilot test facility should have no significant impacts (Section 4.10). The emissions from the baseline incinerator would also be low (U.S. Army 1991; Raytheon 1996). Deposition from the ACWA pilot test facility would add to deposition from the baseline incinerator, but given the low emissions from both units, the impact should be negligible. Other reasonably foreseeable on-post and off-post actions would take place far enough away or be small enough to preclude significant on-post deposition.

4.22.10 Groundwater

Coldwater Spring, which discharges groundwater to the surface, supplies water to ANAD, Fort McClellan Military Reservation, Anniston, Blue Mountain, and several suburban areas (Section 4.11). Coldwater Spring has a minimum reserve of 876 million gal/yr (3.3 million m^3/yr) and a minimum yield of 23.5 million gal/d (61.8 m^3/min) (U.S. Army 1991). ANAD currently uses about 260 million gal/yr (0.98 million m^3/yr) of water.

Impacts on groundwater from the construction of an ACWA pilot test facility and other on-post facilities would be none to negligible if standard precautions to prevent leaks and spills were followed during equipment refueling and other activities (Section 4.11).

Normal operations of an ACWA pilot test facility would result in minor impacts on groundwater (Section 4.11). Depending on the technology chosen, an ACWA pilot test facility's potable and process water use of, at most, 24 million gal/yr (92,000 m^3/yr) would exceed the water use during construction (Table 4.3-1). The baseline incinerator could use up to 94 million gal/yr (356,000 m^3/yr) of water when 365 days per year of operation are assumed (Table 4.22-1). The total use of 120 million gal/yr (450,000 m^3/yr) is about 14% of the minimum reserve of Coldwater Spring but only 1.4% of the spring's minimum flow. Although quantitative water use figures were not available, water use by other reasonably foreseeable on-post actions would be smaller and cumulatively would not exceed the water available from Coldwater Spring.

Neither an ACWA pilot test facility nor the baseline incinerator would release process water (Section 4.11 and U.S. Army 1991). The discharge of treated sanitary sewage from both facilities and from other reasonably foreseeable on-post facilities to surface waters would not affect groundwater flows.

Although data were not available to account for the water supply needs of off-post actions such as the Honda assembly plant, in discussions, local planners indicated that water supplies in the vicinity of ANAD would be expected to be adequate to meet needs (Smith 2001).

4.22.11 Surface Water

Impacts on surface water from the construction of an ACWA pilot test facility would be negligible if standard precautions to prevent leaks and spills were followed during equipment refueling and other activities (Section 4.12). If spills and leaks did occur, remediation procedures would need to be applied quickly to reduce potential impacts on surface waters.

Neither an ACWA pilot test facility nor the baseline incinerator would discharge process water during operations. ACWA pilot test facility operations would thus result in negligible impacts on surface waters (Section 4.12). U.S. Army (1991) found no adverse impacts on surface waters from the operation of the baseline incinerator. Although quantitative water use figures were not available, water use and discharge by other reasonably foreseeable on-post actions would not be expected to affect surface water flows significantly.

An ACWA pilot test facility and the baseline incinerator together would discharge about 15 million gal/yr (57,000 m^3/yr) of treated sanitary sewage. This discharge would be small compared to surface water flows and would not significantly change flow conditions in the vicinity of ANAD.

4.22.12 Biological Resources

4.22.12.1 Terrestrial Habitats and Vegetation

ANAD is predominantly undeveloped, and about 75% of the post is unimproved (Section 4.13). In the past, southern pine beetle infestations required the cutting of trees. Infestations are expected to continue. Land is normally returned to timber after clear-cutting (Smith 2001).

Depending on the site chosen, construction of an ACWA pilot test facility would disturb up to about 77 acres (31 ha) of previously undisturbed land (Table 4.3-2) in addition to the 70 acres (28 ha) disturbed by construction of the baseline incinerator. Construction of other on-post facilities would increase terrestrial habitat and vegetation loss as sites were cleared. In addition, the ongoing clear-cutting to control Southern pine beetle infestations would increase the cumulative loss of vegetation. Using best management practices would minimize impacts on vegetation due to sedimentation and erosion.

A screening-level ecological risk assessment for soils found that air emissions from routine operation of an ACWA pilot test facility would have negligible impacts on terrestrial habitats and vegetation (Section 4.13). U.S. Army (1991) found no adverse impacts associated with routine operation of a baseline incinerator. In addition, the total stockpile to be demilitarized is fixed; if the ACWA pilot test facility and the baseline incinerator were operating, fewer munitions would be demilitarized in an ACWA pilot test facility, thereby reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions or their distance from the ACWA pilot test facility, cumulative impacts on terrestrial habitats and vegetation from an ACWA pilot test facility, the baseline incinerator, and other potential facilities would be negligible during routine operations.

Cumulative impacts associated with off-post facilities should be negligible. The new Honda plant located about 8.5 mi (14 km) west of the western border of ANAD and other reasonably foreseeable actions would have localized impacts that would be negligible on ANAD.

4.22.12.2 Wildlife

Depending on the site chosen, construction of an ACWA pilot test facility would disturb up to 77 acres (31 ha) of previously undisturbed land in addition to the 70 acres (28 ha) disturbed by construction of a baseline incinerator. Each additional on-post construction action would increase loss of habitat, human activity, and construction traffic. Cumulatively, these increases would cause additional deaths among less mobile species and displace additional wildlife during the construction period. Increased noise would cumulatively displace additional small mammals and potentially lead to increased habitat abandonment by songbirds. Similar impacts would have already resulted from the prior construction of the baseline incinerator (U.S. Army 1991). Use of the mitigation measures discussed in Sections 4.13 and 4.14 would reduce adverse cumulative impacts on both habitats and wildlife.

A screening-level ecological risk assessment for soils found that air emissions from routine operation of an ACWA pilot test facility would have negligible impacts on wildlife (Section 4.14). U.S. Army (1991) found no adverse ecological impacts associated with routine operation of the baseline incinerator. In addition, the total stockpile to be demilitarized is fixed; if both the ACWA pilot test facility and the baseline incinerator were operating, fewer munitions would be demilitarized in an ACWA pilot test facility, thereby reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions or their distance from the ACWA pilot test facility, cumulative impacts on wildlife from an ACWA pilot test facility, the baseline incinerator, and other potential facilities would be negligible during routine operations.

Additional operations on post would increase roadkills as worker traffic and deliveries increased.

If it is assumed that the operational noise from an ACWA pilot test facility and the baseline incinerator are about the same, operating an ACWA pilot test facility would increase noise levels by less than 3 dBA. Noise generated at additional locations would increase the area that would be subject to increased noise levels. However, other facilities would be too far away to contribute to average noise levels from an ACWA pilot test facility alone, and the cumulative noise impacts on wildlife would be minor.

Cumulative impacts associated with off-post facilities should be negligible. The new Honda plant located about 8.5 mi (14 km) west of the western border of ANAD and other reasonably foreseeable actions would have localized impacts that would be negligible on ANAD.

4.22.12.3 Aquatic Habitats and Fish

Disturbance of streams in Proposed Area A could result in loss of up to 1,900 ft (580 m) of stream habitat (Section 4.15) and eliminate an excavated pond about 0.4 acre (0.2 ha) in size. Aquatic habitats do not occur in Areas B and C. Construction in any of the three areas could have impacts on downstream habitats. The potential for aquatic habitat loss from construction of other on-post projects was not evaluated for this EIS; any impacts would add to the impacts caused by construction of an ACWA pilot test facility. Avoidance of streams where possible and implementation of best management practices to control erosion and sedimentation would be needed to minimize the impacts at all on-post construction sites.

A screening-level ecological risk assessment for aquatic biota found that air emissions from routine operation of an ACWA pilot test facility have negligible impacts on aquatic habitats and fish (Section 4.15). U.S. Army (1991) found no adverse ecological impacts associated with the routine operation of the baseline incinerator. In addition, the total stockpile to be demilitarized is fixed; if both the ACWA pilot test facility and the baseline incinerator were operating, fewer munitions would be demilitarized in an ACWA pilot test facility, thereby reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions or their distance from the ACWA pilot test facility, cumulative impacts on aquatic habitats and fish from an ACWA pilot test facility, the baseline incinerator, and other reasonably foreseeable on-post and off-post facilities would be negligible during routine operations.

4.22.12.4 Protected Species

Construction in Area A or the associated utility corridors would not be likely to affect Tennessee yellow-eyed grass (federally listed as endangered) adversely. Construction in Areas A, B, or C or the associated utility corridors would have negligible impacts on the aquatic habitats of the blue shiner, tulotoma snail, and painted rocksnail (Section 4.16). Clear-cutting to control Southern pine beetle infestations could increase runoff and the potential for impacts on these species. Implementation of storm-water control measures during construction would reduce the potential for these impacts, and the cumulative impacts would be negligible. The DRMO induction furnace, PEPS, and PTFMC avoid Tennessee yellow-eyed grass populations. The potential of these actions to affect this species by runoff and sedimentation was not assessed for this EIS. Implementing the practices noted in Section 4.16 would reduce the potential for such impacts.

Routine operation of an ACWA pilot test facility would have negligible impacts on protected species (Section 4.16). U.S. Army (1991) found no adverse ecological impacts associated with the routine operation of the baseline incinerator. In addition, the total stockpile to be demilitarized is fixed. If both the ACWA pilot test facility and the baseline incinerator were operating, fewer munitions would be demilitarized in the ACWA pilot test facility, thereby reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions or their distance from the ACWA pilot test facility, cumulative impacts on protected species from an ACWA pilot test facility, the baseline incinerator, and other potential on-post and off-post facilities would be negligible during routine operations.

4.22.12.5 Wetlands

There are about 112 acres (45 ha) of wetlands on ANAD. Locating the ACWA pilot test facility in Area A could result in the loss of wetlands in that area and might require construction in a 100-yr floodplain (Section 4.17). Construction in Area A could cause the loss of up to 1.2 acres (0.49 ha) of palustrine wetland, up to 1,900 ft (580 m) of riverine wetland, and up to 12 acres (4.9 ha) of floodplain. No wetlands occur in Areas B and C. Construction in any of the three areas could affect downstream wetlands. Impacts downstream of the sites would be negligible if standard measures for controlling erosion and runoff were followed. The potential for loss of wetlands due to other on-post projects would need to be addressed for each action. The PTFMF might affect a nearby perennial stream, contributing to adverse cumulative impacts on wetlands. Use of the mitigation measures described in Section 4.17 for controlling runoff and erosion would reduce wetland impacts.

Routine operation of an ACWA pilot test facility would have negligible impacts on wetlands (Section 4.17). U.S. Army (1991) found no adverse ecological impacts associated with the routine operation of the baseline incinerator. In addition, the total stockpile to be demilitarized is fixed; if both the ACWA pilot test facility and the baseline incinerator were operating, fewer munitions would be demilitarized in an ACWA pilot test facility, thereby reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions or their distance from the ACWA pilot test facility, cumulative impacts on wetlands from an ACWA pilot test facility, the baseline incinerator, and other potential facilities would be negligible during routine operations.

4.22.13 Socioeconomics

Construction and operation of an ACWA pilot test facility might result in cumulative impacts if construction and operation activities occurred concurrently with other existing or future activities on post at ANAD and in the three-county ROI (see Section 4.19) surrounding the post.

Other reasonably foreseeable on-post actions could create additional demands on post utility and transportation infrastructures if they occurred concurrently with construction and operation of an ACWA pilot test facility. However, other reasonably foreseeable on-post actions would be expected to employ far fewer people than an ACWA pilot test facility. In the area surrounding the post, any industrial, commercial, and residential development that might occur could also lead to cumulative impacts on local socioeconomic resources if impacts could not be adequately planned for.

The cumulative socioeconomic impacts from the operation of any of the ACWA technologies together with the operation of a baseline incinerator and existing or planned economic development activities would be relatively small. Construction of an ACWA pilot test facility would be expected to generate approximately 1,300 direct and indirect jobs in the peak year in the ROI, with employment during the operation of both facilities likely to be roughly 2,600. Operations jobs for both facilities would be filled partially by workers moving into the ROI; these workers would have a relatively minor effect on the local housing market. Demand for rental housing during the peak year of construction of an ACWA facility would require approximately 8% of the vacant rental housing stock, with roughly 20% of vacant owner-occupied housing required during operation of both an incinerator and an ACWA facility. If current vacancy rates and housing development continue, adverse cumulative impacts on housing should not occur.

A number of local road expansion projects, including bypasses of Anniston and Talladega and the widening of I20, are either under construction or planned for the next five years. Fairly substantial growth in employment is expected to occur in the ROI as a result of the construction of a number of new industrial facilities in the near future. A new car assembly and engine manufacturing facility is under construction 15 mi (24 km) west of ANAD is expected to employ 1,500 workers when construction is complete in 2001. Smaller facilities include a steel coil facility planned for Talladega and a concrete pole plant in Anniston. More specific information on the size and precise timing of these projects was not available. However, when judged from the size of the impact from similar activities on other rural communities, even if these projects were to occur during construction and operation of a baseline incinerator and an ACWA pilot test facility, the potential cumulative impact of these activities, together with other reasonably foreseeable on-post actions on the local economy, local labor markets, and public and community services, would be minor.

Local labor markets would probably not be adversely affected by the construction of an ACWA pilot test facility or the concurrent operation of an ACWA pilot test facility and baseline incinerator and projected off-post activities. The post is located in the Anniston Metropolitan Statistical Area (MSA) and is adjacent to the Gadsden MSA and Birmingham MSA. A variety of occupations are represented in these MSAs, and the number of unemployed workers there would be sufficient to meet the demand for local labor that would be created by both projects.

Concurrent operation of a baseline incinerator, an ACWA pilot test facility, and projected off-post activities might produce moderate impacts on the local transportation network. Construction of an ACWA pilot test facility would result in an additional 1,000 daily trips on CR 109/SR 202, the local road segment most heavily used by existing post employees, representing a 13% increase in annual average daily traffic. Concurrent operation of both facilities would result in an additional 1,300 daily trips, or an increase of 17% in annual average daily traffic on CR 109/SR 202.

Although more local public service employees, medical services workers, and teachers would be needed if the operation of an ACWA pilot test facility and the baseline incinerator, and projected off-post activities were to occur concurrently, given sufficient planning, local public service providers should be able cope with the additional demands through associated increases in city, county, and school district revenue collections.

4.22.14 Environmental Justice

Environmental justice impacts would be related to socioeconomic and human health impacts. No environmental justice impacts are anticipated from construction and routine operation of an ACWA pilot test facility (Section 4.20). During construction and routine operations of any ACWA technology at ANAD, high and adverse impacts would not be anticipated with regard to either socioeconomic activities or human health (Sections 4.7 and 4.19). U.S. Army (1991) did not predict any significant impacts on human health. Moreover, the cumulative impacts associated with an ACWA pilot test facility and other reasonably foreseeable actions, including the operation of the baseline incinerator, would not be anticipated to contribute to high and adverse impacts on populations (Sections 4.22.6 and 4.22.13). As a result, significant cumulative environmental justice impacts from the construction and routine operation of an ACWA pilot test facility, the baseline incinerator, and other reasonably foreseeable actions are not anticipated.

4.23 AGRICULTURE

This section was prepared in response to public comment on the draft of this EIS (see Volume 2, Section 2, Part DD of this final EIS). This assessment describes agriculture near ANAD and evaluates whether toxic air pollutants from pilot facility operations would impact crops and livestock. It also assesses potential agricultural losses from an accident involving release of chemical agent.

4.23.1 Current Environment

4.23.1.1 Land Use

The region of influence (ROI) used to assess impacts on agriculture consists of 11 counties located entirely or partly within a radius of 30 mi (50 km) around ANAD. This agricultural ROI contains 4.7 million acres (1.9 million ha) of land, of which 20% were in farmland in 1997 (USDA 1999). The ROI contained 6,500 farms in 1997, of which about a third were operated by full-time farmers (Table 4.23-1). Among the ROI counties, average farm size varied from 97 to 249 acres (39 to 101 ha).

4.23.1.2 Employment

Agriculture was historically only a moderately significant local source of employment in the 11-county ROI, and its importance declined during the 1990s. Farm worker and agricultural services employment totaled 9,589, contributing a little more than 1% to total employment in the ROI in 1999 (U.S. Bureau of the Census 2001a). In Calhoun County, 659 people were employed in agriculture in 1999 (U.S. Bureau of the Census 2001a). This number constitutes 1.6% of employment in the county. Information on numbers of migrant and seasonal farm workers was unavailable. Within the South Census Region in 1998, about half of such farm workers were White, 37% were Hispanic, and the remainder were Black and other racial/ethnic groups (Runyan 2000).

TABLE 4.23-1 Farms and Crop Acreage in the Agricultural Region of Influence around ANAD in 1997[a]

Farms and Land	Land (acres) and Farms (no.) ROI	State
Land in farms (acres)	964,346	8,704,385
Number of farms	6,532	41,384
Full-time farms	2,429	15,568
Average farm size (acres)	97–249	210
Total cropland (acres)	479,250	4,197,670
Harvested cropland (acres)	203,026	2,077,139

[a] The agricultural ROI is composed of the following counties: Blount, Calhoun, Cherokee, Clay, Cleburne, Etowah, Jefferson, Randolph, Shelby, St. Clair, and Talladega.

Source: USDA (1999).

4.23.1.3 Production and Sales

Hay, cotton, beans, corn, and wheat are the primary crops harvested (Table 4.23-2). Poultry production for eggs and for meat is a major component of livestock production in the ROI. Farms in the region generated $540 million in agricultural sales in 1997, representing 17% of total agricultural sales in the state as a whole. Livestock contributed the majority of sales (88%), with a smaller contribution from crops (Table 4.23-3) (USDA 1999).

4.23.2 Site-Specific Factors

The only aspect of pilot facility operations that could have an impact on agriculture is the release of substances that could cause toxic effects on crops or livestock. Routine or fluctuating operations of a pilot facility or an accident could release organic or inorganic compounds, including agent or processing by-products, to the environment (see Sections 4.5 and 4.6). Atmospheric releases could result in the widespread dispersal and deposition of contaminants. Exposures might result in lethal effects, reduced growth or other limiting effects, or no observable effect.

TABLE 4.23-2 Agricultural Production in the Agricultural Region of Influence around ANAD in 1997[a]

Crops and Livestock	Crops (acres) and Livestock (no.) ROI	State
Selected crops harvested		
Hay	115,282	778,602
Cotton	30,569	433,160
Beans	26,931	316,019
Corn	16,765	230,484
Wheat	6,364	82,440
Livestock inventory		
Cattle and calves	214,701[b]	1,530,566
Hogs and pigs	28,444[b]	183,811
Sheep and lambs	911[b]	8,173
Layers and pullets	870,535[b]	13,432,845
Broilers sold	181,877,784[b]	871,123,702

[a] The agricultural ROI is composed of the following counties: Blount, Calhoun, Cherokee, Clay, Cleburne, Etowah, Jefferson, Randolph, Shelby, St. Clair, and Talladega.

[b] ROI inventory is an underestimate due to data unavailability for some counties.

Source: USDA (1999).

4.23.3 Impacts of the Proposed Action

Impacts from construction and operations are discussed below. This analysis considers effects on agricultural production, employment, and sales. The impacts of no action are provided for comparison.

4.23.3.1 Impacts of Construction

Construction impacts would be confined to the installation; therefore, no significant impacts on agriculture would be likely from facility construction activities.

TABLE 4.23-3 Sales by Farms in the Agricultural Region of Influence around ANAD in 1992 and 1997[a]

	Sales (millions of $)	
Product	1992	1997
Livestock	277.8	476.0
Harvested crops	54.6	64.4
Agricultural ROI total	332.5	540.4
State total	2,369.2	3,099.0

[a] The agricultural ROI is composed of the following counties: Blount, Calhoun, Cherokee, Clay, Cleburne, Etowah, Jefferson, Randolph, Shelby, St. Clair, and Talladega.

Sources: USDA (1994, 1999).

4.23.3.2 Impacts of Routine Operations

During routine operations, crops and livestock in the vicinity of the pilot test facility would be exposed to atmospheric emissions from the boiler stack and process stack. All such facility emissions, including emissions of criteria pollutants, organic compounds, and trace elements, would be within applicable air quality standards (see Sections 4.5 and 4.6).

A screening-level ecological/agricultural risk assessment was conducted to assess the risk to agriculture resources from deposition of air emissions during routine operations of each of the four pilot test technologies. For this evaluation, it was assumed that all emissions were deposited on the soils within a circle defined by the distance from the proposed pilot test site to the nearest ANAD installation boundary. This assumption provides an upper limit on possible deposition at off-site locations. Actual deposition of pollutants would be less than this value and would tend to decline with distance from ANAD. Within this area, the deposited emissions were assumed to be completely mixed into the top 1 cm (0.5 in.) of soil. The resulting pollutant concentration was compared with the lowest soil benchmark value available from the EPA and state sources. These benchmark concentrations for soil are based on conservative ecological endpoints and sensitive toxicological effects on plants, wildlife, and soil invertebrates. Soil chemical concentrations that fall below the benchmark are considered to have negligible risk. Those chemicals that exceed the benchmark values are considered to be contaminants of concern and would be evaluated in further detail. None of the chemicals emitted by the pilot test facilities, when deposited on soils, would exceed the soil benchmark values, indicating that the risks of impacts on agriculture from maximum concentrations would be negligible (Tsao 2001g). Off-site concentrations would be substantially lower due to the effect of emission dilution over a larger area.

Most of the toxic air pollutants emitted by a pilot test facility (Section 4.6) would be from the boiler stack, a source type commonly found in any combustion facility that requires fuel to heat up the system. Boiler emissions would be followed in quantity by the emissions from the emergency diesel generator, which would operate only in case of power failure. The technology-specific emissions would contribute very little to the overall deposition of metals and organics onto soil. There is no evidence that deposited residuals from agent emitted due to fluctuating operations would bioaccumulate through the food chain (USACHPPM 1999b).

4.23.3.3 Impacts of Accidents

Section 4.21 describes potential accidents for both the proposed action and no action, including a catastrophic event that would release agent to surrounding land areas. Although extremely unlikely, release of agent might affect a major portion of the ROI. The largest impact of an accident on agriculture would result if all of the crops and livestock produced in a single season in the ROI were interdicted (either by federal or state authorities) and removed from the marketplace. The impacts from such losses in agricultural output on the economy of the counties within the 30-mi (50-km) radius surrounding ANAD would be significant. Table 4.23-4 presents three scenarios of regional losses of employment and income associated with 50, 75, or 100% loss of agricultural production (see Appendix G). These scenarios are presented for each of the pilot test technologies and for no action. The estimated losses do not include the losses that would occur in the case of death of breeding stocks of animals. Because scenarios involving widespread agent release were identified for both the proposed action and no action, the magnitude of such losses is unlikely to differ between the proposed action and no action.

4.23.4 Impacts of No Action

4.23.4.1 Impacts of Routine Operations

The agricultural impacts of continuing routine operations at ANAD would be negligible and as included in baseline conditions for the ANAD region.

TABLE 4.23-4 Agricultural Impacts of Accidents at ANAD Associated with the Proposed Action and No Action[a]

Parameter	Neut/Bio	Neut/ SCWO	Neut/ GPCR/ TW-SCWO	Elchem Ox	No Action
Impacts to the regional economy from a one-year loss of agricultural output					
100% loss of agricultural output					
Employment (no. of jobs)	47,000	47,000	47,000	47,000	47,000
Income (millions of $)	1,360	1,360	1,360	1,360	1,360
75% loss of agricultural output					
Employment (no. of jobs)	35,200	35,200	35,200	35,200	35,200
Income (millions of $)	1,020	1,020	1,020	1,020	1,020
50% loss of agricultural output					
Employment (no. of jobs)	23,500	23,500	23,500	23,500	23,500
Income (millions of $)	680	680	680	680	680

[a] Impacts for no action and the proposed action are presented for the first year of operation of an ACWA facility (2009).

4.23.4.2 Impacts of Accidents

Potential impacts on agriculture associated with the accident scenarios under the no action alternative would be the same as those discussed under the proposed action alternatives (Section 4.23.3.3).

4.24 OTHER IMPACTS

4.24.1 Unavoidable Adverse Impacts

Most potential adverse impacts identified in this EIS would either be negligible or could be avoided through careful facility siting and adherence to best management practices during the construction and operation of industrial facilities. However, some minor to moderate unavoidable adverse impacts could result from implementing an ACWA technology. These are described in this section.

ACWA facility construction activities, including land clearing and moving of personnel and equipment in the construction staging area(s), would require disturbance of as much as 75 acres (30 ha) of land and could result in unavoidable adverse impacts comparable to those that would occur at any construction site of similar size.

As much as 77 acres (31 ha) of vegetative and terrestrial habitats could be disturbed. Cleared lands would include hardwood forests, which have an understory containing a greater number of species than other forest types. Most disturbances would be short-term (less than 34 months) and would be mitigated through revegetation and careful construction siting and planning.

Wildlife would be affected by landscape modification, loss of habitat, increased human activity in the construction area, increased traffic on local roads, and noise. Less mobile and burrowing species (such as amphibians, some reptiles, and small mammals) could be killed during vegetation clearing and other site preparation activities. Increased population densities and competition in adjacent habitats could reduce the survival rates or reproductive capacity of displaced individuals. However, wildlife communities associated with habitats in any of the construction areas (A, B, or C) are relatively common and well represented near the site.

Aquatic habitats, fish, and wetlands could be affected by grading during site preparations, which could disturb surface waters and drainage patterns throughout the site because of sedimentation, accidental releases of contaminants into streams, erosion, or storm-water runoff. Aquatic habitats are not present in Areas B or C but could be indirectly affected by construction in these areas because of these factors. Area A has aquatic habitats that could be directly affected by construction activities. The physical requirements of the post may preclude the avoidance of specific water features, including the two streams that converge on post. Rerouting or culverting of the streams at Area A, if necessary, could result in the loss of up to 1,912 ft (583 m) of stream habitat (excavated channels). Construction in Area A could also eliminate a small excavated pond.

Air quality would be affected during construction as a result of increased fugitive dust emissions (PM_{10} and $PM_{2.5}$). Background concentrations of $PM_{2.5}$ are already near the maximum levels of applicable air quality standards. Emissions from construction of an ACWA pilot test facility, although they would be very low overall, would result in levels near the applicable NAAQS, primarily because of high background concentration levels. Similarly, emissions of $PM_{2.5}$ during operations would be very low but would be near the maximum NAAQS because the background levels are high.

Adverse health impacts from PM inhalation could occur because the background level for $PM_{2.5}$ in the vicinity of ANAD is at the health-based annual NAAQS level. (Note: This risk would be present with or without an ACWA facility.)

A small number of worker injuries would be expected during construction of an ACWA facility: 49 for Neut/Bio, 61 for Neut/SCWO, 55 for Neut/GPCR/TW-SCWO, and 61 for Elchem Ox. Worker injuries were estimated on the basis of the number of workers and duration of construction. When workers follow established safety precautions, the risk of worker fatalities is very low.

The normal operations of an ACWA facility would have minor unavoidable adverse impacts. Facility workers would be subject to some risks from operations, and an estimated 53–286 worker injuries would be expected (about 53 for mustard agent processing only and about 274–286 for both mustard and nerve agent processing). There would also be minor increases in emissions of air pollutants, but these emissions would be well below allowable levels and would not significantly affect human health, ecological resources, or wetlands. Impacts related to fluctuating operations are also expected to be minimal, given the safety features that would be built into the design of ACWA facilities, which would prevent migration of contaminants to the environment in the event of a spill or other operational accident. While there would be significant unavoidable adverse impacts related to a catastrophic accident, the probability of this scenario is extremely remote.

4.24.2 Irreversible and Irretrievable Commitment of Resources

Irreversible commitments are those that cannot be reversed (i.e., the resource is permanently lost or consumed). Irreversible commitments that would result from the construction and operation of a proposed ACWA pilot test facility include consumption of electricity, natural gas, and fuel oil, as described in Section 4.3. Materials such as the concrete and steel used to construct the pilot test facility would also generally be irreversible commitments because they would probably not be recyclable because of potential agent contamination. Data on the quantities of construction materials required for an ACWA pilot facility are provided in Kimmell et al. (2001).

Irretrievable commitments are those that are lost for a period of time. Irretrievable commitments that would result from the construction and operation of a proposed ACWA pilot test facility would include water and habitat. Implementation of an ACWA technology would consume both process and potable water for the period of construction and operations (i.e., less than six years total). (Amounts of water consumed are discussed in Section 4.3.) When proposed operations would cease, water used by an ACWA technology would be available for other uses. Habitat lost because of the construction of an ACWA pilot test facility would also represent an irretrievable commitment. Habitat in the footprint of an ACWA pilot facility would be lost during the period of construction and operations (i.e., less than seven years total). After decontamination and decommissioning, the land could be revegetated, and habitat could be restored. Depending on the methods chosen for decommissioning, habitat losses could also be considered irreversible.

4.24.3 Short-Term Uses of the Environment and Enhancement of Long-Term Productivity

Constructing and operating one or more pilot test facilities would be an action of limited duration — less than six years. Construction would disturb soils, wildlife, and other biota, and it would produce temporary air emissions. Operations would produce air emissions, liquid effluents, and liquid and solid wastes. Air emissions and liquid effluent releases would be temporary, ceasing at the end of the project life. Disposal of wastes on post and off post would be a long-term commitment of land with restricted use. Construction and operation of one or more pilot test facilities would have short-term socioeconomic impacts for the duration of construction and pilot testing by creating jobs, increasing tax revenues, and increasing demand for housing and public services.

After pilot testing, the ACWA facility might be used to destroy the remaining on-post ACW stockpile. At the end of stockpile destruction, the facilities would be decontaminated and demolished, and the land would be returned to long-term productivity.

The pilot testing of an ACWA technology system would not substantially reduce or increase the risks to the public from accidents involving chemical agent. This situation would occur because the accidents with the greatest consequences, although highly unlikely, are associated with ACW storage, and ACW storage would continue during pilot testing. The consequences from highly unlikely accidents involving agents at a pilot test facility would be less than the consequences from similar highly unlikely accidents, including ACW storage.

4.25 MITIGATION

For environmental resource areas where adverse impacts have been identified, mitigation measures have been developed to minimize or avoid potential impacts from constructing and operating an ACWA pilot facility. The mitigation measures are outlined below. Because no adverse impacts on land use, infrastructure, noise, visual resources, protected species, socioeconomics, or environmental justice were identified, no mitigation would be required for these resource areas.

4.25.1 Waste Management

Adequate facilities exist to handle hazardous and nonhazardous wastes that would be generated by construction activities. Large potentially hazardous waste streams would be produced from operating any of the neutralization pilot test facilities; Elchem Ox would generate a smaller volume of hazardous wastes. The Army would work with regulators to develop procedures for handling potentially hazardous wastes resulting from ACW destruction. These procedures might include conducting tests to determine the toxicity of wastes, developing a process to stabilize salt wastes, sending wastes to a permitted hazardous waste disposal facility, or others.

4.25.2 Air Quality — Criteria Pollutants

Fugitive dust emissions would be generated during construction of an ACWA pilot facility. To minimize dust emissions, access roads would be paved with asphaltic concrete, and standard dust suppression measures (i.e., watering) would be employed at the construction sites.

4.25.3 Air Quality — Toxic Air Pollutants

No significant emissions of hazardous air pollutants are expected during construction of an ACWA pilot facility. During operations, the ACWA facility would be equipped with multiple carbon filter banks and with agent monitoring devices between banks to ensure that, in the unlikely event that some agent was not destroyed in the neutralization process and subsequent treatment, it would be detected, and the causes would be mitigated immediately.

4.25.4 Human Health

Some risk to workers is present as a result of constructing and operating an ACWA pilot facility. Workers would adhere to safety standards and use protective equipment as necessary to reduce these risks. Also, the ACWA facility would be designed and operated to contain potential agent emissions to air, water, or soils. Design components (e.g., recycling process effluents, surrounding the facility with a berm, installing automated agent detection devices) would be incorporated to minimize operational and accidental emissions. Emergency response procedures are in place to protect human health and safety, both on post and off post, in the unlikely event of a significant release to the environment from a catastrophic accident (see Section 7.21).

4.25.5 Geology and Soils

Best management practices (e.g., use of siltation fences, berms, and liners; revegetation of disturbed land following construction) would be employed to minimize the potential for soil erosion potentially caused by construction of an ACWA pilot facility. A berm would surround the facilities to contain any potential releases from spills or fluctuating operations. In addition, the facilities would be designed with many safety features (e.g., detection devices, automatic shutoff) to prevent migration of spills from an operational accident.

4.25.6 Groundwater, Surface Water, and Wetlands

Runoff created by construction or preparation for construction (i.e., grading) would be contained or minimized by using standard erosion and storm-water runoff control measures (i.e., siltation fences or straw bales, stormwater retention ponds). In addition, construction activities or equipment within buffer areas along streams would be avoided where possible.

A berm would surround the facilities to contain any potential releases from spills or fluctuating operations. The facilities would be designed with many safety features (e.g., detection devices, automatic shutoff) to prevent migration of spills from an operational accident. A storm-water management plan would be developed to minimize the potentially adverse effects of storm-water runoff on aquatic habitats, fish, and wetlands.

4.25.7 Vegetation, Wildlife, and Aquatic Resources

Construction could affect as much as 77 acres (31 ha) of vegetative, terrestrial, and aquatic habitat. The following mitigation measures would be implemented to reduce adverse impacts on ecological resources during construction.

- Best management practices would be implemented for erosion and sedimentation control to avoid impacts to ecological resources from changes in stream flow characteristics or water quality.

- Storm-water retention ponds would be implemented to contain erosion and sedimentation from stormwater runoff during construction or operations.

- Disturbed areas would be immediately replanted with native species

- Where possible, a buffer area would be instituted for construction activities and equipment along the stream channels in Area A. A buffer area would also be instituted for construction of the utility corridors north of Area A (adjacent to the stream) and southwest of Area A (crossing the stream) to minimize impacts on the streams and downstream aquatic habitats and wetlands.

- A buffer area would be maintained around wetlands during construction.

- Wetlands would be avoided during construction, where possible.

- Construction workers would be briefed on sensitive ecological resources and mitigation measures.

4.25.8 Cultural Resources

The construction areas have been largely surveyed for archaeological resources. Those areas that were not surveyed were previously disturbed and are not considered likely to contain important resources. While it is not likely, it is possible that archaeological artifacts could be encountered during construction activities. If cultural material were unexpectedly encountered during ground-disturbing activities at previously disturbed or surveyed areas of the depot, construction would stop immediately, and the Alabama SHPO and a qualified archaeologist would be consulted to evaluate the significance of the cultural artifacts.

4.26 REFERENCES FOR CHAPTER 4

Acoustical Society of America, 1983, *American National Standard Specification for Sound Level Meters, ANSI S1.4-1983*, New York, N.Y., Feb.

Acoustical Society of America, 1985, *American National Standard Specification for Sound Level Meters, ANSI S1.4A-1985, Amendment to ANSI S1.4-1983*, New York, N.Y., June.

Adams, G.I., et al., 1926, *Geology of Alabama*, Special Report 14, Geological Survey of Alabama.

Agency for Toxic Substances and Disease Registry, 1999, *Public Health Assessment*, *Anniston Army Depot*, *Anniston, Alabama*, prepared by Federal Facilities Assessment Branch, Division of Health Assessment and Consultation, Jan. 12, http://www.atsdr.cdc.gov/HAC/PHA/anniston/ann_toc.html, accessed in Aug. 2000.

American Medical Association, 1999, *Physician Characteristics and Distribution in the U.S.*, Chicago, Ill.

ADEM, 1999, *1999 Annual Air Quality Report*, Alabama Department of Environmental Management, Montgomery, Ala.

Allison, T., 2001, *Forecasted Data for ACWA Socioeconomic Analyses*, intralaboratory memorandum from Allison to M. Goldberg (Argonne National Laboratory, Argonne, Ill.), Oct. 22.

ANAD: see Anniston Army Depot.

Andersen, P., 2000, e-mail on noise associated with Tooele incineration from Andersen (EG&G Inc., Tooele, Utah) to Y.-S. Chang (Argonne National Laboratory, Argonne, Ill.), Oct. 4.

Anniston Army Depot, 1997, *Clean Air Act Title V Permit Application*, Directorate of Risk Management, Environmental Control & Engineering Division, Anniston, Ala., Dec. 15.

Anniston Army Depot, 1999, *Anniston Army Depot Integrated Solid Waste Management Plan*, Anniston, Ala., Oct.

Anniston Army Depot, 2000a, *Hazardous Waste Management Plan for Anniston Army Depot*, Anniston, Ala., Jan.

Anniston Army Depot, 2000b, *Anniston Army Depot, Anniston, Alabama*, fact sheet, http://www.anad.army.mil/RestorationAdvisoryBoard/index.htm, accessed in Aug. 2000.

Anniston Army Depot, undated, *Installation Compatible Use Zone (ICUZ) Analysis*, Anniston, Ala.

ATSDR: see Agency for Toxic Substances and Disease Registry.

Bailey, M.A., 1997, *Survey of the Breeding Birds of Anniston Army Depot, Alabama*, final report, prepared by the Nature Conservancy/Alabama Natural Heritage Program, Montgomery, Ala., for the U.S. Fish and Wildlife Service, Southeast Region, Atlanta, Ga.

Brown, L.N., 1997, *A Guide to the Mammals of the Southeastern United States*, The University of Tennessee Press, Knoxville, Tenn.

Burdell, A.L., 2000a, e-mail on Building 88 from Burdell (Anniston Army Depot, Anniston, Ala.) to T. Lindsey (Anniston Army Depot, Anniston, Ala.) and B.T. Verhaaren (Argonne National Laboratory, Argonne, Ill.), Sept. 28.

Burdell, A.L., 2000b, *Location of Maximum Inventories by Munition Type*, personal communication from Burdell (Anniston Army Depot, Anniston, Ala.) to M. Lazaro (Argonne National Laboratory, Argonne, Ill.), Aug.

Burdell, A.L., 2000c, *Development of an Environmental Impact Statement for the Potential Pilot-Scale Testing by the Program Manager Assembled Chemical Weapons Assessment (PMACWA)*, personal communication from Burdell (Anniston Army Depot, Anniston, Ala.) to M. Lazaro (Argonne National Laboratory, Argonne, Ill.), Sept. 4.

Burdell, A.L., 2000d, record of telephone conversation between Burdell (Anniston Army Depot, Anniston, Ala.) and T. Allison (Argonne National Laboratory, Argonne, Ill.), Aug.

Burns, W., 2000a, fax on tank firing range, site A building, from Burns (Anniston Army Depot, Anniston, Ala.) to C.L. Tsao (Argonne National Laboratory, Argonne, Ill.) Aug. 10.

Burns, W., 2000b, personal communication from Burns (Anniston Army Depot, Anniston, Ala.) to B.T. Verhaaren (Argonne National Laboratory, Argonne, Ill.), Aug. 31.

Burton, T.M., 2001, *Breathing Rates for Toxicity Data*, memorandum from Burton (U.S. Army Nuclear and Chemical Agency, Springfield, Va.) to Commander (Soldier and Biological Chemical Command, Aberdeen Proving Ground, Md.), May 24.

CBDCOM, 1997, *Solicitation No. DAAM01-97-R-0031*, U.S. Army Chemical and Biological Defense Command, Aberdeen Proving Ground, Md., Aug.

CDC: see Centers for Disease Control and Prevention.

Centers for Disease Control and Prevention, 1988, "Final Recommendations for Protecting the Health and Safety against Potential Adverse Effects of Long-Term Exposure to Low Doses of Agents: GA, GB, VX, Mustard Agent (H, HD, T) and Lewisite (L)," U.S. Department of Health and Human Services, *Federal Register* 53(50):8504–8507, March 15.

CEQ: see Council on Environmental Quality.

COE: see U.S. Army Corps of Engineers.

Corbitt, R.A., 1990, *Standard Handbook of Environmental Engineering*, McGraw-Hill, Inc.

Council on Environmental Quality, 1997, *Environmental Justice Guidance under the National Environmental Policy Act*, CEQ, Executive Office of the President, Washington, D.C., Dec.

Crawford, B., 2000, fax on Alabama student/teacher ratios from Crawford (Alabama Department of Education) to L. Nieves (Argonne National Laboratory, Argonne, Ill.), Sept.

Dawson, S.V., and G.V Alexeef, 2001, "Multi-Stage Model Estimates of Lung Cancer Risk from Exposure to Diesel Exhaust, Based on a U.S. Railroad Worker Cohort," *Risk Analysis* 21(1): 1–18.

DOI: see U.S. Department of the Interior.

Dye, D.H., 1984, *An Archeological Overview and Management Plan for the Anniston Army Depot, Calhoun County, Alabama*, DARCOM Report No. 26, prepared by Dye, Memphis State University, Memphis, Tenn., for Woodward-Clyde Consultants, Walnut Creek, Calif., for the National Park Service, Atlanta, Ga., for U.S. Army Material Development and Readiness Command, Sept. 24.

EPA: see U.S. Environmental Protection Agency.

Executive Order 13045, 1997, "Protection of Children from Environmental Health Risks and Safety Risks," *Federal Register* 62(78):19885–19888, Apr. 23.

FEMA: see Federal Emergency Management Agency.

Folga, S.M., 2001a, *Solid Process Waste Numbers for Incineration at ANAD and the PBA*, e-mail with attachments of spreadsheet calculations from Folga (Argonne National Laboratory, Argonne, Ill.) to file, Apr. 5.

Folga, S.M., 2001b, *Incinerator Utility Usage*, intraoffice e-mail from Folga to A.E. Smith and L.A. Nieves (Argonne National Laboratory, Argonne, Ill.), May 25.

Freeman, B., 2000, personal communication from Freeman (Anniston Army Depot, Anniston, Ala.) to T. Allison (Argonne National Laboratory, Argonne, Ill.), Sept. 25.

Freil, G.E., 1997, *Maximum Credible Events (MCE) for Daily Chemical Operations*, memorandum and attachments from Freil (U.S. Army Material Command, Alexandria, Va.) to various Army staff, Apr. 30.

GA Technologies, 1987, *Risk Analysis of the Continued Storage of Chemical Munitions, Chemical Stockpile Disposal Program*, SAPEO-CDE-IS-87009, prepared by GA Technologies, Inc., San Diego, Calif., for Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Aug.

General Atomics, 1999, *Assembled Chemical Weapons Assessment (ACWA) Draft Test Technical Report*, DAAM01-98-D-003 129300/0, San Diego, Calif., June 30.

Geonex Corporation, 1995, *National Wetlands Inventory, Mapping Report for United States Army, Anniston Army Depot*, prepared by Geonex, St. Petersburg, Fla., for U.S. Fish and Wildlife Service, St. Petersburg, Fla.

Godwin, J.C., et al., 1994, *Faunal and Floral Survey of Anniston Army Depot, and Coosa River Annex: Federal Endangered, Threatened, and Candidate Species*, prepared by Alabama Natural Heritage Program, Alabama Department of Conservation and Natural Resources, State Lands Division, Montgomery, Ala., for Anniston Army Depot, Anniston, Ala., June.

Goldman, L.E., 2000, letter from Goldman (U.S. Fish and Wildlife Service, Daphne, Ala.) to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), May 25.

Goodheer, I., 1994, *Dose Response Data for the Tooele Chemical Agent Disposal Facility Quantitative Risk Assessment (TOCDF QRA)*, memorandum from Goodheer (U.S. Army Nuclear and Chemical Agency, Springfield, Va.) to Commander (U.S. Army Chemical Materiel Destruction Agency, Aberdeen Proving Ground, Md.), June 13.

Harlin, W.V., and E.A. Perry, 1961, *Soil Survey, Calhoun County Alabama*, Series 1958, No. 9, U.S. Department of Agriculture, Soil Conservation Service, and Alabama Department of Agriculture and Industries, Alabama Agricultural Experiment Station, Sept.

Hightower, B.E., 1984, *Written Historical and Descriptive Data, Historic American Engineering Record, Anniston Army Depot*, HAER No. AL-10, prepared by Building Technology Incorporated for the Historic American Building Survey/Historic American Engineering Record, National Park Service, Washington, D.C.

Jordan, W.R., and T.G. Whitley, 1999, *Phase II Excavations of Field Site 1, Anniston Army Depot, Calhoun County, Alabama*, COESAM/PDER-98/013, prepared by Brockington and Associates, Inc., for U.S. Army Corps of Engineers, Mobile District, Mobile, Ala., and Anniston Army Depot, Anniston, Ala.

Kimmell, T.A., et al., 2001, *Technology Resource Document for the Assembled Chemical Weapons Assessment Environmental Impact Statement*, ANL/EAD/TM-101, Vols. 1–5 and errata, Argonne National Laboratory, Argonne, Ill.

Larkins, J., 2000a, *Emissions Summary Report, Anniston Army Depot (301-0023)*, e-mail with attachment from Larkins (Anniston Army Depot, Anniston, Ala.) to H. Hartmann (Argonne National Laboratory, Argonne, Ill.), Nov. 2.

Larkins, J., 2000b, *Existing Air Emissions at ANAD*, record of telephone conversation between Larkins (Anniston Army Depot, Anniston, Ala.) and Y.-S. Chang (Argonne National Laboratory, Argonne, Ill.), Nov. 27.

Lewis, J., 2000a, letter from Lewis (Alabama Department of Conservation and Natural Resources, Natural Heritage Section, Montgomery, Ala.) to C.L. Tsao (Argonne National Laboratory, Argonne, Ill.), Aug. 8.

Lewis, J., 2000b, *Sensitive Species DBF*, e-mail from Lewis (Alabama Department of Conservation and Natural Resources, Natural Heritage Section, Montgomery, Ala.) to C.L. Tsao (Argonne National Laboratory, Argonne, Ill.), Aug. 28.

Library of Congress, 2000, *HABS/HAER Field Notes*, e-mail from Library (Reference Section, Prints and Photographs Division, Washington, D.C.) to B.T. Verhaaren (Argonne National Laboratory, Argonne, Ill.), Nov. 15.

McCaleb, J.E., 1973, *Some Aspects of the Ecology and Life History of the Pygmy Sculpin*, Cottus pygmaeus Williams, *a Rare Spring Species of Calhoun County, Alabama* (Pisces: Cottidae), M.S. Thesis, Auburn University, Auburn, Ala., Dec. 12.

Mitretek, 2001a, *Estimates of Environmental Releases Associated with the Destruction of Assembled Chemical Weapons during Pilot Plant Testing of the Parsons Honeywell Neutralization/Biotreatment Process*, Mitretek Systems, Inc., McLean, Va., May.

Mitretek, 2001b, *Estimates of Environmental Releases Associated with the Destruction of Assembled Chemical Weapons during Pilot Plant Testing of the General Atomics Neutralization/Supercritical Water Oxidation Process*, Mitretek Systems, Inc., McLean, Va., May.

Mitretek, 2001c, *Estimates of Environmental Releases Associated with the Destruction of Assembled Chemical Weapons during Pilot Plant Testing of the Foster Wheeler-Ecologic-Kvaerner Neutralization/Supercritical Water Oxidation with Gas Phase Chemical Reduction Process*, Mitretek Systems, Inc., McLean, Va., May.

Mitretek, 2001d, *Estimates of Environmental Releases Associated with the Destruction of Assembled Chemical Weapons during Pilot Plant Testing of the AEA Technology Silver II Electrochemical Oxidation Process*, Mitretek Systems, Inc., McLean, Va., May.

Moser, P.H, and S.S. DeJarnette, 1992, *Ground-Water Availability in Calhoun County, Alabama*, Special Map 228, Geological Survey of Alabama.

Munro, N.B., et al., 1999, “The Sources, Fate, and Toxicity of Chemical Warfare Agent Degradation Products,” *Environmental Health Perspectives* 107(12):933-974, Dec.

National Oceanic and Atmospheric Administration, 1999, *Local Climatological Data: Annual Summary with Comparative Data for Birmingham Municipal Airport, Alabama*, National Climatic Data Center, Asheville, N.C.

National Research Council, 1997a, *Risk Assessment and Management at Deseret Chemical Depot and the Tooele Chemical Agent Disposal Facility*, prepared by National Research Council, Washington, D.C., published by National Academy Press, Washington, D.C.

National Research Council, 1997b, *Review of Acute Human-Toxicity Estimates for Selected Chemical-Warfare Agents*, prepared by Subcommittee on Toxicity Values for Selected Nerve and Vesicant Agents, Washington, D.C., published by National Academy Press, Washington, D.C.

National Research Council, 1999, *Review and Evaluation of Alternative Technologies for Demilitarization of Assembled Chemical Weapons*, Washington, D.C.

National Safety Council, 1999, *Injury Facts, 1999 Edition*, Itasca, Ill.

Neathery, T.L., et al., 1972, *Mineral Resources of Calhoun County, Alabama*, Circular 81, Geological Survey of Alabama.

Nieves, L., 2000, record of telephone conversations between Nieves (Argonne National Laboratory, Argonne, Ill.), and local government sources Joiner and Goodwin (Calhoun County), Cantrell (Anniston), Duremos (Hobson City), Sproull (Jacksonville, McDowell (Ohatchee), Wait (Oxford), Hendrix and Morgan (Piedmont), and Gokey (Weaver), Oct. 10.

NOAA: see National Oceanic and Atmospheric Administration.

Oliver, R., 2000, personal communication from Oliver (Alabama Department of Transportation) to T. Allison (Argonne National Laboratory, Argonne, Ill.), Dec.

Omernik, J.M., 1986, *Ecoregions of the United States*, Corvallis Environmental Research Laboratory, U.S. Environmental Protection Agency.

Operations Support Command, 2000, *Anniston Army Depot*, http://www.osc.army.mil/rm/oscfact/anad2.htm, accessed in Aug. 2000.

Opresko, D.M., et al., 1998, "Chemical Warfare Agents: Estimating Oral Reference Doses," in G.W. Ware (editor), *Reviews of Environmental Contamination and Toxicology*, Vol. 156, Springer-Verlag, New York, N.Y.

Pacific Northwest National Laboratory, 1999, land cover data from Federal Emergency Management Information System (FEMIS), a geographic information system, http://www.pnl.gov/femis/about/overview_146.htm.

Parker, P.L., 1995, *Guidelines for Evaluating and Documenting Traditional Cultural Properties*, National Register Bulletin 38, U.S. Department of the Interior, National Park Service, Washington, D.C.

Parsons and Allied Signal, 1999, *Assessment of Technologies for Assembled Chemical Weapon Demilitarization*, draft demonstration test final report, prepared by Parsons, Infrastructure & Technology Group, Inc., and Allied Signal for U.S. Army, Chemical and Biological Defense Command, July.

Phillips, A., 2000, *Hazardous Waste Generated in 1999 at ANAD,* record of telephone conversation between Phillips (Anniston Army Depot, Anniston, Ala.) and B. Wilkins (Argonne National Laboratory, Argonne, Ill.), Nov. 2.

PMACWA, 1999, *Assembled Chemical Weapons Assessment Program: Supplemental Report to Congress*, U.S. Department of Defense, Program Manager Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md., Sept. 30.

PMACWA, 2001, *Final Technical Evaluation: AEA Technology/CH2MHill SILVER II Electrochemical Oxidation, Foster Wheeler/Eco Logic International/Kvaerner Neutralization/ GPCR/TW-SCWO, Teledyne Commodore Solvated Electron Systems*, Appendix C in *Assembled Chemical Weapons Assessment Program: Supplemental Report to Congress*, June 2001, U.S. Department of Defense, Program Manager Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md., March.

Raytheon, 1996, *Johnston Atoll Chemical Agent Disposal System (JACADS) Human Health & Ecological Risk Assessment*, prepared by Raytheon Engineers & Constructors, Inc., Philadelphia, Penn., for U.S. Army Chemical Demilitarization and Remediation Activity, Aberdeen Proving Ground, Md., Dec. 30.

Reisz Engineers, 1998, *Red-Cockaded Woodpecker Endangered Species Survey for the U.S. Army Chemical and Military Police Centers and Fort McClellan*, prepared by Reisz, Huntsville, Ala., for Fort McClellan, Ala.

Reisz Engineers, 1999, *Pollination Biology of the Endangered Plant,* Xyris tennesseensis (Xyridaceae), prepared by Reisz, Huntsville, Ala., for Auburn University, Department of Botany and Microbiology, Auburn, Ala., Apr.

Rheams, K.F., 1992, *Mineral Resources of the Valley and Ridge Providence, Alabama*, Bulletin 147, Geological Survey of Alabama, Tuscaloosa, Ala.

Rheams, K.F., and K.E. Richter, 1988, *Tripoli Deposits in Northern Alabama — A Preliminary Investigation*, Circular 135, Geological Survey of Alabama, Tuscaloosa, Ala.

Rhodes, M., 2000, e-mail from Rhodes (University of Illinois, Urbana, Ill.) to Y.-S. Chang (Argonne National Laboratory, Argonne, Ill.), Sept. 1.

Ruffner, J.A. (editor), 1985, *Climates of the States: National Oceanic and Atmospheric Administration Narrative Summaries, Tables, and Maps for Each State with Overview of State Climatologist Programs,* 3rd ed., Gale Research Co., Detroit, Mich.

Runyan, J.L., 2000, *Profile of Hired Farmworkers, 1998 Annual Averages*, U.S. Department of Agriculture, Economic Research Service, Washington, D.C., http://www.ers.usda.gov/Publications/AER790/.

SAIC: see Science Applications International Corporation.

SBCCOM, 2000, *Anniston Chemical Activity*, Soldier and Biological Chemical Command, http://anniston.sbccom.army.mil/, accessed in Aug. 2000.

Science Applications International Corporation, 1997, *Anniston Chemical Agent Disposal Facility Phase 1 Quantitative Risk Assessment, Revision 1*, prepared by SAIC, Abingdon, Md., for U.S. Army, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., May.

Science Applications International Corporation, 1998, *Anniston Army Depot Southeast Industrial Area, Phase 2 Remedial Investigation*, preliminary draft report, prepared by SAIC, McLean, Va., for U.S. Army Corps of Engineers, Mobile District, Mobile, Ala.

Science Applications International Corporation, 2000, *Survey of Understory Vegetation, Small Mammals, and Herpetofauna at Anniston Army Depot, Anniston, Alabama*, final report, prepared by SAIC, Oak Ridge, Tenn., for U.S. Army Corps of Engineers, Mobile District, Ala., Oct.

SMG Marketing Group, Inc., 2001, data from Hospital Select web site, Chicago, Ill., http://www.hospitalselect.com.

Smith, A.E., 2001, record of telephone conversations on actions in Calhoun and Talladego Counties in the vicinity of Anniston Army Depot between Smith (Argonne National Laboratory, Argonne, Ill.) and various sources, Apr. 3.

Staub, W.P., 1991, "Nuclear Power Station Seismic Hazard Curves in the Eastern United States and the Uniform Building Code," *Bulletin of the Association of Engineering Geologists* 28(3):227–232.

Storm Prediction Center, 2000, *Historical Tornado Data Archive*, http://www.spc.noaa.gov/archive/tornadoes/index.html.

Suter, G.W., II, and C.L. Tsao, 1996, *Toxicological Benchmarks for Screening of Potential Contaminants of Concern for Effects on Aquatic Biota on Oak Ridge Reservation: 1996 Revision,* Oak Ridge National Laboratory, Oak Ridge, Tenn.

Technos Inc., 1985, *Investigation of Possible Paleochannels at the Anniston Army Depot, Anniston, Alabama*, prepared by Technos for Environmental Science and Engineering, Inc., Gainesville, Fla., and U.S. Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, Md.

Thompson, M.D., et al., 1999, *Seismic Characterization of the Karst Bedrock Surface in the Southeast Industrial Area at Anniston Army Depot, Alabama*, U.S. Army Environmental Center, Aberdeen, Md., http://AEC.army.mil/USAEC/restoration/geophysics.pdf01.

Transportation Research Board, 1985, *Highway Capacity Manual,* National Research Council, Washington, D.C.

Tsao, C.L., 2001a, *Calculation of Inhalation HQ of HD (Mustard Gas) for Terrestrial Wildlife Ecological Risk Assessment at Anniston Army Depot (ANAD),* intraoffice memorandum from Tsao to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), Jan. 15.

Tsao, C.L., 2001b, *Calculation of Inhalation HQ of GB (Sarin) for Federally Threatened and Endangered Species Ecological Risk Assessment at Anniston Army Depot (ANAD)*, intraoffice memorandum from Tsao to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), Jan. 15.

Tsao, C.L., 2001c, *Calculation of Inhalation HQ of VX for Federally Threatened and Endangered Species Ecological Risk Assessment at Anniston Army Depot (ANAD)*, intraoffice memorandum from Tsao to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), Jan. 15.

Tsao, C.L., 2001d, *Calculation of Inhalation HQ of HD (Mustard Gas) for Federally Threatened and Endangered Species Ecological Risk Assessment at Anniston Army Depot (ANAD)*, intraoffice memorandum from Tsao to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), Jan. 15.

Tsao, C.L., 2001e, *Calculation of Inhalation HQ of GB (Sarin) for Terrestrial Wildlife Ecological Risk Assessment at Anniston Army Depot (ANAD)*, intraoffice memorandum from Tsao to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), Jan. 15.

Tsao, C.L., 2001f, *Calculation of Inhalation HQ of VX for Terrestrial Wildlife Ecological Risk Assessment at Anniston Army Depot (ANAD),* intraoffice memorandum from Tsao to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), Jan. 15.

Tsao, C.L., 2001g, *Ecological Risk Assessment of Chemical Emissions from an ACWA Pilot Facility during Normal Operation for Anniston Army Depot (ANAD),* intraoffice memorandum from Tsao to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), Nov. 30.

USACHPPM: see U.S. Army Center for Health Promotion and Preventive Medicine.

U.S. Army, 1988, *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Jan.

U.S. Army, 1991, *Final Environmental Impact Statement for Disposal of Chemical Agents and Munitions Stored at Anniston Army Depot, Anniston, Alabama,* Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., May.

U.S. Army, 1995, *Natural Resource Management Plan for Anniston Army Depo*t, Apr. 5.

U.S. Army, 1997a, *Environmental Protection and Enhancement*, Army Regulation 200-1, Headquarters, Washington, D.C. Pg. 4-107.

U.S. Army, 1997b, *Revised Final Environmental Impact Statement for Disposal of Chemical Agents and Munitions Stored at Pine Bluff Arsenal, Arkansas,* Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Apr.

U.S. Army, 1998a, *Resource Conservation and Recovery Act Hazardous Waste Permit Application for the Department of the Army, Anniston Army Depot, Anniston, AL,* submitted by Anniston Army Depot, Anniston, Ala., to Alabama Department of Environmental Management, Montgomery, Ala.

U.S. Army, 1998b, *Integrated Natural Resources Management Plan, 1998–2002, Fort McClellan, Alabama*, prepared by Reisz Engineers, Huntsville, Ala., and Gene Stout and Associates, Loveland, Colo., for Directorate of the Environment, Fort McClellan, Ala., Oct. 1.

U.S. Army, 2000, Anniston Army Depot home page, www.anad.army.mil, accessed in Sept. 2000.

U.S. Army Center for Health Promotion and Preventive Medicine, 1999a, *Development and Derivation of Inhalation Benchmark Values for Wildlife: An Application to Identify Ecological Risk to Airborne Contaminants*, Study 87-1299-99, Health Effects Research Program, Toxicology Directorate, USACHPPM, Aberdeen Proving Ground, Md., Dec.

U.S. Army Center for Health Promotion and Preventive Medicine, 1999b, *Derivation of Health-Based Environmental Screening Levels for Chemical Warfare Agents*, Aberdeen Proving Ground, Md.

U.S. Army Corps of Engineers, 1984, *A Cultural Resource Survey of the M-55 Rocket Demilitarization Plant of the Anniston Army Depot, Calhoun County, Alabama*, Mobile District, Mobile, Ala., Jan. 17.

U.S. Army Corps of Engineers, 1991, *Cultural Resource Survey of the Demilitarization Project, Anniston Army Depot, Calhoun County, Alabama*, Mobile District, Feb.

U.S. Army Corps of Engineers, 1997, *Integrated Cultural Resources Management Plan, Anniston Army Depot, Calhoun County, Alabama*, prepared by the Environmental Resources Planning Section, Mobile District, for the Directorate of Risk Management, Anniston Army Depot, Anniston, Ala., May.

U.S. Bureau of Labor Statistics, 2001, *Local Area Unemployment Statistics,* Washington, D.C., ftp://ftp.bls.gov/pub/time.series/la/.

U.S. Bureau of the Census, 1991, *1990 Census of Population and Housing, Summary of Population and Housing Characteristics, Alabama,* Washington, D.C.

U.S. Bureau of the Census, 1992a, *1990 Census of Population and Housing, Summary of Social, Economic, and Housing Characteristics, Alabama,* Washington, D.C.

U.S. Bureau of the Census, 1992b, *1990 Census of Population and Housing*, data including STF 1 and STF 3a, http://factfinder.census.gov., accessed in Sept. 2000.

U.S. Bureau of the Census, 1992c, *County Business Patterns, 1990,* Washington, D.C., http://www.census.gov/ftp/pub/epcd/cbp/view/cbpview.html, accessed in Sept. 2000.

U.S. Bureau of the Census, 1994, *City and County Data Book, 1994,* Washington, D.C.

U.S. Bureau of the Census, 2000, *1997 Census of Governments*, Compendium of Public Employment,Washington, D.C., http://www.census.gov/ftp/pub/govs/www/cog.html.

U.S. Bureau of the Census, 2001a, *County Business Patterns, 1999,* Washington, D.C., http://www.census.gov/ftp/pub/epcd/cbp/view/cbpview.html, accessed in Sept. 2000.

U.S. Bureau of the Census, 2001b, *American FactFinder,* Washington, D.C., http://factfinder.census.gov.

U.S. Bureau of the Census, 2001c, *State and County Quickfacts,* Washington, D.C., http://quickfacts.census.gov/qfd/states/01000.html, accessed in Sept. 2001.

U.S. Bureau of the Census, 2001d, *Census 2000 Redistricting Data (Public Law 94-171) Summary File,* Washington, D.C., http://www.census.gov/clo/www/redistricting.html, accessed in Aug. 2001.

USDA: see U.S. Department of Agriculture.

U.S. Department of Agriculture, 1994, *Census of Agriculture 1992,* National Agricultural Statistics Service, Washington, D.C., http://www.nass.usda.gov/census/census92/agrimenu.htm.

U.S. Department of Agriculture, 1999, *Census of Agriculture 1997,* National Agricultural Statistics Service, Washington, D.C., http://www.nass.usda.gov/census/census97/volume1/vol1pubs.htm.

U.S. Department of Commerce, 2001, *Local Area Personal Income,* Bureau of Economic Analysis, Washington, D.C., http://www.bea.doc.gov/bea/regional/reis/.

U.S. Department of the Interior, 1986a, *Visual Resource Inventory*, BLM Manual Handbook H-8410-1, Bureau of Land Management, Washington, D.C., Jan.

U.S. Department of the Interior, 1986b, *Visual Resource Contrast Rating*, BLM Manual Handbook H-8431-1, Bureau of Land Management, Washington, D.C., Jan.

U.S. Environmental Protection Agency, 1974, *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, EPA-550/9-74-004, Washington, D.C.

U.S. Environmental Protection Agency, 1979, "Protective Noise Levels" (condensed version of *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, EPA/ONAC 550/9-74-004, March 1974), http://www.nonoise.org/library/levels/levels.htm.

U.S. Environmental Protection Agency, 1989, *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A),* EPA/540/1-89/002, Interim Final, Office of Emergency and Remedial Response, Washington, D.C., Dec.

U.S. Environmental Protection Agency, 1994, *Exposure Assessment Guidance for RCRA Hazardous Waste Combustion Facilities (Draft),* EPA 530/R-94/021, Office of Solid Waste, Washington, D.C.

U.S. Environmental Protection Agency, 1995, *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models,* EPA-454/B-95-003a and updated model (Version 00101), Office of Air Quality Planning and Standards, Research Triangle Park, N.C., Sept.

U.S. Environmental Protection Agency, 1997, *Exposure Factors Handbook*, EPA/600/P-95/002Fa, Office of Health and Environmental Assessment, Washington, D.C., Aug.

U.S. Environmental Protection Agency, 1998a, *Final Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses*, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency, 1998b, *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Peer Review Draft*, EPA/530/D-98/001A, July.

U.S. Environmental Protection Agency, 2000a, *Surface Meteorological Data,* Office of Air Quality Planning and Standards, Research Triangle Park, N.C., Support Center for Regulatory Air Models (SCRAM), TTNWeb, http://www.epa.gov/ttn/scram, accessed in Sept. 2000.

U.S. Environmental Protection Agency, 2000b, *National Emission Trends Inventory (NET 1996), County and Plant Emission Summaries,* Office of Air Quality Planning and Standards, Research Triangle Park, N.C., Regional Transport Office (RTO), TTNWeb, http://www.epa.gov/ttn/rto/areas/net.htm, accessed in Oct. 2000.

U.S. Environmental Protection Agency, 2000c, *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources,* Office of Air Quality Planning and Standards, Research Triangle Park, N.C., Clearinghouse for Inventories and Emission Factors (CHIEF), TTNWeb, http://www.epa.gov/ttn/chief/ap42/index.htm.

U.S. Environmental Protection Agency, 2000d, *Documentation for the 1996 Base Year National Toxics Inventory for Nonroad Vehicle and Equipment Mobile Sources,* prepared by Eastern Research Group, Inc., Morrisville, N.C., for EPA, Emissions Monitoring and Analysis Division, Research Triangle Park, N.C., June 2.

U.S. Environmental Protection Agency, 2000e, *Technical Support Document: Control of Emissions of Hazardous Air Pollutants from Motor Vehicles and Motor Vehicle Fuels,* EPA-420-R-00-023, Office of Air Radiation, Dec.

U.S. Environmental Protection Agency, 2001, *AIRData*, *Monitor Values Report*, Office of Air Quality Planning and Standards, Research Triangle Park, N.C., http://www.epa.gov/air/data/monvals.html, accessed in Apr. 2001.

USFS: see U.S. Forest Service.

U.S. Forest Service, 1994, *Talladega Ranger District*, *Shoal Creek Ranger District*, *Talladega National Forest, Timber Stands*, data from geographic information system, U.S. Department of Agriculture, Forest Service, Southern Region, Geographic Data Center, Alabama, http://www.r8web.com/gis/alabama/default.htm.

USGS: see U.S. Geological Survey.

U.S. Geological Survey, 1998, *Timber Land Tracts*, geospatial data for Anniston Army Depot supplied by W. Burns, Anniston Army Depot, Anniston, Ala.

U.S. Geological Survey, 2000, *Earthquake History of Alabama*, National Earthquake Information Center, World Data Center for Seismology, Denver, Colo., http://wwwneic.cr.usgs.gov/neis/states/alabama/alabama_history.html, accessed on July 27, 2000.

U.S. Navy, 1998, *Best Manufacturing Practices: Report of Survey Conducted at Anniston Army Depot*, *Anniston*, *AL*, prepared by Office of Naval Research, Best Manufacturing Practices (BMP) Center of Excellence, College Park, Md., Apr., http://www.bmpcoe.org/bestpractices/internal/anad/.

Whatley, S., 2000, personal communication from Whatley (Anniston Army Depot, Anniston, Ala.) to T. Allison (Argonne National Laboratory, Argonne, Ill.), June.

Whelan, D.C., et al., 1997, *Historic Context for Department of Defense World War II Permanent Construction*, prepared for R. Christopher Goodwin Associates Inc., Frederick, Md., for U.S. Army Corps of Engineers, Baltimore District, Baltimore, Md., June.

Whitacre, G.C., et al., 1987, *Personal Computer Program for Chemical Hazard Prediction (D2PC)*, CRDEC-TR-87021, U.S. Army, Armament Munitions Chemical Command, Chemical Research, Development, and Engineering Center, Aberdeen Proving Ground, Md., Jan.

Yankee Atomic Electric Company, 1994, *Probabilistic Seismic Hazard Evaluation for the Anniston Alabama Chemical Agent Disposal Facility*, Boston, Mass.

5 PINE BLUFF ARSENAL (PBA), ARKANSAS

5.1 INTRODUCTION

PBA is located in Jefferson County, Arkansas, approximately 30 mi (50 km) south and slightly east of the capital of Little Rock (Figure 5.1-1). PBA is about 15,000 acres (6,000 ha) (U.S. Army 1997) in size. The U.S. Food and Drug Administration (FDA), National Center for Toxicological Research (NCTR), which employs 670 workers, occupies an area located adjacent to the northern portion of PBA that is approximately 500 acres (200 ha) in size.

5.1.1 Potential Sites and Facility Locations

The three potential areas selected for the proposed ACWA pilot facility at PBA are located in the northern part of the arsenal, near the chemical storage area. They are shown in Figure 5.1-2. All three proposed areas are located in relatively flat terrain; the topography in these areas is flat to gently rolling hills. These areas were chosen on the basis of their suitability for construction, access to the chemical storage area, and nearness to other structures and boundaries, and the availability of required utilities.

Area A is located adjacent to the chemical storage area. This potential construction area is wooded and about 25 acres (10 ha) in size. It is about 0.8 mi (1.3 km) from the western boundary of PBA and about 2 mi (3 km) from the U.S. Army Program Manager for Chemical Demilitarization (PMCD) Pine Bluff Chemical Demilitarization Facility (PBCDF).

Area B is approximately halfway between the chemical storage area and the PBCDF. This potential construction area is not wooded and is about 34 acres (14 ha) in size. It is about 1.5 mi (2.5 km) from the western boundary of PBA and about 1.5 mi (2.5 km) from the PBCDF. It is about 0.7 mi (1 km) from the chemical storage area and approximately 0.4 mi (0.6 km) from the NCTR located on the northern boundary of PBA.

Area C was originally identified as a potential location for an ACWA facility because of its proximity to both the chemical storage area and existing utilities. However, Area C is no longer being considered in this document because it has been identified as a location for a potential nonstockpile demilitarization facility.

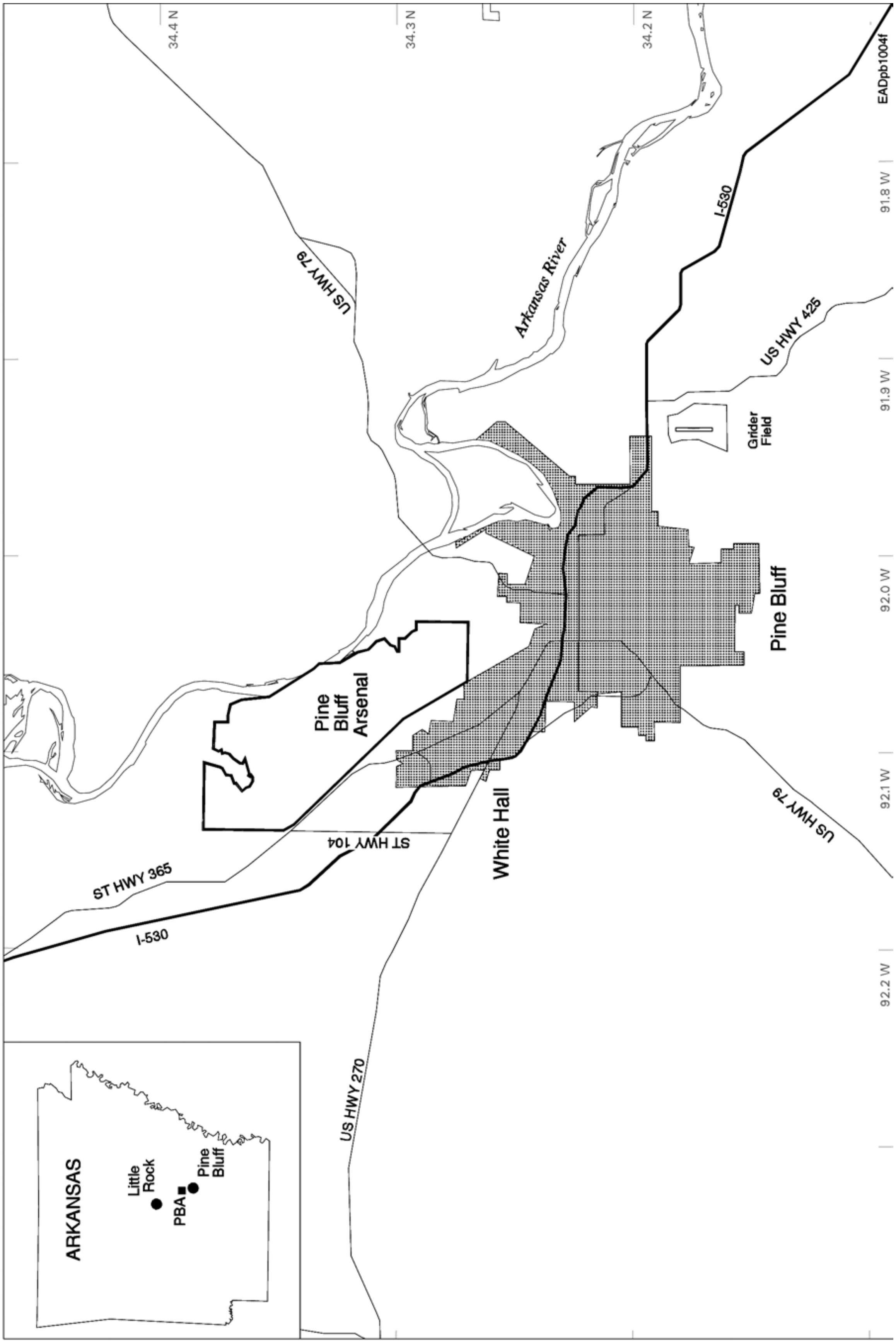

FIGURE 5.1-1 Location of PBA

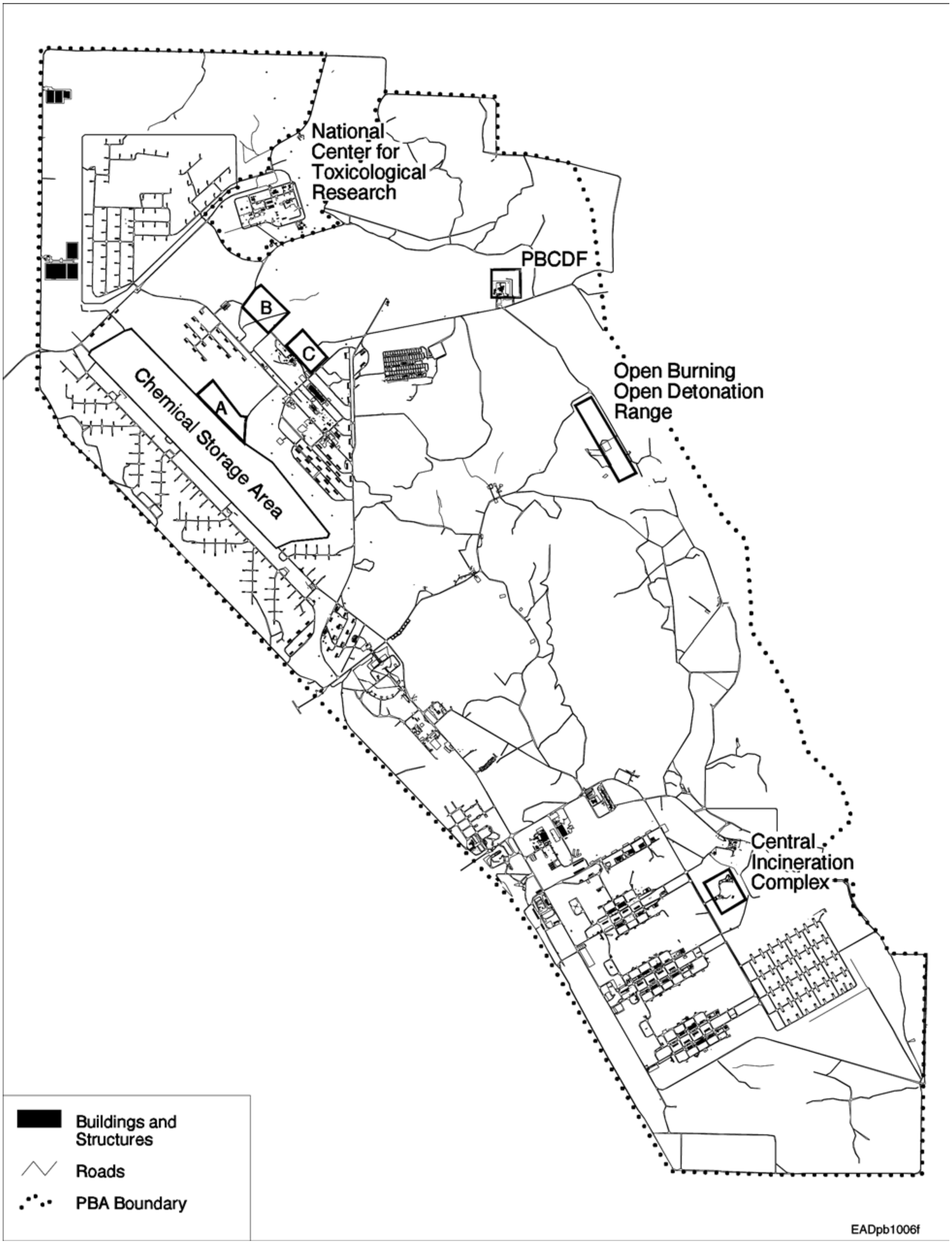

FIGURE 5.1-2 Existing Facilities and Potential Locations for the Proposed ACWA Pilot Test Facility at PBA

5.1.2 Munitions Inventory

Chemical agents stored at PBA include both nerve and blister agents; however, only nerve agent munitions are present as assembled chemical weapons (ACWs). Table 5.1-1 lists the current assembled chemical munitions inventory at PBA, which consists of the nerve agents GB (sarin) and VX. The stockpile is stored in two basic configurations, mines and rockets. Both configurations contain chemical agent and propellants and/or explosives. All munitions that contain propellant or explosives are stored inside earth-covered concrete igloos. Access is restricted by redundant systems, and each igloo has an intrusion detection system.

The chemical munitions undergo routine inspection and inventory in accordance with applicable Army regulations and guidelines. In addition to the Army regulated inspection and maintenance, igloos are monitored regularly in accordance with applicable U.S. Environmental Protection Agency (EPA) regulations. This monitoring may occur, depending on the item stored, quarterly, monthly, or weekly.

Small quantities of stored chemical munitions (mostly M55 rockets) have begun to leak. If a leaking munition is detected, it is identified and removed from the surrounding munitions; the surrounding munitions and area are then decontaminated. The leaking munition is placed into a munition-specific steel overpack and moved to an isolation igloo approved under the *Resource Conservation and Recovery Act* (RCRA). This procedure provides a high degree of assurance that agent will be contained, even if the munition continues to leak.

TABLE 5.1-1 Assembled Chemical Weapons Inventory at PBA[a]

Type of Munition	Total No. of Munitions	Agent	Total Weight (lb)
M55 rockets	90,231	GB	965,480
M55 rockets	19,582	VX	195,820
M56 rockets	178	GB	1,900
M56 rockets	26	VX	260
M23 land mines	9,378	VX	99,460

[a] Unit conversion: 1 lb = 0.45 kg.

Source: Modified from U.S. Army (1997).

5.2 LAND USE

5.2.1 Installation History and Uses

5.2.1.1 History

PBA was established in November of 1941 as the Chemical Warfare Arsenal, Pine Bluff, Arkansas. Construction of (1) facilities for the manufacture, loading, and assembly of incendiary and chemical munitions; (2) storage bunkers; (3) laboratories; and (4) associated administration and support facilities began in December. The arsenal was designated Pine Bluff Arsenal (PBA) in March of 1942, and the headquarters was moved from the city of Pine Bluff to PBA in April of the same year.

Initial production began in July 1942 with an incendiary grenade (AN M14). Production expanded during World War II to include bulk chemical agent production and filling of various chemical munitions (incendiary, smoke, and other types). Between 1945 and the Korean Conflict, PBA's main mission was maintenance of chemical supplies and equipment, industrial mobilization planning, and demilitarization. During the Korean Conflict, industrial operations at PBA expanded from the 24 different end items produced at the end of World War II to 38 different end items.

In 1953, biological warfare facilities were completed at PBA and designated as the Production Development Laboratories. In 1957, these facilities were added as a mission element of PBA under the designation Directorate of Biological Operations. PBA was also selected for BZ munition production, and the production facility was completed in 1962.

In November 1969, a Presidential Executive Order discontinued the U.S. biological warfare effort and production of biological warfare munitions. Demilitarization of all inventories of antipersonnel biological agents and munitions was completed at PBA in January 1972. The facilities used for the biological warfare mission were transferred to the FDA, which currently operates them as the NCTR.

In 1976, a program was initiated to dispose of the chemical agent BZ. Operation of this demilitarization facility began in 1988, and demilitarization of the chemical agent BZ at PBA was complete in 1990. An area adjacent to the BZ demilitarization site is currently being used for construction of the PBCDF for demilitarization of stockpiled chemical weapons stored at PBA.

PBA was selected as the sole site for the Binary Production Facilities in 1978, and the program was active until 1990.

5.2.1.2 Current Mission

PBA serves as the Group Technology Center for Illumination and Infrared Munitions, serves as the Specified Mission Facility for smoke munitions, and maintains the sole U.S. capability for white phosphorus fill. PBA produces and demilitarizes conventional ammunition, and Pine Bluff Chemical Activity (PBCA) supports the storage and destruction of the second largest stateside chemical weapons stockpile. PBA is currently the only installation east of the Rocky Mountains permitted for acceptance of nonstockpile chemical munitions (Industrial Operations Command [IOC] 2000).

PBA operates a Central Incinerator Complex (CIC) that includes a RCRA-permitted rotary deactivation furnace (RDF) and a fluidized-bed incinerator. It also includes a car-bottom furnace that is not RCRA-permitted for hazardous waste. The RDF is currently used to process nonhazardous munitions from the production facilities that do not meet specifications (e.g., smoke grenades, tear agent [CS]). The RDF and the car-bottom furnace share an afterburner and pollution abatement system. The fluidized-bed incinerator, which is used to process nonhazardous liquid and dry bulk wastes (e.g., solvents, smoke mixes, CS/tear agent), has its own pollution abatement system. The two pollution abatement systems use the same stack (U.S. Army 1997). The RDF and the fluidized-bed incinerator were permitted through RCRA in 1989; however, they have operated intermittently since that time to process only nonhazardous wastes.

PBCA supports the enforcement of international treaty efforts through compliance and education of worldwide inspectors. It is the Joint Services Center of Expertise for Chemical/Biological Defensive Equipment, where it supports production, maintenance, testing, certification, and training. It also offers design agencies support in development, engineering, prototype production, testing, and demonstration. PBA promotes environmental excellence through hazardous material and waste management programs.

The U.S. Army Soldier and Biological Chemical Command (SBCCOM) assumed operational control of PBA on October 1, 1999, and assumed full command and control on October 1, 2000 (IOC 2000).

5.2.2 Current and Planned On-Post Land Use

Table 5.2-1[1] lists the current land use classes and the approximate acreage devoted to their use at PBA. Land use at PBA consists of family and troop housing, recreation facilities,

---

[1] After this document was developed, PBA transferred two parcels of land with a total area of approximately 1,500 acres (607 ha) to The Alliance, a nonprofit corporation dedicated to economic development in the PBA area. These two parcels are located immediately to the west and east of the NCTR. The discussions in this chapter do not include this information.

TABLE 5.2-1 Land Use at PBA

Land Use	Approximate Area (acres)	Percentage of Total Area
Family and troop housing	127	1.0
Community facilities and recreation	499	3.8
Administration, operational facilities, and outleased land	154	1.2
Maintenance and production		
Nontoxic	878	6.8
Toxic	NA[a]	NA
Supply and storage		
Nontoxic	2,595	20.0
Toxic	514	4.0
Open space/clearance zones	7,673	59.1
Utilities and pollution abatement	302	2.3
Security	245	1.9

[a] Not applicable; currently, there are no toxic production areas.

Source: Adapted from U.S. Army (1997).

maintenance and production areas, supply and storage areas, open space, utilities, security, and the NCTR area. In general, production areas are located in the south, storage is in the north, and administration and housing are in the west-center portions of PBA. The PBCDF is currently under construction in the northeast portion of the installation, east of the chemical storage areas. Testing was scheduled for 2001, with operation beginning in 2003 and closure by 2007.

PBA is accessed by Interstate 530 (I 530) from the north or south. State Route (SR) 256 is a direct connector from I 530 to Plainview Gate, and SR 365 parallels the west boundary of PBA and provides access to Plainview, Dexter, and Stark Gates.

The majority of the installation's current total of 15,000 acres (6,000 ha) is designated as open space and clearance zones (Table 5.2-1; Figure 5.2-1). Other dominant uses include supply and storage (about 22% of the total area) and maintenance and production (roughly 6% of the total).

The chemical weapons stockpile is located on about 436 acres (175 ha) in the northwestern portion of PBA (see Figure 5.1-2) (U.S. Army 1997). About 3,850 tons of chemical weapons are stored at the installation (IOC 2000). The storage facilities consist of 66 igloos constructed of steel-reinforced concrete and are dedicated to storing chemical weapons.

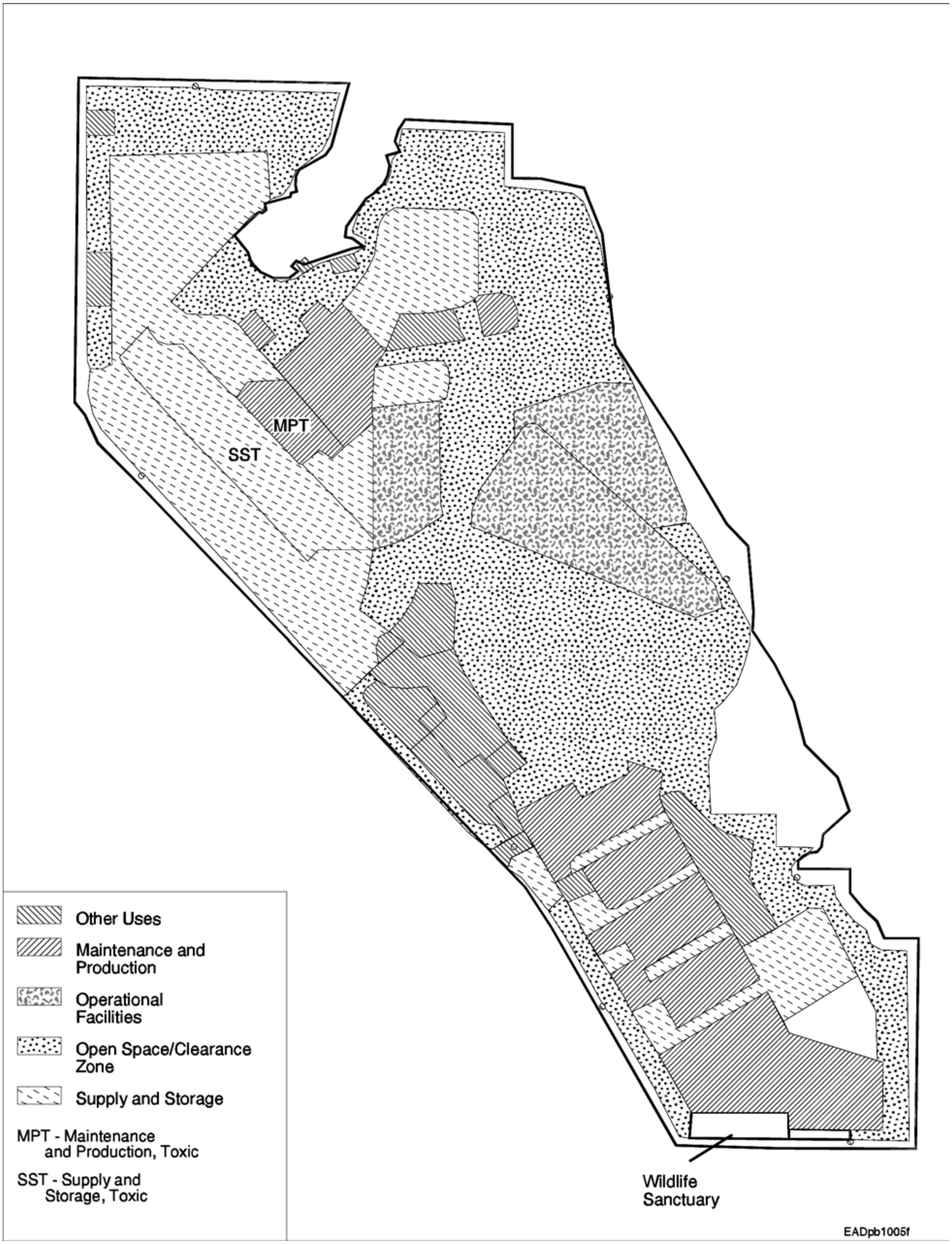

FIGURE 5.2-1 Land Use at PBA

Future land use at PBA is anticipated to remain generally the same as it is now. The land should provide a rural arsenal setting for the supply, storage, manufacturing, and maintenance of munitions and assorted administrative and operational facilities to support this general mission. The majority of the installation's land surface is expected to remain open space. The amount of PBA designated for chemical weapons storage is expected to decline as chemical demilitarization activities take place over the coming years.

5.2.3 Current and Planned Off-Post Land Use

PBA lies in Jefferson County, Arkansas, about 30 mi (48 km) southeast of Little Rock and roughly 8 mi (13 km) northwest of Pine Bluff, Arkansas. Communities closest to the installation include Pine Bluff, White Hall, Dexter, and Jefferson, Arkansas.

The northern boundary of PBA borders privately owned agricultural and timber lands with scattered residences. The town of Redfield, with a population of about 1,100, is located 5 mi (8 km) northwest of the PBA boundary. The NCTR is on the northeast boundary. The southern boundary borders developed and undeveloped industrial property. The University of Arkansas, Pine Bluff, is located 2 mi (3 km) to the southeast. The eastern boundary of PBA is the Arkansas River. The western boundary adjoins the Union-Pacific Railroad right-of-way, residential properties, and the town of Whitehall, with approximately 5,000 residents. Land use in these adjacent, off-post areas is expected to continue to follow current trends during the proposed period of operation of an ACWA pilot facility. No major construction activities or land use changes are anticipated; none were noted at the public meetings by PBA personnel, or by the Chemical Stockpile Emergency Preparedness and Planning (CSEPP) office.

Land use immediately to the east and north of PBA is primarily rural; the area is known for agricultural crops and livestock including soybeans, rice, wheat, hay, cotton, and beef cattle (SBCCOM 2000b). Agricultural area is interspersed with areas of residential use (communities and isolated residences) and mixed forest. To the west and south are built-up bedroom communities and a major urban area, the city of Pine Bluff. In 1997, Jefferson County contained 362 farms covering 288,635 acres (116,811 ha) (U.S. Department of Agriculture [USDA] 1999a). Cropland on these farms totaled 258,344 acres (104,552 ha), with the remaining 30,291 acres (12,259 ha) used mainly for grazing. Substantial changes in land use near the installation are not anticipated in the immediate future.

5.2.4 Impacts on Land Use

5.2.4.1 Impacts of the Proposed Action

The proposed ACWA testing facility at PBA would have negligible effects on both on- and off-post land use. Proposed ACWA pilot testing activities at PBA would be conducted within the portion of the installation that has been reserved for chemical weapon activities. Impacts on land use within the installation are expected to be negligible. Impacts from normal operations at the proposed ACWA pilot testing facility would be consistent with current and past installation use, and they would not significantly adversely affect those continuing installation operations.

Impacts on off-post land use as a result of normal construction and operations also are expected to be negligible. Any releases of chemical agents that could occur would be of such a small magnitude that they would cause no impacts off the installation. Impacts on more distant land use patterns in the community of Pine Bluff and other, closer communities would be reduced in correspondence to their distance from the installation.

5.2.4.2 Impacts of No Action

Under the no action alternative, storage of chemical stockpile components at PBA would continue. Land use in the immediate storage area, already identified for activities associated with chemical weapons, similarly would continue.

5.3 INFRASTRUCTURE

Utilities (electric power, water, sewer, and natural gas) are located within less than 1 mi (1.6 km) of either Area A or Area B. Figure 5.3-1 shows the corridors that would most likely be used to provide utilities for Areas A and B. Electric power transmission lines would be constructed from an existing substation, while water, sewer, and gas lines would be constructed from existing utilities located at the Binary Production Facilities. Utility corridors would generally follow existing roadways and, wherever possible, be constructed in previously disturbed areas. Table 5.3-1 lists an upper bound estimate of the area that would be disturbed during construction of these utility access corridors. For these estimates, it was assumed that (1) the water/sewer/gas/communications corridor would be 60 ft (20 m) wide and the entire corridor width would be disturbed during construction, (2) the power line corridor would be 30 ft (10 m) wide and the entire corridor width would be disturbed during vegetation clearing, and (3) the access road would be 50 ft (15 m) wide. The same amount of area would be disturbed by installation of the utility corridors for any of the ACWA technologies.

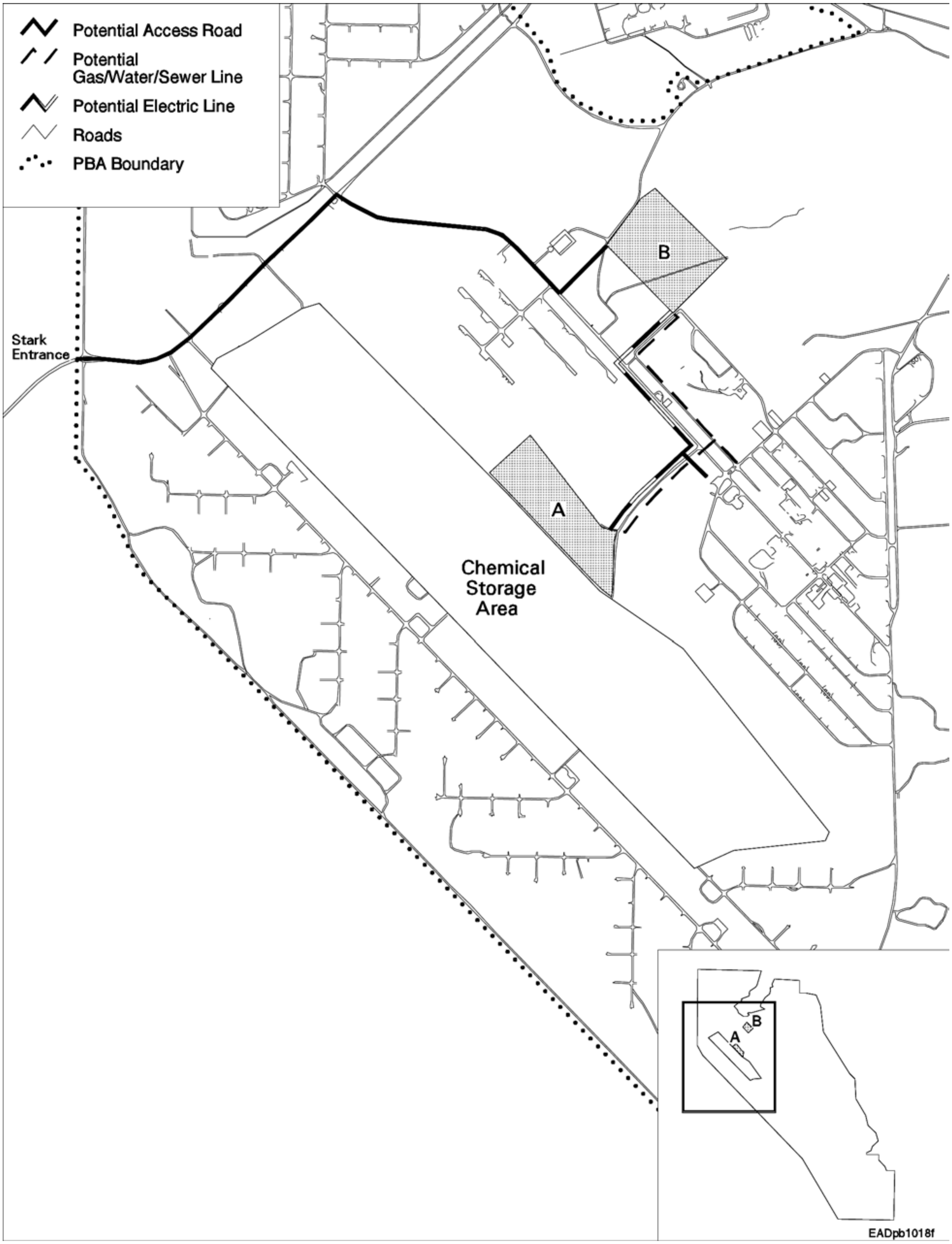

FIGURE 5.3-1 Proposed Utility and Road Access Corridors for the ACWA Pilot Facility at PBA

TABLE 5.3-1 Estimated Land Area Disturbed for Construction of an ACWA Pilot Test Facility and Associated Infrastructure at PBA[a]

	Area Disturbed (acres)	
Construction Activity	Area A	Area B
Pilot facility	25	25
Electric power	2.3	3.5
Water/sewer/gas/communications	2.5	7.0
Access road	0	1.3

[a] Unit conversion: 1 acre = 0.4 ha.

5.3.1 Electric Power

5.3.1.1 Current Supply and Use

The current electric power supplier is Entergy Systems. It has sufficient capacity to meet current and projected needs at PBA. Current electric power usage at PBA is 26,700 MWh/yr.

5.3.1.2 ACWA Pilot Facility Requirements

Table 5.3-2 lists the electric power requirements for each of the ACWA technologies. Electricity use would range up to 120 GWh/yr. The estimated power requirement for the PBCDF currently under construction is 36 GWh/yr.

5.3.1.3 Impacts of the Proposed Action

The electric power needs of the ACWA pilot test facility would be met by a power line from an existing substation located south of the chemical storage area. It is also possible that a new high-voltage line could be constructed from an Arkansas Power and Light transmission line. Any of the proposed technologies would require additional electric transmission lines to be constructed. Figure 5.3-1 shows the assumed utility corridors for both Areas A and B, and Table 5.3-1 lists the estimated areas that would be disturbed by this construction. Impacts on the existing electric power infrastructure would be negligible.

TABLE 5.3-2 Approximate Annual Utility Demands for Operation of an ACWA Pilot Test Facility at PBA[a]

	Annual Demand		
Utility	Neut/SCWO	Neut/GPCR/ TW-SCWO	Elchem Ox
Electric power (GWh)	60	26	120
Natural gas (scf)	52,000,000	140,000,000	48,000,000
Fuel oil (gal)	48,000	48,000	48,000
Process water (gal)	6,100,000	18,000,000	900,000
Potable water (gal)	5,500,000	6,400,000	6,400,000
Sewage (produced) (gal)	7,500,000	7,500,000	7,500,000

[a] Neut/Bio was not considered because it does not work with nerve agent, and because there is no mustard agent in ACWs at PBA. Unit conversions: 1 scf (standard cubic foot) = 0.028 Nm^3. 1 gal = 3.8 L.

5.3.1.4 Impacts of No Action

There would be no impact on the electric power infrastructure from the no action alternative.

5.3.2 Natural Gas

5.3.2.1 Current Supply and Use

The natural gas supplier for PBA is Reliant Energy. It has sufficient capacity to meet current and projected needs at PBA. Current natural gas usage at PBA is approximately 45 million scf.

5.3.2.2 ACWA System Natural Gas Requirements

Table 5.3-2 lists the natural gas requirements for each of the ACWA technologies. Annual natural gas use would range from 48 million scf for Elchem Ox to 140 million scf for Neut/GPCR/TW-SCWO.

5.3.2.3 Impacts of the Proposed Action

The natural gas power needs of the ACWA facility would be met by a gas line from the Binary Production Facilities located southeast of the chemical storage area. Natural gas consumption for a full-scale pilot ACWA facility would be similar to that for the PBCDF currently under construction. Current plans are for the PBCDF to cease operations before the proposed ACWA pilot plant is operational, which would make the natural gas resources it used available for the ACWA facility. However, even if the PBCDF and proposed ACWA facility operated concurrently, the existing infrastructure would be adequate to supply them as long as new supply lines were added.

The proposed ACWA facility would require additional natural gas pipelines to be built. Figure 5.3-1 shows the assumed utility corridors for both Areas A and B, and Table 5.3-1 lists the estimated areas that would be disturbed by this construction. Impacts from this construction on the existing natural gas infrastructure would be negligible.

5.3.2.4 Impacts of No Action

There would be no impacts on the natural gas infrastructure from the no action alternative.

5.3.3 Water

5.3.3.1 Current Supply and Use

Water at PBA is supplied by 12 on-post wells (U.S. Army 1997). These 12 wells have a combined maximum short-term production of 20.7 million gal/d (78,000 m^3/d) (U.S. Army 1997). Current water usage at PBA is approximately 900,000 gal/d (3,400 m^3/d) or 319 million gal/yr (1.2 million m^3/yr). The PBCDF currently under construction is estimated to require an additional average of 145,000 gal/d (53 million gal/yr) with peak usage of about 370,000 gal/d (1,400 m^3/d) or 135 million gal/yr (500,000 m^3/yr) (U.S. Army 1997).

5.3.3.2 ACWA Pilot Facility Requirements

The proposed ACWA facilities would require additional water supply lines to be built. Figure 5.3-1 shows the assumed utility corridors for both Areas A and B, and Table 5.3-1 lists the estimated areas that would be disturbed by this construction.

Table 5.3-2 lists the amounts of water (potable and process) that each of the proposed ACWA technologies would use during normal operations and the amounts of sewage each one would generate. Water use for the ACWA technologies would range from about 7 million gal/yr (2,000 m^3/yr) for Elchem Ox to 24 million gal/yr (91,000 m^3/yr) for Neut/GPCR/TW-SCWO. This usage represents an increase of 2.2 to 7.5% over existing water use, depending on the technology. The current water supply infrastructure at PBA would be sufficient to meet these needs.

Potable water lines and connections to the sewage treatment system would be available to both Areas A and B from existing lines and connections built to supply the Binary Production Facilities. Construction of additional pipelines would be required to provide these utilities to the proposed areas. The length of additional pipeline for Area A would be about 0.6 mi (1 km) and for Area B would be about 0.9 mi (1.5 km).

5.3.3.3 Impacts of the Proposed Action

The existing water supply systems would be sufficient to meet the needs of any of the proposed ACWA pilot facilities. The needs of an ACWA facility would represent only a small fraction of the current capacity of the system. Impacts from any of the ACWA technologies would be negligible. In addition, the PBCDF is currently scheduled to finish operating before an ACWA pilot plant would begin full-scale pilot testing. Thus, the additional water supply system currently being constructed for the PBCDF would be available to meet the needs of the ACWA pilot test facility.

Construction of an ACWA facility would require water for numerous uses including washing, dust control, preparation of concrete, and fire control. These needs have not been estimated quantitatively, but experience at PBA with construction activities of similar size has shown that the wells would be adequate and that impacts on the water supply would be negligible. Impacts on the sewage treatment infrastructure from construction activities would be negligible as well. Minor local disruptions in supply could occur when the ACWA facility was being connected to the existing infrastructure. However, this type of common disruption would be minor and short-lived.

Operations of the proposed ACWA pilot facility would have a negligible impact on the water supply systems. Even if the PBCDF was still in operation when full-scale ACWA pilot testing began, the water supply at PBA would be sufficient to meet both ACWA and PBCDF needs. Operations of the ACWA facility would have a negligible impact on water supply.

Sewage treatment facilities would be sufficient to meet the additional need of a proposed ACWA pilot facility. Construction and operation of the facility would have a negligible impact on the sewage treatment infrastructure.

The existing water supply system would not be able to provide enough water for fire fighting and other potential emergency response needs. To meet such emergency needs, the ACWA facility would be provided with a storage tank of sufficient capacity.

There would be no off-post impacts on the water supply or sewage treatment infrastructure from construction and operation of an ACWA pilot facility. PBA water and sewage infrastructure are self-contained.

5.3.3.4 Impacts of No Action

There would be no impacts on the water use and supply infrastructure from the no action alternative.

5.3.4 Communications

5.3.4.1 Current System

No information was available.

5.3.4.2 ACWA Pilot Test Facility Requirements

It is assumed that extension of the existing communications system to the proposed areas for a pilot facility would be required.

5.3.4.3 Impacts of Proposed Action

Extending the communications system would be unlikely to have any adverse impacts.

5.3.4.4 Impacts of No Action

No impacts on the communications system are likely from the no action alternative.

5.4 WASTE MANAGEMENT

This section presents the potential environmental consequences on waste management at PBA from siting, constructing, and operating an ACWA pilot test facility as well as the consequences from following the no action alternative. Included is a description of the environmental impacts at PBA from current waste management activities.

At PBA, an incinerator that will be used to destroy some or all of the chemical munitions held in inventory at the installation is currently under construction. For the purposes of this environmental impact statement (EIS), the discussion of the affected environment at PBA assumes that the incinerator is being built. Impacts from the ACWA pilot test facility discussed under the proposed action consider an operational incinerator as part of the environmental background.

5.4.1 Current Waste Generation and Management

5.4.1.1 Hazardous Wastes

PBA generates a variety of hazardous wastes associated with its missions for the Army. Most of these hazardous wastes are packaged and transported off post to appropriately permitted treatment and disposal facilities. The principal activities that are sources of these hazardous wastes at PBA include the following:

- Vehicle maintenance (used oil, batteries, coolant, degreaser, etc.),
- Facility maintenance (paints, solvents, water conditions, etc.),
- Chemical agent decontamination (field test materials, toxic chemical analysis agents, personal protective equipment [PPE], etc.),
- Conventional munitions management (spent and rejected munitions, contaminated filters, explosive residues, etc.), and
- Hazardous material management (organic and inorganic laboratory packs, other laboratory wastes, etc.).

Hazardous wastes accumulated at the generation points at PBA are transferred to the hazardous waste storage facility for further storage (up to 90 days) awaiting off-site transport. Various types of waste requiring some type of treatment (e.g., dewatering, shredding, incineration, etc.) can be stored in RCRA-permitted storage buildings (i.e., solid hazardous waste storage facility, liquid hazardous waste storage facility, phosphorus storage facility, waste container magazine, etc.) until such treatment is obtained. most of the wastes generated at PBA are collected and disposed of off post in accordance with the U.S. Army, state, and federal regulations. Any waste listed as hazardous in the RCRA regulations is stored, treated, and disposed of in appropriately permitted facilities as prescribed by the EPA and applicable state and local regulations.

PBA also maintains RCRA Subpart X interim status for a waste volume reduction unit (WVRU), used to reduce the volume of different types of waste and segregate them, and an open burning and open detonation area for treatment of reactive wastes, such as unserviceable and obsolete munitions and explosives that cannot be processed by any other means. PBA also maintains an Arkansas-permitted hazardous waste landfill (PBA 2000). This facility is used for disposal of remedial action waste from PBA's RCRA Corrective Action Program. It is also used for disposal of various pyrotechnic production wastes, demilitarization wastes, and industrial treatment plant sludge obtained from PBA. PBA also operates its Central Incinerator Complex, which includes a rotary deactivation furnace and a fluidized-bed incinerator (see Section 5.2.1.2). Although this unit was permitted to process RCRA hazardous wastes, it is currently used only intermittently to burn nonhazardous wastes.

PBA has a hazardous waste management plan that outlines the treatment and management of hazardous wastes at the site (PBA 1999). This plan describes the procedures, policies, and responsibilities for hazardous waste management activities, such as the waste identification, handling, storage, treatment, and disposal tasks performed at the installation. The plan is designed to ensure that the hazardous waste tasks performed at the installation comply with applicable federal, state, local, and Army regulations. An incinerator for the destruction of chemical agents and munitions stored in inventory at PBA is now being built at PBA. This treatment facility, upon completion, will generate many wastes for disposal at off-site permitted treatment, storage, and disposal facilities (TSDFs).

5.4.1.2 Nonhazardous Wastes

PBA generates a wide variety of nonhazardous solid wastes, such as office trash, scrap wood, industrial and demolition wastes, used equipment, and uncontaminated PPE. These wastes are collected and disposed off post in a RCRA Subtitle D landfill or recycled if possible. Sanitary wastes are treated in an on-post sewage treatment plant. Table 5.4-1 lists the hazardous and nonhazardous wastes generated at PBA during the year 1999.

TABLE 5.4-1 Hazardous and Nonhazardous Wastes Generated at PBA in 1999

Type of Waste	Amount (tons)
Hazardous wastes (total)	65.5
Liquids	18.4
Solids	46.1
Solids treated on site	1.0
Nonhazardous wastes	
Solids	1,730
Recyclable solids	1,780
Sanitary waste (solids after treatment)	400

Source: PBA (1999).

5.4.2 ACWA Pilot Test Facility Waste Generation and Treatment Requirements

The construction and operation of an ACWA pilot test facility would generate an array of solid and liquid wastes, both hazardous and nonhazardous. Estimates of waste generated during construction of the facility are based on waste generation from construction of comparable buildings and then scaling the values according to building size and number of construction workers (full-time equivalents [FTEs]). The types and amounts of waste expected to be generated from the operation of this facility were estimated by using the techniques of stoichiometric mass balance[2] for each unit process, coupled with the analytical results obtained from initial demonstration tests for the technologies. This technique relies on a number of assumptions that have not been fully verified (Kimmell et al. 2001). How sensitive these estimated results are to the various assumptions used in this procedure has not been determined.

The ACWA pilot facility would produce brine salts as solid waste. These salts could contain significant amounts of toxic heavy metals (e.g., lead [Pb]). Such solid waste would probably fail the RCRA Toxicity Characteristic Leaching Procedure (TCLP). If so, the hazardous salt waste would need to be stabilized by a procedure that would reduce the leaching of the heavy metal to a level that would allow it to be approved for land disposal as a hazardous solid waste. Salt wastes have proven somewhat difficult to stabilize, so additional studies might be required to identify an effective stabilization technology. If stabilization of the solid salt waste were required, either a waste management process for stabilizing the waste would be needed on site, or, alternatively, the waste would need to be shipped off post to an appropriately permitted waste treatment facility. Commercial facilities exist for managing this type of waste.

[2] Calculations are based on the principle of the conservation of mass in chemical reactions (i.e., the total mass in is equal to the total mass out).

Nerve agents are not listed hazardous wastes under Arkansas regulations. Therefore, if nerve agent residues did not demonstrate a hazardous characteristic, they would not be characterized as hazardous waste under Arkansas regulations. However, PBA has entered into a Consent Administrative Order with ADEQ concerning the management and storage of M55 rockets as hazardous waste, including the explosive charges and the GB and VX contained within them (Consent Administrative Order LIS 84-068).

It is assumed that most wastes generated by the proposed action would be collected and disposed of off post in accordance with U.S. Army, state, and federal regulations. Any wastes determined to be hazardous under RCRA regulations would be stored and disposed of as prescribed by the EPA and applicable state and local regulations.

5.4.3 Impacts of the Proposed Action

5.4.3.1 Impacts of Construction

Construction of an ACWA pilot facility would generate substantial amounts of nonhazardous wastes, such as building material debris and excavation spoils. Small amounts of hazardous wastes, such as solvents, paints, cleaning solutions, waste oils, contaminated rags, and pesticides, would also be generated. Construction activities would generate liquid nonhazardous wastes in the form of wastewater from wash-downs and sanitary wastes.

Estimates of the amounts of waste that would be generated during construction of an ACWA pilot test facility at PBA are shown in Table 5.4-2. This table includes waste estimates for Neut/SCWO, Neut/GRCR/TW-SCWO, and Elchem Ox.

No significant impacts are expected from the generation of hazardous wastes during construction of an ACWA facility. It is assumed that most wastes generated during construction would be collected and disposed of off post in accordance with U.S. Army, state, and federal regulations. Any wastes defined as hazardous in the RCRA regulations would be stored and disposed of in RCRA-permitted facilities as prescribed by the EPA and applicable state and local regulations. Existing on- and off-post facilities would be adequate to handle the increased wastes generated by construction of an ACWA facility, and no significant impacts on the internal, temporary storage facilities or the off-post treatment facilities would be expected.

No significant impacts are expected from the generation of nonhazardous wastes during construction of an ACWA facility. Nonhazardous solid wastes would be collected and disposed in a local landfill. Sanitary wastes would be treated in an on-post sewage treatment plant.

TABLE 5.4-2 Wastes Generated during Construction of an ACWA Pilot Test Facility at PBA

Waste	Neut/SCWO	Neut/GPCR/ TW-SCWO	Elchem Ox
Hazardous wastes			
Solids (yd^3)	90	90	90
Liquids (gal)	38,000	35,000	39,000
Nonhazardous wastes			
Solids			
Concrete (yd^3)	210	210	190
Steel (tons)	36	29	33
Other (yd^3)	1,700	1,700	1,500
Liquids			
Wastewater (gal)	2,500,000	2,300,000	2,500,000
Sanitary (gal)	5,500,000	5,100,000	5,600,000

Source: Kimmell et al. (2001).

5.4.3.2 Impacts of Operations

Munitions are not generally considered wastes while they are in storage. Typically, munitions are reclassified as wastes upon their removal from storage for treatment and disposal or if they are no longer usable. Upon the processing and destruction of a munition, however, the residuals become wastes. The Army has reclassified the M55 rockets stored at PBA as waste because of their obsolescence. PBA has entered into a Consent Administrative Order with ADEQ concerning the management and storage of M55 rockets as hazardous waste, including the explosive charges and the GB and VX contained within them (Consent Administrative Order LIS 84-068). Wastes resulting from the normal operations of an ACWA pilot test facility would include components from the treatment of metal parts and dunnage as well as process residues, such as the contaminated salts generated from treating chemical agents and energetics. Operations would also generate a number of nonprocess wastes (e.g., office trash, PPE, decontamination solutions, spent carbon filters). Current operating plans include recycling all process liquids obtained during operation back through the reaction vessel. Such recycling would eliminate these liquids from the waste streams. In summary, no activities or operations that would result in significant impacts on waste management systems or the environment were identified. If stabilization of the hazardous solids salt waste obtained during normal operations was required, either a waste management process for stabilizing the waste would be needed, or, alternatively, the waste would need to be shipped off post to an appropriately permitted treatment facility. Depending on the technology chosen for stabilization of the salt waste, a new off-post treatment facility might need to be built.

PBA has substantial amounts of nerve agent in its chemical munition inventory. The estimates of annual waste generation from the operation of an ACWA pilot test facility are based on 276 days of operation per year using the Neut/SCWO technology. For the Neut/GPCR/TW-SCWO and Elchem Ox technologies, the bases are 276 days of operation per year for GB and 108 days per year for VX.

Polychlorinated biphenyls (PCBs) have been identified as a constituent in the firing tubes of M55 rockets held in the inventory at PBA. The concentration of PCBs in the tubes can range from less than 50 parts per millions (ppm) to more than 2,000 ppm. Therefore, treating these munitions might involve treating PCB wastes. In addition, the treatment process might generate brine wastes containing more than 50 ppm of PCBs or unacceptable amounts of toxic PCB intermediate by-products such as dioxins or furans. PCB concentrations in wastes generated during the pilot-scale testing of ACWA technologies would need to be evaluated. Wastes containing PCBs in excess of 50 ppm are subject to regulation under the *Toxic Substances Control Act* (TSCA).

Hazardous Wastes. Waste generated from the operation of ACWA pilot test facilities are summarized in Table 5.4-3. The numbers in Table 5.4-3 account for only those waste streams that would be generated during processing of the nerve agent. The table does not include the wastes that would be generated during storage, which would include primarily contaminated solids such as PPE and pallets and a small quantity of contaminated liquids in the form of decontamination water. PBA would continue to generate wastes associated with storage at decreasing rates during the ACWA facility operation until the stockpile was completely destroyed.

Neutralization/SCWO. Process effluents from the SCWO units would be combined, and brine salts (mostly sodium sulfate, sodium fluoride, and sodium phosphate, see Table 5.4-3) would be extracted and dried for disposal as solid hazardous waste. No liquid wastes would be released from the process, since process liquids would be recycled back into the SCWO units.

Nonprocess operational wastes (e.g., dunnage, PPE, spent carbon filters, pallets, decontamination solution) were estimated by the technology provider (General Atomics 1999). All these wastes could potentially be contaminated by agent. Such contamination would require treatment. Current operating plans include recycling all nonprocess liquids obtained in the operations phase back through the reaction vessel. Such recycling would eliminate these liquids from the waste streams. Recycling of nonprocess wastes would result in approximately 44 tons of brine waste, which are included in the overall brine waste numbers shown in Table 5.4-3, and 13 tons of metals waste, which are included in Table 5.4-4 (Kimmell et al. 2001).

No significant impacts are expected from the generation of hazardous wastes during operation of an ACWA pilot test facility. It is assumed that most wastes generated during

TABLE 5.4-3 Hazardous Wastes Generated Annually from the Operation of an ACWA Pilot Test Facility at PBA[a]

	Amount of Waste Generated (tons/yr) per Technology and Agent Being Processed				
	Neut/SCWO	Neut/GPCR/ TW-SCWO		Elchem Ox	
Hazardous Waste	Nerve[b]	GB	VX	GB	VX
Brine salts (total)	2,900	3,170	970	120	50
Sodium phosphate	2,300	2,620	760	-[c]	-
Sodium fluoride	80	100	-	-	-
Sodium sulfate	43	-	76	-	-
Other salts	60	40	10	120	50
Water in salt cake	370	410	124	-	-
Aluminum oxide	1,300	760	230	-	-
Anolyte-catholyte waste	-	-	-	230	330
Hazardous liquids	-	-	-	10	4

[a] Values are based on 276 d/yr of operation for Neut/SCWO technology and also for Neut/GPCR/TW-SCWO and Elchem Ox Technologies processing GB. The latter two technologies would operate 108 d/yr when processing VX.

[b] The value for nerve agent includes GB and VX. Separate values were not provided for this technology from the results of demonstrations.

[c] A hyphen means that the waste stream is not generated by the specific technology.

Source: Kimmell et al. (2001).

operation would be collected and disposed of off post in accordance with U.S. Army, state, and federal regulations. Any wastes determined to be hazardous in the RCRA regulations would be stored and disposed of in RCRA-permitted facilities as prescribed by the EPA and applicable state and local regulations.

If the brine salts failed the RCRA TCLP tests, some type of stabilization of the salt would be necessary. Depending on the technology chosen and the amount of loading of the salt wastes in the stabilization matrix, the amount of stabilized salt waste could easily exceed the salt waste estimate given in Table 5.4-3 by a factor of approximately 2.5. If stabilization of the solid salt waste was required, either a waste management process for stabilizing the waste would be

TABLE 5.4-4 Nonhazardous Wastes Generated Annually from the Operation of an ACWA Pilot Test Facility at PBA

	Amount of Waste Generated per Technology		
Nonhazardous Waste	Neut/SCWO	Neut/GPCR/ TW-SCWO	Elchem Ox
Sanitary wastes (gal)	7,500,000	7,500,000	7,5000,00
Other solid wastes (yd^3)[a]	1,800	1,800	1,800
Recyclable wastes (yd^3)[b]	720	720	720
Metal waste (nerve) (tons)	1,030[c]	NA[d]	NA
Metal waste (GB) (tons)	NA	2,900[c]	1,800[c]
Metal waste (VX) (tons)	NA	660	650

[a] Domestic trash and office waste.

[b] Recyclable wastes include paper and aluminum.

[c] This waste includes glass fiber.

[d] NA = not applicable.

Source: Kimmell et al. (2001).

needed on post, or, alternatively, the waste would need to be shipped off post to an appropriately permitted treatment facility. Depending on the treatment chosen, a new facility might need to be constructed, or an existing off-post facility might need to handle the off-post shipment of solid salt waste.

Neut/GPCR/TW-SCWO. This technology would incorporate several sources of waste generation. Hydrolysates for both agent and energetics would be combined and sent to the TW-SCWO unit. This unit, operating at supercritical conditions, would rapidly oxidize all input materials. Upon completion, the liquid effluents from this unit would contain soluble and unsoluble salts and metal oxides. These would be sent to the evaporator/crystallizer unit. The resulting dried hazardous brine salts (primarily sodium phosphate, sodium sulfate, and sodium fluoride, see Table 5.4-3) would then be ready for disposal as hazardous wastes. The liquid effluent would be recycled back to the neutralizer unit as makeup water.

The GPCR unit consists of a thermal reduction batch processor (TRBP) and the GPCR reactor itself. In the TRBP, contaminated materials such as dunnage and metal parts contaminated with agent and energetics would be placed in a heated oven. The resulting volatile organics would be swept by heated hydrogen gas into the GPCR reactor, where they would be reduced to simple hydrocarbons (HCs) and acid gases. The gaseous effluent would pass through a caustic scrubber that would generate brine salts from the acid gases. These hazardous salts would be combined with the brine salts obtained from the TW-SCWO unit (amounts are listed in Table 5.4-3). All liquids would be recycled.

Nonprocess operational wastes (e.g., PPE, spent carbon filters, pallets, decontamination solution) were estimated by the technology provider (General Atomics 1999). All these wastes could potentially be contaminated by agent. Such contamination would require treatment. Current operating plans include recycling all nonprocess liquids obtained in the operations phase back through the reaction vessel. Such recycling would eliminate these liquids from the waste streams. Recycling of nonprocess wastes would result in approximately 190 tons of brine waste; this amount is included in the overall brine waste numbers shown in Table 5.4-3.

No significant impacts are expected from the generation of hazardous wastes during the operation of an ACWA pilot test facility. It is assumed that most wastes generated during operation would be collected and disposed of off post in accordance with U.S. Army, state, and federal regulations. Any wastes determined to be hazardous in the RCRA regulations would be stored and disposed of off post as prescribed by the EPA and applicable state and local regulations.

If the brine salts failed the RCRA TCLP tests, some type of stabilization of the salt would be necessary. Depending on the technology chosen and the amount of loading of the salt wastes in the stabilization matrix, the amount of stabilized salt waste could easily exceed the salt waste estimate given in Table 5.4-3 by a factor of approximately 2.5. If stabilization of the solid salt waste was required, either a waste management process for stabilizing the waste would be needed on post, or, alternatively, the waste would need to be shipped off post to an appropriately permitted treatment facility. Depending on the treatment chosen, a new facility might need to be constructed, or an existing facility might need to handle the off-post shipment of solid salt waste.

Electrochemical Oxidation. This system would incorporate several sources of waste generation. It would destroy both the agents and energetics by electrochemical oxidation in the SILVER II process. SILVER II employees an electrochemical oxidation reaction that generates Ag^{+2} ions in aqueous nitric acid that is circulated through stirred tank reactors (the anolyte and catholyte circuits). Agents and energetics would be oxidized in similar but separate systems. When the current was turned on, the generated Ag^{+2} ions would oxidize the organic feed. Silver chloride (AgCl) would be precipitated when organochlorine compounds, such as mustard, are treated. The AgCl salt cake containing various metal particulates would be collected, dried, and shipped off site for silver recovery. The remaining salts, solids, and metal impurities would be disposed of as hazardous salts. Amounts are listed in Table 5.4-3 as anolyte-catholyte waste. The anode-cathode reaction would also generate a number of off-gases, including gases such as nitrogen oxides (NO_X). Most of the NO_X would be recovered at the NO_X reformer unit (as concentrated nitric acid) and recycled. Small amounts of dilute nitric acid would be neutralized and disposed of as a hazardous liquid (see Table 5.4.3). The remaining off-gas would be swept to a caustic scrubber, where any remaining corrosive gases would be neutralized and dried for disposal as hazardous brine salts (see Table 5.4-3). All liquids from this unit would be recycled as makeup water.

Various types of nonprocess wastes would be generated from the operation of this technology. These would include dunnage, PPE, spent carbon filters, pallets, and decontamination solution. All these wastes could potentially be contaminated by agent. Such contamination would require treatment. Nonprocess wastes would be treated by the MPT. Treatment of nonprocess wastes would result in approximately 130 tons of residual brine waste; this amount is listed in the overall brine waste numbers shown in Table 5.4-3. Nonprocess waste would generate about 60 tons of metal wastes; this total is included in Table 5.4-4.

No significant impacts are expected from the generation of hazardous waste during operation of an ACWA pilot test facility. It is assumed that most wastes generated during operation would be collected and disposed of off post in accordance with U.S. Army, state, and federal regulations. Any wastes defined as hazardous in the RCRA regulations would be stored and disposed of off post as prescribed by the EPA and applicable state and local regulations.

If the salts and the anolyte-catholyte wastes failed the RCRA TCLP tests, some type of stabilization of these wastes would be necessary. Depending on the technology chosen and the amount of loading of the wastes in the stabilization matrix, the amount of stabilized waste could easily exceed the hazardous waste estimates given in Table 5.4-3 by a factor of approximately 2.5. If stabilization of the solid salt waste was required, either a waste management process for stabilizing the waste would be needed on post, or, alternatively, the waste would need to be shipped off post to an appropriately permitted treatment facility. Depending on the treatment chosen, a new facility might need to be constructed, or an existing off-post facility might need to handle the off-post shipment of solid salt waste.

Nonhazardous Wastes. Estimates of nonhazardous solid wastes associated with facility operations were made by scaling data on comparable buildings according to the size of the operating work force (Kimmell et al. 2001) (Table 5.4-2).

No significant impacts are expected from the generation of nonhazardous solid wastes during operation of an ACWA pilot test facility. Nonhazardous solid wastes would be collected and disposed of in a local landfill by a licensed waste hauler. In each technology, recyclable metals would be generated from the decontamination of various munition parts. These are listed in Table 5.4-4. Nonprocess waste would also generate a small amount of metal wastes, which are included in Table 5.4-4.

During normal operations, an estimated 7,500,000 gal/yr of sanitary sewage would be generated (Table 5.4-4) (Kimmell et al. 2001). Sanitary waste would be treated in an on-post sewage treatment plant. There would be no discharge of any wastewater from operations. Thus, no impacts are expected from the generation of wastewater during operation of an ACWA pilot test facility.

5.4.4 Impacts of No Action

5.4.4.1 Hazardous Wastes

No construction activities are anticipated under the continued storage alternative. Continued storage of munitions at PBA would generate relatively small quantities of hazardous wastes from leaks, spills, and contaminated solids, such as PPE, pallets, and dunnage. The estimated annual generation associated with storage is 5 tons of liquid wastes (decontamination water) and about 1 ton of hazardous solid waste from PPE and pallets. The continued degradation of agent containers over time would probably generate slowing increasing amounts of waste from leaks, but again, these quantities would be relatively small.

Continued storage of chemical weapons at PBA would not adversely affect waste management. Hazardous wastes are collected and disposed of off post in accordance with U.S. Army, state, and federal regulations. Any wastes determined to be hazardous in the RCRA regulations are stored and disposed of in RCRA permitted facilities as prescribed by the EPA and applicable state and local regulations.

The proposed no action alternative assumes that all chemical munitions held in inventory at PBA would be incinerated as presented in an earlier EIS (U.S. Army 1997). An estimate of waste generation from such an incinerator can be obtained by using data from the earlier PBA EIS coupled with the same methodology used to generate waste estimates for the ACWA technologies . Estimates of waste generation from operation of a chemical munitions incinerator are given in Table 5.4-5.

5.4.4.2 Nonhazardous Wastes

No construction activities are anticipated under the continued storage alternative. A small amount of nonhazardous solid waste and nonhazardous sanitary waste would be generated during the storage of chemical weapons. However, these amounts would not be significant. Nonhazardous wastes associated with the operation of a chemical munitions incinerator at PBA are listed in Table 5.4-5. Process liquids from the incinerator would be recycled and not released

TABLE 5.4-5 Solid Process Wastes Generated from the Operation of an ACW Incinerator at PBA[a]

Type	Description	Peak-Hour[b] (lb/h)	Average-Day (lb/d)	Annual (tons/yr except as noted)
Hazardous waste				
Brine salt	From brine reduction[c]	3,100	3,100	10,300
Scrap/ash	From liquid incinerator	0	0	0
Scrap/ash	From dunnage furnace	100	2,100	80
Scrap/ash	From deactivation furnace	1,400	NA	NA
Nonhazardous waste				
Metal scrap	From metal parts treater	1,100	10,000	1,800
Sanitary waste	Liquid	-	-	7,500,000 gal
Other wastes[d]	Solids	-	-	1,800 yd^3
Recyclable wastes[e]	Solids	-	-	720 yd^3

[a] NA = not applicable. A hyphen means that the data were not available.

[b] Source for peak-hour generation rates: U.S. Army (1997).

[c] Contains 10–15% moisture.

[d] Nonhazardous (other) wastes include domestic trash and office waste.

[e] Recycle wastes include paper, aluminum, etc., generated by the facility.

to the environment. Continued storage of chemical weapons at PBA would not adversely affect waste management. Facilities exist to handle sanitary waste, and solid wastes would continue to be hauled off post by a licensed contractor.

5.5 AIR QUALITY — CRITERIA POLLUTANTS

This section describes existing meteorology, air emissions, and air quality at PBA and environmental consequences on air quality that might result from constructing and operating an ACWA pilot test facility at PBA. Data on potential air emissions and environmental consequences on air quality under the no action alternative are also presented. Potential impacts on human health as a result of air emissions during construction and normal operations are described in Sections 5.6 and 5.7. Potential impacts on air quality and human health as a result of air emissions from accidents involving explosives and chemical agents are described in Section 5.21.

The analysis of impacts on air quality from both construction and operations was conducted for Area A (see Figure 5.1-2), which is closest to the PBA installation boundary in the direction of the nearest off-site residence. The two potential locations for pilot test facilities are adjacent to one another and would require similar infrastructure. Therefore, the analysis for one location would provide an adequate representation of the potential impacts from construction and operations for the other facility location.

Because the facility size, number of construction workers, and infrastructure required for each of the ACW destruction systems proposed for pilot testing would be similar, only one model analysis of the impacts from construction on air quality was conducted. The technologies are expected to differ in the amount of fossil fuel they would combust to generate heat.

The analyses presented in the following sections conclude that the total (modeled plus background) concentrations associated with fugitive dust emissions during construction would be below applicable standards. However, total annual average $PM_{2.5}$ levels would be close to the standard because of their higher background levels, which were recorded at many statewide monitoring stations.[3] Accordingly, construction activities should be conducted so as to minimize further impacts on ambient air quality. Because of Neut/GPCR/TW-SCWO's higher process heat requirements, emission levels from fossil fuel combustion would be higher for that technology than for the other two technologies (Neut/SCWO and Elchem Ox). However, concentration increments of air pollutants due to these emissions, by themselves or added to background, would be similar for all three destruction technologies and within applicable standards.

5.5.1 Current Meteorology, Emissions, and Air Quality

5.5.1.1 Meteorology

Arkansas is geographically divided into two regions. The dividing line runs diagonally across the state from northeast to southwest. West and north of this line are the interior highlands; to the east and south are the flat lowlands, where PBA is located. The climate of the area surrounding PBA is modified continental, which includes exposure to all of the North American air mass types. However, because of the area's proximity to the Gulf of Mexico (about 310 mi [500 km]) away, the summer season is marked by prolonged periods of warm and humid weather. The following description of climate is based on data recorded at the Little Rock Airport (Adams Field) located about 30 mi (48 km) north-northwest of PBA (National Oceanic and Atmospheric Administration [NOAA] 1999). Wind data measured at the PBA on-post meteorological towers are also presented to evaluate how well the airport data used in the dispersion analysis represent installation conditions at PBA (Rhodes 2000).

---

[3] PM = particulate matter. PM_{10} = coarse, inhalable PM with a mean aerodynamic diameter of 10 µm or less. $PM_{2.5}$ = fine, inhalable PM with a mean aerodynamic diameter of 2.5 µm or less.

The average wind speed measured at 20-ft (6.1-m) above ground level (agl) at the Little Rock Airport, Arkansas, is about 7.7 mi/h or mph (3.4 m/s). The average wind speed of 8.8 mph [3.9 m/s]) in winter months (January–March) is higher than that of 6.6 mph [2.9 m/s]) in summer months (July–September). Dominant wind directions are from the south-to-southwest sector throughout the year, except in September, when they are from the northeast.

Seven CSEPP towers, which are distributed around PBA, are currently in operation for emergency response purposes. Two towers (Towers 1 and 6) house instruments that monitor winds at 15-, 30-, and 60-m agl, while instruments at other towers monitor winds at 60-m agl only. Wind data collected at Tower 1, which is near the chemical weapons storage igloos and the proposed locations for a destruction facility, are presented to examine the general wind patterns around the installation. The wind roses at the three (15-, 30-, and 60-m) levels of Tower 1 for 1995 are shown in Figure 5.5-1(a–c). For comparison, the wind rose at the 20-ft (6.1-m) level of the Little Rock Airport for the period of 1984–1992 is also presented in Figure 5.5-1(d) (EPA 2000a). Wind patterns at the three levels of Tower 1 are quite similar in terms of dominant wind directions (north-northeast and south-southwest) but different in terms of wind speeds. The wind patterns at PBA are similar to those at Little Rock Airport, except that the predominant wind direction at the airport is shifted slightly.

Winds in the area appear to be influenced by regional topographical features, including the Ouachita Mountains and Ozark Mountains, which tend to align winds in a north-northeasterly or south-southeasterly direction. The Arkansas River Valley to the east of the facility influences local winds, but not enough to dominate, even in areas as close to the river as PBA is. Wind roses from all PBA towers indicate the north-northeasterly and south-southwesterly tendencies, even though the Arkansas River is within about 2 mi (3.2 km) from the farthest tower.

Because of the area's proximity to the Gulf of Mexico, maritime tropical air dominates the summer season, causing prolonged periods of warm and humid conditions. Winters are short and mild, but cold periods of short duration do occur. The average annual winter temperature at Little Rock Airport is 62°F (17°C). January is the coldest month, averaging 40°F (5°C), and July is the warmest month, averaging 82°F (28°C). Extreme temperatures have ranged from –5°F (–21°C) in February 1951 to 112°F (44°C) in July 1986. The number of freeze-free days per year (i.e., when the daily-minimum temperature is greater than 32°F [0°C]) is about 305 days, and no freeze days occur May through September. Daily maximum temperatures of 90°F (32°C) or higher occur about 72 days per year, most of which occur in June, July, and August.

The average annual precipitation at Little Rock Airport is about 51 in. (129 cm). Precipitation is relatively evenly distributed throughout the year, ranging from 3.3 in. (8.3 cm) in August to 5.5 in (14 cm) in April. The average number of days with measurable precipitation (0.01 in. [0.025 cm] or more) is about 105 days per year. The greatest amount of precipitation in a single month was about 16 in. (42 cm) in December 1987, and the greatest amount in a 24-hour period was about 8 in. (20 cm) in April 1974. Snowfall is generally light and remains on the

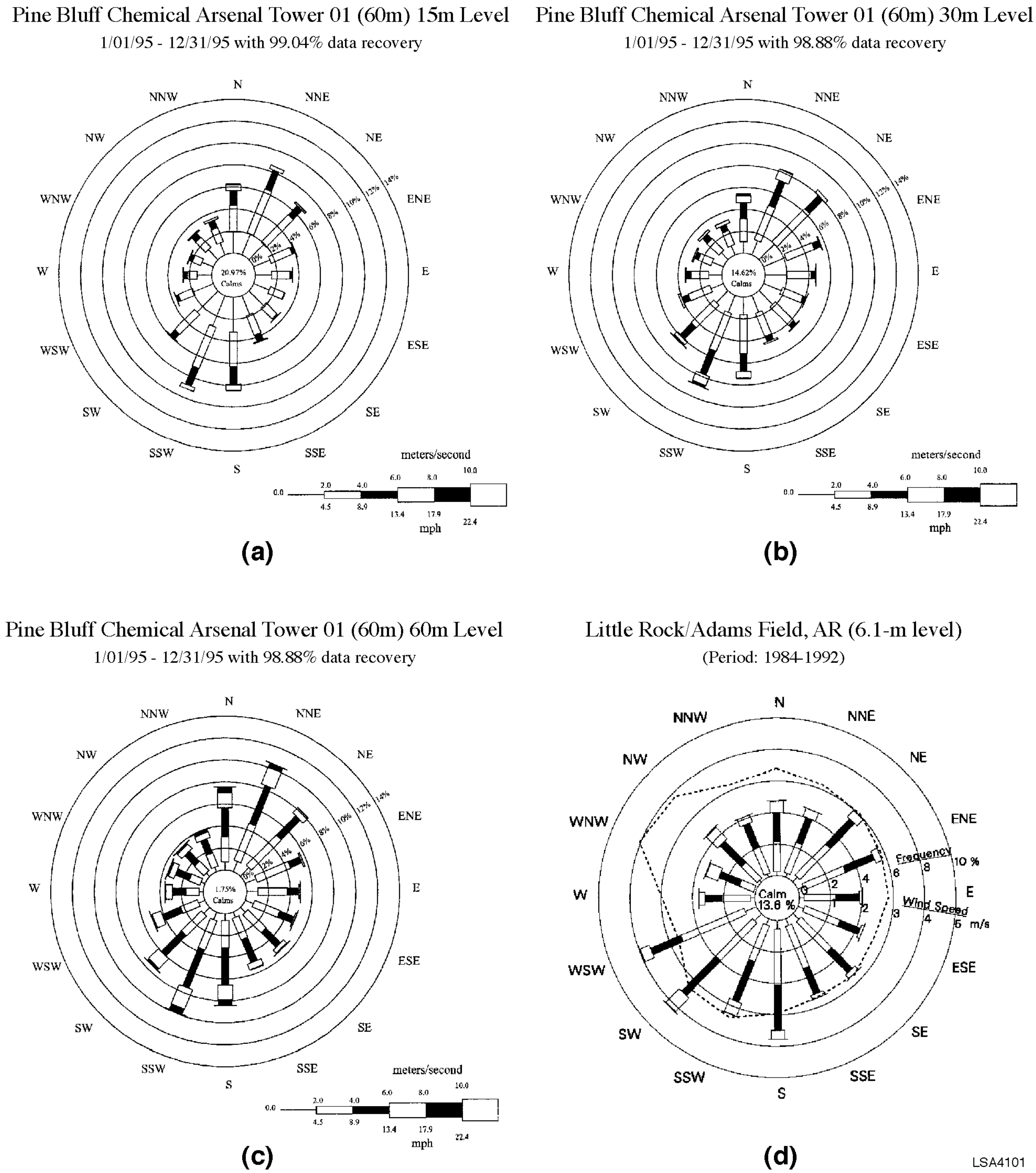

FIGURE 5.5-1 Annual Wind Roses for Three Heights Aboveground at Tower 1 at PBA in 1995 (a = 15 m, b = 30 m, c = 60 m) and for One Height at Little Rock Airport from 1984 through 1992 (d = 6.1 m) (Sources: Rhodes [2000] for a,b,c; EPA [2000a] for d)

ground only briefly. Annual average snowfall is about 6 in. (15 cm). The greatest amounts of snow reported in a single month and in a 24-hour period were about 14 in. (35 cm) and 12 in. (31 cm), respectively, in January 1988.

Average annual relative humidity at Little Rock Airport is 70%, ranging from 79 to 84% for the first half of the day, and from 57 to 60% for the second half. Heavy fogs in the area are rare. The average number of days with heavy fog (visibility of 0.25 mi [0.4 km] or less) is about 16 days per year, with higher frequencies in winter months. Thunderstorms can occur in any month, and about 57 thunderstorms are reported each year, with the greatest frequency in June and July.

Tornadoes are rare in the area surrounding PBA and are less frequent and destructive than those in the tornado alley, which stretches north from Texas to Nebraska and Iowa. For the 46-year period of 1950 through 1995, 878 tornadoes were reported in Arkansas, with a tornado event frequency of $3.7 \times 10^{-4}/mi^2$ per year and an average of 19 tornadoes per year (Storm Prediction Center 2000). For the same period, 15 tornadoes were reported in Jefferson County, with a tornado event frequency of $3.7 \times 10^{-4}/mi^2$ per year. During the 46-year period, most tornadoes that occurred in Jefferson County were relatively weak (F3 on the Fujita tornado scale was the highest level attained), with only one fatality.[4]

5.5.1.2 Emissions

PBA has a unique and varied mission. PBA is the Army's only chemical arsenal and the only installation with both manufacturing and depot functions. PBA's mission operations can be grouped into the following six categories:

- Ammunition operations;
- Chemical and biological defense operations;
- Product and process development;
- Demilitarization, waste treatment, and resource recovery;

[4] The Fujita scale is used to classify tornadoes in terms of wind damage. F0 = light damage associated with winds traveling at speeds up to 72 mph. F3 = severe damage associated with winds traveling at 158 through 206 mph. F4 = devastating damage associated with winds traveling at 207 through 260 mph. F5 = incredible damage associated with winds traveling at 261 mph and faster.

- Base operations; and

- Chemical stockpile disposal.

These operations are emission sources and are thus being carried out in accordance with permits issued by the Arkansas Department of Environmental Quality (ADEQ). Table 5.5-1 presents the PBA emission summary information of existing sources from the Title V air permit application submitted to the state of Arkansas (Wachowiak 2000). On the basis of all categories of PBA sources with permits from the state, the annual total permitted emissions were 171.05 tons of volatile organic compounds (VOCs), 139.97 tons of nitrogen oxides (NO_x), 138.57 tons of PM_{10}, 52.33 tons of carbon monoxide (CO), 15.61 tons of sulfur dioxide (SO_2), and 0.4 ton of lead (Pb). PBA is classified as a major stationary source for Prevention of Significant Deterioration (PSD) purposes, for which actual or potential emissions are above the applicable source threshold.

For comparison, annual estimates of actual air pollutant emissions in 1996 from Jefferson County and the total permitted amounts from PBA are listed in Table 5.5-2. Actual PBA emissions were significantly less than the total permitted amounts. The significance of PBA emissions is shown by presenting them as a percentage of the total Jefferson County emissions. As the table indicates, PBA emissions account for very small fractions of the emissions released from the Jefferson County, that is, about 2.2%, 0.8%, 0.4%, 0.1%, and 0.03% of the total Jefferson County emissions for VOCs, PM_{10}, NO_x, CO, and SO_2, respectively. Jefferson County contains the White Bluff Electric Station, one of the largest emitters of air pollutants in the state, which accounts for about 71 and 93% of Jefferson County's total NO_x and SO_2 emissions, respectively.

5.5.1.3 Air Quality

The State Ambient Air Quality Standards (SAAQS) for six criteria pollutants — SO_2, PM (PM_{10} and $PM_{2.5}$), CO, ozone (O_3), nitrogen dioxide (NO_2), and Pb — are identical to the National Ambient Air Quality Standards (NAAQS), as shown in Table 5.5-3 (Arkansas Pollution Control and Ecology Commission 1999). In 1997, the EPA revised the NAAQS for O_3 and PM. The standards were challenged, and the lower court decision was appealed to the U.S. Supreme Court. On February 27, 2001, the U.S. Supreme Court unanimously upheld the constitutionality of the CAA as the EPA had interpreted it in setting the $PM_{2.5}$ and O_3 standards. However, the case was remanded back to the D.C. Circuit Court of Appeals to resolve the remaining issues, which include EPA's justification for the numerical levels. While the case is pending, the O_3 and fine particle standards remain in effect as a legal matter, because the D.C. Circuit Court decision did not vacate the standards. The EPA has not, however, started implementing the revised $PM_{2.5}$ and O_3 standards. The monitoring station nearest to PBA for SO_2, NO_2, CO, and O_3 is in Little Rock, while those for PM_{10} and $PM_{2.5}$ are in Pine Bluff (EPA 2000c). In Pine Bluff,

TABLE 5.5-1 Estimated Emissions of Air Pollutants from Existing PBA Sources

	Emissions (tons/yr)[a]					
Source Category	SO_2	NO_x	CO	VOCs	PM_{10}	Pb
Ammunition operations	-	-	-	132.69	17.5	-
Chemical and biological defense operations	-	-	-	0.78	-	-
Product and process development	2.9	0.21	0.04	2.8	0.08	-
Demilitarization, waste treatment, and resource recovery	11.56	42.45	28.17	12.53	107.63	0.4
Base operations	1.15	97.31	24.12	22.25	13.36	-
Total	15.61	139.97	52.33	171.05	138.57	0.4

[a] A hyphen means that there was no emission, the emission was negligible, or the emission was not estimated.

Source: Wachowiak (2000).

TABLE 5.5-2 Emissions of Air Pollutants from Jefferson County Sources in 1996 Compared to PBA Sources

	Emissions (tons/yr)[a]	
Air Pollutant	Jefferson County[b]	PBA[c]
SO_2	59,542	15.61 (0.03)
NO_x	31,465	139.97 (0.4)
CO	45,921	52.33 (0.1)
VOCs	7,856	171.05 (2.2)
PM_{10}	16,562	138.57 (0.8)
Pb	-	0.4

[a] A hyphen indicates that data are not available.

[b] Source: EPA (2000b).

[c] From Table 5.5-1. Numbers in parentheses are PBA emissions as a percentage of Jefferson County emissions.

$PM_{2.5}$ monitoring was started in 1999. As a direct result of the phase-out of leaded gasoline in automobiles, lead concentrations in urban areas decreased dramatically. Thus, the ambient lead concentration is no longer monitored in many parts of the country including the state of Arkansas. Highest background air-quality data measured at the monitoring station nearest to PBA for pollutants subject to the NAAQSs (EPA 2000c) are also presented in Table 5.5-3.

PBA is located in Jefferson County, which is located in the Central Arkansas Intrastate Air Quality Control Region (AQCR Code 016). This region covers the central and southeastern parts of the state of Arkansas (Figure 5.5-2). Currently, Jefferson County is designated as being in attainment for all NAAQS (40 CFR 81.304). Recent six-year monitoring data indicate that concentration levels for SO_2 and NO_2 around PBA are less than 21% of their respective NAAQS. In general, CO concentrations exhibit a downward trend, except for one exceedance for an 8-hour average in 1998 in Little Rock. The second highest value of 4.8 parts per million (ppm), used to determine the EPA's attainment, is well below the standard of 9 ppm. The highest 1-hour and 8-hour O_3 concentrations are higher than the applicable NAAQS. The 24-hour and annual average PM_{10} and 24-hour average $PM_{2.5}$ concentration levels are around 50% of their respective NAAQS. However, annual $PM_{2.5}$ concentrations are almost up to the standard level, about 94% of the standard.

PSD regulations (40 CFR 52.21) limit the maximum allowable incremental increases in ambient concentrations of SO_2, NO_2, and PM_{10} above established baseline levels, as shown in Table 5.5-3. The PSD regulations, which are designed to protect ambient air quality in attainment areas, apply to major new sources and major modifications to existing sources. Within the State of Arkansas, two wilderness areas are designated as Class I areas (40 CFR 81.404).[5] The PSD Class I area nearest to PBA is the Caney Creek Wilderness Area, which is located 115 mi (185 km) west of PBA. The other, is the Upper Buffalo Wilderness Area, located about 138 mi (222 km) northwest of PBA. These two wilderness areas are located upwind of prevailing winds at PBA, as shown in Figure 5.5-1.

5.5.2 ACWA Facility Emissions

5.5.2.1 Emissions from Construction

Emissions of criteria pollutants (such as SO_2, NO_x, CO, PM_{10}, and $PM_{2.5}$) and VOCs during the construction period would include fugitive dust emissions from earth-moving

[5] In 1975, the EPA developed a classification system to allow some economic development in clean air areas while still protecting air from significant deterioration. These classes are defined in the 1977 *Clean Air Act Amendments* (CAAA). Very little deterioration is allowed in Class I areas (e.g., larger national parks and wilderness area). Class II areas allow moderate deterioration. Class III areas allow deterioration up to the secondary standard.

TABLE 5.5-3 National Ambient Air Quality Standards (NAAQS), Maximum Allowable Increments for Prevention of Significant Deterioration (PSD), and Highest Background Levels Representative of PBA[a]

		NAAQS[b]		PSD Increments ($\mu g/m^3$)		Highest Background Level	
Pollutant	Averaging Time	Primary	Secondary	Class I	Class II	Concentration[c]	Location (Year)
SO_2	3 hours	-	0.50 ppm (1,300 $\mu g/m^3$)	25	512	0.030 ppm (6%)	N. Little Rock (1995)
	24 hours	0.14 ppm (365 $\mu g/m^3$)	-	5	91	0.011 ppm (8%)	N. Little Rock (1997)
	Annual	0.03 ppm (80 $\mu g/m^3$)	-	2	20	0.002 ppm (7%)	N. Little Rock (2000)
NO_2	Annual	0.053 ppm (100 $\mu g/m^3$)	0.053 ppm (100 $\mu g/m^3$)	2.5	25	0.011 ppm (21%)	N. Little Rock (1999)
CO	1 hour	35 ppm (40 mg/m^3)	-	-	-	17.0 ppm (49%)	Little Rock (1998)
	8 hours	9 ppm (10 mg/m^3)	-	-	-	13.5 ppm[d] (150%)	Little Rock (1998)
O_3	1 hour	0.12 ppm (235 $\mu g/m^3$)	0.12 ppm (235 $\mu g/m^3$)	-	-	0.125 ppm (104%)	N. Little Rock (2000)
	8 hours	0.08 ppm (157 $\mu g/m^3$)	0.08 ppm (157 $\mu g/m^3$)	-	-	0.098 ppm (123%)	N. Little Rock (1999)
PM_{10}	24 hours	150 $\mu g/m^3$	150 $\mu g/m^3$	8	30	78 $\mu g/m^3$ (52%)	Pine Bluff (1997)
	Annual	50 $\mu g/m^3$	50 $\mu g/m^3$	4	17	26.4 $\mu g/m^3$ (53%)	Pine Bluff (1995)
$PM_{2.5}$	24 hours	65 $\mu g/m^3$	65 $\mu g/m^3$	-	-	29.4 $\mu g/m^3$ (45%)	Pine Bluff (1999)
	Annual	15 $\mu g/m^3$	15 $\mu g/m^3$	-	-	14.03 $\mu g/m^3$ (94%)	Pine Bluff (2000)
Pb	Calendar quarter	1.5 $\mu g/m^3$	1.5 $\mu g/m^3$	-	-	-	-

[a] Hyphen indicates that no standards or monitoring data exist.

[b] Refer to 40 CFR 50 for detailed information on the implementation of the new $PM_{2.5}$ and O_3 standard and the interim treatment of the existing standards.

[c] Values in parentheses are monitored concentrations as a percentage of NAAQS.

[d] For the impact analysis, the second-highest maximum of 4.8 ppm was used as background concentration because the EPA evaluates exceedance of NAAQS on the basis of the second-highest values for short-term averages.

Sources: 40 CFR 50; 40 CFR 52.21; Arkansas Pollution Control and Ecology Commission (2000); EPA (2000c).

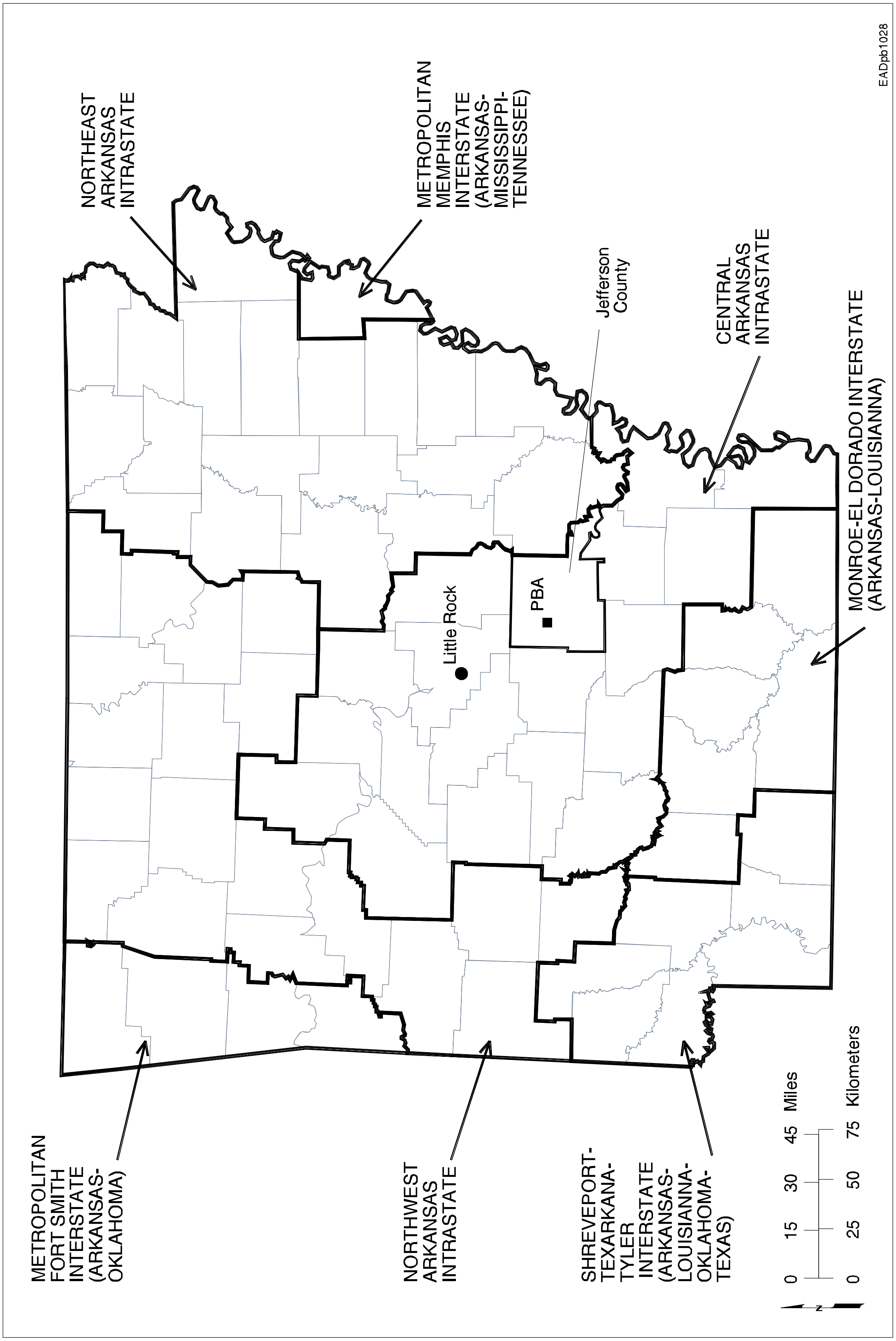

FIGURE 5.5-2 PBA and Air Quality Control Regions in Arkansas

activities and exhaust emissions from equipment and commuter and delivery vehicles. Exhaust emissions are expected to be relatively small when compared with fugitive dust emissions from earth-moving activities (Kimmell et al. 2001). Also, impacts from exhaust emissions would be smaller because of their elevated buoyant release, different from ground-level fugitive dust emissions. Accordingly, only the potential impacts on ambient air quality from fugitive emissions of PM_{10} and $PM_{2.5}$ from earth-moving activities were analyzed. Emission factors and other assumptions used in estimating emission rates of PM_{10} and $PM_{2.5}$ are described in Appendix B.

5.5.2.2 Emissions from Operations

The emission levels currently permitted to PBA are more than 100 tons per year of a regulated air pollutant. Therefore, PBA is classified as a major stationary source of air emissions. Emission factors and other assumptions used in estimating emission rates of criteria pollutants and VOCs during operations are described in Appendix B. Maximum short-term and annual total emission rates, along with stack parameters (i.e., heights, inside diameters, gas exit temperatures, and gas exit velocities) used in the dispersion modeling, are listed in Table 5.5-4 for the Neut/SCWO, Table 5.5-5 for Neut/GPCR/TW-SCWO, and Table 5.5-6 for Elchem Ox.

Neutralization/SCWO. In a Neut/SCWO pilot test facility, air pollutants would be emitted from four different types of stacks: (1) three stacks for natural-gas-burning boilers (two operating, one on standby) used to generate process steam and building heat, (2) two stacks for the diesel-powered generators used as a backup to provide emergency electricity, (3) a filter farm stack for building circulating air and non-SCWO air effluents (e.g., rotary hydrolyzer, metal parts treater [MPT]), and (4) a stack for exhaust from the SCWO process. The principal sources of criteria pollutant and VOC emissions would be boilers and emergency generators, while the primary sources of hazardous air pollutant (HAP) emissions would be the filter farm stack and the SCWO stack. (HAPs are discussed in Sections 5.6 and 5.7.)

Neutralization/GPCR/TW-SCWO. In a Neut/GPCR/TW-SCWO facility, air pollutants would be emitted from four different kinds of stacks, similar to those of the Neut/SCWO facility. The only difference is that a process gas burner stack would replace a SCWO stack. This stack would be used to discharge treated supplementary process fuel gas produced from the GPCR process (which consists of a central reactor for destroying organic waste streams). This stack would emit criteria pollutants, VOCs, and various HAPs. Its criteria pollutants and VOC emissions would amount to much less than those from boilers or diesel generators.

TABLE 5.5-4 Emission Rates of Criteria Pollutants and Volatile Organic Compounds and Stack Parameters Associated with Normal Operations of the Neutralization/SCWO Technology at PBA

Stack Parameters and Estimated Peak Emission Rates	Steam Boilers	Emergency Diesel Generators
Stack parameters[a]		
Height	70 ft (21.3 m)	47 ft (14.3 m)
Inside diameter	0.81 ft (0.25 m)	0.67 ft (0.20 m)
Gas exit temperature	325°F (436 K)	925°F (769 K)
Gas exit velocity	60 ft/s (18 m/s)	323 ft/s (98 m/s)
Estimated rates[b]		
SO_2	0.01 lb/h (0.02 ton/yr)	3.2 lb/h (0.95 ton/yr)
NO_x	2.2 lb/h (3.64 tons/yr)	48.4 lb/h (14.5 tons/yr)
CO	1.3 lb/h (2.18 tons/yr)	10.4 lb/h (3.12 tons/yr)
PM_{10}	0.12 lb/h (0.20 ton/yr)	3.4 lb/h (1.02 tons/yr)
$PM_{2.5}$[c]	0.12 lb/h (0.20 ton/yr)	3.4 lb/h (1.02 tons/yr)
VOCs	0.09 lb/h (0.14 ton/yr)	4.0 lb/h (1.18 tons/yr)

[a] For the modeling analysis, emissions from the three boilers were assumed to occur from one stack location. Similarly, emissions from the two emergency generators were assumed to occur from one stack location.

[b] Estimated peak emission rates are for the simultaneous operations of three steam boilers and two emergency generators at full load.

[c] $PM_{2.5}$ emissions were conservatively assumed to be 100% of PM_{10} emissions for natural-gas-fired boilers and diesel generators (EPA 2000e).

Source: Kimmell et al. (2001).

Electrochemical Oxidation. In an Elchem Ox facility, air pollutants would be emitted from three types of stacks. The major difference from a Neut/SCWO facility is the absence of a SCWO stack. Thus, the assumption is that all air effluents from all treatment processes would be emitted into the atmosphere via the filter farm stack.

Other Sources. Other sources of air pollution during operations would include vehicle traffic, such as cars, pickup trucks, and buses transporting personnel to and from the facility. Trucks and forklifts would be used to deliver supplies to the facility. Parking lots and access roads to the facility would be paved with asphalt concrete to minimize fugitive dust emissions. Other potential emissions would include VOCs from the aboveground and underground fuel storage tanks. However, these emissions would be negligible because diesel fuel has a low volatility and because facility operation would consume a low level of fuel and thus require infrequent refilling.

TABLE 5.5-5 Emission Rates of Criteria Pollutants and Volatile Organic Compounds and Stack Parameters Associated with Normal Operations of the Neutralization/GPCR/TW-SCWO Technology at PBA

Stack Parameters and Estimated Peak Emission Rates	Steam Boilers	Emergency Diesel Generators	Process Gas Burner
Stack parameters[a]			
Height	70 ft (21.3 m)	47 ft (14.3 m)	80 ft (24.4 m)
Inside diameter	1.1 ft (0.33 m)	0.67 ft (0.20 m)	0.42 ft (0.13 m)
Gas exit temperature	325°F (436 K)	925°F (769 K)	77°F (298 K)
Gas exit velocity	60 ft/s (18 m/s)	323 ft/s (98 m/s)	64 ft/s (19 m/s)
Estimated rates[b]			
SO_2	0.02 lb/h (0.03 ton/yr)	3.2 lb/h (0.95 ton/yr)	0.004 lb/h (0.007 ton/yr)
NO_x	4.2 lb/h (6.99 tons/yr)	48.4 lb/h (14.5 tons/yr)	0.10 lb/h (0.17 ton/yr)
CO	2.5 lb/h (4.20 tons/yr)	10.4 lb/h (3.12 tons/yr)	0.16 lb/h (0.27 ton/yr)
PM_{10}	0.23 lb/h (0.38 ton/yr)	3.4 lb/h (1.02 tons/yr)	0.03 lb/h (0.05 ton/yr)
$PM_{2.5}$[c]	0.23 lb/h (0.38 ton/yr)	3.4 lb/h (1.02 tons/yr)	0.03 lb/h (0.05 ton/yr)
VOCs	0.17 lb/h (0.27 ton/yr)	4.0 lb/h (1.18 tons/yr)	0.05 lb/h (0.08 ton/yr)

[a] For the modeling analysis, emissions from the three boilers were assumed to occur from one stack location. Similarly, emissions from the two emergency generators were assumed to occur from one stack location.

[b] Estimated peak emission rates are for the simultaneous operations of three steam boilers and two emergency generators at full load.

[c] $PM_{2.5}$ emissions were conservatively assumed to be 100% of PM_{10} emissions for natural-gas-fired boilers, diesel generators, and a process gas burner (EPA 2000e).

Source: Kimmell et al. (2001).

5.5.3 Impacts of the Proposed Action

Potential impacts of air pollutant emissions during pilot facility construction and operation were evaluated by estimating maximum ground-level concentration increments of criteria air pollutants resulting from construction and operations, adding these estimates to background concentrations, and comparing the results with applicable ambient air quality standards. As indicated in Table 5.5-3, the Arkansas SAAQS for criteria air pollutants are identical to the NAAQS (Arkansas Pollution Control and Ecology Commission 1999).

To evaluate air quality impacts from PBA operations with respect to PSD requirements, estimated maximum increments in ground-level concentrations that would result from the operation of the proposed facility were compared with allowable PSD increments above the baseline. Applicable PSD increments are also summarized in Table 5.5-3.

TABLE 5.5-6 Emission Rates of Criteria Pollutants and Volatile Organic Compounds and Stack Parameters Associated with Normal Operations of Electrochemical Oxidation Technology at PBA

Stack Parameters and Estimated Peak Emission Rates	Steam Boilers	Emergency Diesel Generators
Stack parameters[a]		
Height	70 ft (21.3 m)	47 ft (14.3 m)
Inside diameter	0.74 ft (0.23 m)	0.67 ft (0.20 m)
Gas exit temperature	325°F (436 K)	925°F (769 K)
Gas exit velocity	60 ft/s (18 m/s)	323 ft/s (98 m/s)
Estimated rates[b]		
SO_2	0.009 lb/h (0.014 ton/yr)	3.2 lb/h (0.95 ton/yr)
NO_x	2.0 lb/h (3.36 tons/yr)	48.4 lb/h (14.5 tons/yr)
CO	1.2 lb/h (2.02 tons/yr)	10.4 lb/h (3.12 tons/yr)
PM_{10}	0.11 lb/h (0.18 ton/yr)	3.4 lb/h (1.02 tons/yr)
$PM_{2.5}$[c]	0.11 lb/h (0.18 ton/yr)	3.4 lb/h (1.02 tons/yr)
VOCs	0.08 lb/h (0.13 ton/yr)	4.0 lb/h (1.18 tons/yr)

[a] For the modeling analysis, emissions from the three boilers were assumed to occur from one stack location. Similarly, emissions from the two emergency generators were assumed to occur from one stack location.

[b] Estimated peak emission rates are for the simultaneous operations of three steam boilers and two emergency generators at full load.

[c] $PM_{2.5}$ emissions were conservatively assumed to be 100% of PM_{10} emissions for natural-gas-fired boilers and diesel generators (EPA 2000e).

Source: Kimmell et al. (2001).

The air quality model, model input data (meteorological data, source and receptor locations, and elevation data), and other assumptions used in estimating potential construction and operational impacts on ambient air quality at the PBA boundaries and surrounding areas are described in Appendix B.

5.5.3.1 Impacts of Construction

The modeling results for both PM_{10} and $PM_{2.5}$ concentration increments that would result from construction-related fugitive emissions are summarized in Table 5.5-7. At the installation boundaries, for both PM_{10} and $PM_{2.5}$, the maximum 24-hour and annual average concentration increments above background would occur about 1.2 mi (2.0 km) and 0.9 mi

TABLE 5.5-7 Maximum Predicted Off-Post Concentration Increments and Total Concentrations of PM_{10} and $PM_{2.5}$ during Construction at PBA

		Concentration ($\mu g/m^3$)				
Pollutant	Averaging Time	Maximum Increment[a,b]	Background[c]	Total[d]	NAAQS	Percent of NAAQS[e]
PM_{10}	24 hours	44.7	78	122.7	150	82 (30)
	Annual	1.1	26.4	27.5	50	55 (2.2)
$PM_{2.5}$	24 hours	22.4	29.4	51.8	65	80 (34)
	Annual	0.53	14.0	14.5	15	97 (3.5)

[a] The maximum concentration increments were estimated by using the Industrial Source Complex Short-Term 3 (ISCST3) model (Version 00101; EPA 1995).

[b] Maximum modeled 24-hour and annual average concentrations occur at receptors about 1.2 mi (2.0 km) and 0.9 mi (1.4 km), respectively, to the north and southwest of the proposed facility.

[c] See Table 5.5-3.

[d] Total equals maximum modeled concentration plus background concentration.

[e] The values are total concentration as a percent of NAAQS. The values in parentheses are maximum concentration increments as a percent of NAAQS.

(1.4 km) north and southwest of the proposed facility, respectively. At these locations, for PM_{10}, the maximum 24-hour and annual concentration increments above background would be about 30% and 2.2% of the NAAQS, respectively. For $PM_{2.5}$, the maximum 24-hour and annual concentration increments above background would be about 34% and 3.5% of the NAAQS, respectively.

To obtain the overall concentrations for comparison with applicable NAAQS, the maximum PM_{10} and $PM_{2.5}$ concentration increments (Table 5.5-7) were added to background values (from Table 5.5-3). For PM_{10}, the maximum estimated 24-hour and annual average concentrations would be about 82% and 55% of the NAAQS, respectively. For $PM_{2.5}$, the maximum estimated 24-hour and annual average concentrations would be about 80% and 97% of the NAAQS, respectively. Maximum predicted concentrations would occur at the northern PBA boundaries adjoining the NCTR facility. Accordingly, concentration levels at the publicly accessible installation boundaries would be much lower. The annual average $PM_{2.5}$ background concentration of 14 μg/m^3 around the PBA area is already close to the standard of 15 μg/m^3. Accordingly, construction activities should be conducted so as to minimize further impacts on ambient air quality.

In summary, the maximum estimated 24-hour and annual concentration increments of PM_{10} and $PM_{2.5}$ that would result from construction-related fugitive emissions would be relatively small fractions of the applicable NAAQS. The total (maximum increments plus background) estimated 24-hour and annual concentrations of PM_{10} and 24-hour concentrations of $PM_{2.5}$ would be equal to or less than 82% of the applicable NAAQS. The total estimated annual concentration of $PM_{2.5}$ would be below but close to its applicable NAAQS, primarily because of high background concentration levels.

5.5.3.2 Impacts of Operations

In the air quality analysis for the operational period, air quality impacts were modeled for each of the three ACWA technologies. The results are presented in tabular format for each case. The modeling results for concentration increments of SO_2, NO_2, CO, PM_{10}, and $PM_{2.5}$ due to emissions from the proposed facility operations are summarized in Table 5.5-8 through 5.5-10 for the three technologies. The receptor locations where maximum concentration increments would occur are also listed in these tables.

The estimated maximum concentration increments due to operation of the proposed facility would contribute less than 6% of applicable NAAQS for all pollutants (Tables 5.5-8 through 5.5-10). Irrespective of the ACWA technology chosen, concentration increments would be almost the same. In most cases, maximum predicted concentrations would occur at the PBA boundaries southwest of the ACWA facilities. Accordingly, potential impacts from the proposed facility operations at nearby residences would be much lower.

The maximum 3-hour, 24-hour, and annual SO_2 concentration increments predicted to result from the proposed facility operations (Tables 5.5-8 through 5.5-10) would be less than 4% of the applicable PSD increments (Table 5.5-3). The maximum predicted increments in annual average NO_2 concentrations due to the proposed facility operations would be about 1% of the applicable PSD increments. The 24-hour and annual PM_{10} concentration increases predicted to result from the proposed operations would be less than about 12% of the applicable PSD increments. The predicted concentration increment at a receptor located 30 mi (50 km) away from the proposed facility (the maximum distance the Industrial Source Complex Short-Term 3 [ISCST3] model could reliably estimate concentrations) in the direction of the nearest Class I PSD area (the Caney Creek Wilderness Area) would be less than 0.7% of the applicable PSD increments. Therefore, concentration increments at the Caney Creek Wilderness Area, which is located about 115 mi (185 km) west of PBA, would be much lower.

TABLE 5.5-8 Maximum Predicted Off-Post Concentration Increments and Total Concentrations of Criteria Pollutants during Normal Operations of the Neutralization/SCWO Technology at PBA

		Concentration ($\mu g/m^3$)					Receptor Location[e]	
Pollutant	Averaging Time	Maximum Increment[a]	Background[b]	Total[c]	NAAQS	Percent of NAAQS[d]	Distance [mi (km)]	Direction
SO_2	3 hours	9.9	78	88	1,300	6.8 (0.8)	1.0 (1.5)	WSW
	24 hours	3.2	29	32	365	8.8 (0.9)	0.9 (1.5)	SW
	Annual	0.02	5.3	5.3	80	6.7 (0.03)	0.9 (1.5)	SW
NO_2	Annual	0.31	21	21.3	100	21 (0.3)	0.9 (1.5)	SW
CO	1 hour	60	19,429	19,489	40,000	49 (0.2)	1.0 (1.7)	WSW
	8 hours	28	5,333	5,361	10,000	54 (0.3)	0.9 (1.5)	SW
PM_{10}	24 hours	3.6	78	82	150	54 (2.4)	0.9 (1.5)	SW
	Annual	0.02	26.4	26.4	50	53 (0.04)	0.9 (1.5)	SW
$PM_{2.5}$	24 hours	3.6	29.4	33	65	51 (5.5)	0.9 (1.5)	SW
	Annual	0.02	14.0	14.0	15	93 (0.1)	0.9 (1.5)	SW

[a] Maximum concentration increments were estimated by using the ISCST3 model (Version 00101; EPA 1995).

[b] See Table 5.5-3.

[c] Total equals maximum concentration increment plus background concentration.

[d] The values are total concentration as percent of NAAQS. The values in parentheses are maximum concentration increments as a percentage of NAAQS.

[e] Receptor locations (distance and directions) of maximum concentrations are from the approximate center of the Neut/SCWO facility.

Concentration increments for the two remaining criteria pollutants, lead and ozone, were not modeled. As a direct result of the phase-out of leaded gasoline in automobiles, average lead concentrations in urban areas throughout the country have decreased dramatically. It is expected that emissions of lead from the proposed facility operations would be negligible and therefore would have no adverse impacts on lead concentrations in surrounding areas. Contributions to the production of ozone, a secondary pollutant formed from complex photochemical reactions involving ozone precursors including NO_X and VOCs, cannot be accurately quantified. As discussed in Section 5.5.1.3, Jefferson County, including the PBA, is currently in attainment for ozone (40 CFR 81.304). Ozone precursor emissions from the proposed facility operations would be small, making up about 0.07% and 0.02% of the 1996 actual emissions of NO_X and VOCs, respectively, from Jefferson County. As a consequence, the cumulative impacts of potential releases from PBA facility operations on regional ozone concentrations would not be of any concern.

TABLE 5.5-9 Maximum Predicted Off-Post Concentration Increments and Total Concentrations of Criteria Pollutants during Normal Operations of the Neutralization/GPCR/TW-SCWO Technology at PBA

		Concentration ($\mu g/m^3$)					Receptor Location[e]	
Pollutant	Averaging Time	Maximum Increment[a]	Background[b]	Total[c]	NAAQS	Percent of NAAQS[d]	Distance [mi (km)]	Direction
SO_2	3 hours	9.9	78	88	1,300	6.8 (0.8)	1.0 (1.5)	WSW
	24 hours	3.2	29	32	365	8.8 (0.9)	0.9 (1.5)	SW
	Annual	0.02	5.3	5.3	80	6.7 (0.03)	0.9 (1.5)	SW
NO_2	Annual	0.37	21	21.4	100	21 (0.4)	0.9 (1.5)	SW
CO	1 hour	66	19,429	19,495	40,000	49 (0.2)	1.2 (2.0)	W
	8 hours	30	5,333	5,363	10,000	54 (0.3)	0.9 (1.5)	SW
PM_{10}	24 hours	3.7	78	82	150	54 (2.5)	0.9 (1.5)	WSW
	Annual	0.02	26.4	26.4	50	53 (0.04)	0.9 (1.5)	SW
$PM_{2.5}$	24 hours	3.7	29.4	33	65	51 (5.7)	0.9 (1.5)	WSW
	Annual	0.02	14.0	14.0	15	93 (0.1)	0.9 (1.5)	SW

[a] Maximum concentration increments were estimated by using the ISCST3 model (Version 00101; EPA 1995).

[b] See Table 5.5-3.

[c] Total equals maximum concentration increment plus background concentration.

[d] The values are total concentration as percent of NAAQS. The values in parentheses are maximum concentration increments as a percentage of NAAQS.

[e] Receptor locations (distance and directions) of maximum concentrations are from the approximate center of the GPCR/TW-SCWO facility.

The total concentrations of criteria pollutants obtained by adding the predicted maximum concentration increments to background values (from Table 5.5-3) are compared with applicable NAAQS (Tables 5.5-8 through 5.5-10). Except for annual $PM_{2.5}$, maximum estimated concentrations of criteria pollutants are less than or equal to 54% of the NAAQS. Total annual $PM_{2.5}$ concentrations would be close to, but still below, applicable standards, primarily because of high background levels.

5.5.3.3 Impacts of Fluctuating Operations

To assess potential impacts that could result from possible fluctuations in operations that could occur during pilot testing, it was assumed that levels of organic compounds emissions would be 10 times higher than the estimated annual average for 5% of the time and that levels of inorganic compound emissions would be 10 times higher than the estimated annual average for 20% of the time. These assumptions are based on EPA guidance (EPA 1994, as cited in National Research Council 1997a).

TABLE 5.5-10 Maximum Predicted Off-Post Concentration Increments and Total Concentrations of Criteria Pollutants during Normal Operations of the Electrochemical Oxidation Technology at PBA

		Concentration (µg/m^3)					Receptor Location[e]	
Pollutant	Averaging Time	Maximum Increment[a]	Background[b]	Total[c]	NAAQS	Percent of NAAQS[d]	Distance [mi (km)]	Direction
SO_2	3 hours	9.4	78	87	1,300	6.7 (0.7)	1.0 (1.5)	WSW
	24 hours	3.2	29	32	365	8.8 (0.9)	0.9 (1.5)	SW
	Annual	0.02	5.3	5.3	80	6.7 (0.03)	0.9 (1.5)	SW
NO_2	Annual	0.31	21	21.3	100	21 (0.3)	0.9 (1.5)	SW
CO	1 hour	59	19,429	19,488	40,000	49 (0.1)	1.0 (1.7)	WSW
	8 hours	27	5,333	5,360	10,000	54 (0.3)	0.9 (1.5)	SW
PM_{10}	24 hours	3.5	78	82	150	54 (2.3)	0.9 (1.5)	SW
	Annual	0.02	26.4	26.4	50	53 (0.04)	0.9 (1.5)	SW
$PM_{2.5}$	24 hours	3.5	29.4	33	65	51 (5.4)	0.9 (1.5)	SW
	Annual	0.02	14.0	14.0	15	93 (0.1)	0.9 (1.5)	SW

[a] Maximum concentration increments were estimated by using the ISCST3 model (Version 00101; EPA 1995).

[b] See Table 5.5-3.

[c] Total equals maximum concentration increment plus background concentration.

[d] The values are total concentration as percent of NAAQS. The values in parentheses are maximum concentration increments as a percentage of NAAQS.

[e] Receptor locations (distance and directions) of maximum concentrations are from the approximate center of the Elchem Ox facility.

Over long time periods, such conditions would be assumed to increase organic emissions to 145% of their normal values and metal emissions to 280% of their normal values (EPA 1994, as cited in National Research Council 1997a). VOCs contribute to the formation of ozone, a criteria pollutant; multiplying VOC emissions from the proposed facility by 1.45 would result in about 2 tons per year, or less than 0.03% of the 1996 VOC emissions in Jefferson County (Table 5.5-2). Therefore, the potential increase in ozone concentration that could result from VOC emissions from the proposed facility operations under fluctuating operational conditions would be almost the same as that under normal operating conditions. Lead (Pb) is the only metal among criteria pollutants. Expected emissions of lead from the proposed facility are currently too small to quantify; therefore, increasing these emissions by 280% of their normal value would probably not lead to any appreciable increase in atmospheric Pb concentrations. Therefore, when fluctuating operational conditions are considered, the potential impacts of criteria pollutants involved would still be expected to be insignificant.

5.5.5 Impacts of No Action

The principal sources of air pollutant emissions associated with stockpile maintenance activities are exhaust emissions and road dust generated by vehicle operations. These emissions contribute to the background air quality at the installation. Emissions of air pollutants from these sources are minor both in absolute terms and in comparison with emissions from other natural and anthropogenic sources on and off PBA. Therefore, potential air quality impacts that would occur as a result of the continued storage of the stockpile are expected to be minimal.

5.6 AIR QUALITY — TOXIC AIR POLLUTANTS

5.6.1 Current Emissions and Air Quality

In 1999, the only reportable emission from PBA regulated under the EPA's Toxic Release Inventory (TRI) was 1,900 lb (862 kg) of hydrochloric acid generated as a by-product of incineration at the CIC (Vestal 2001). No other toxic air pollutant emissions exceeded TRI reporting limits. Other minor sources of VOC emissions at PBA include boilers, munitions manufacturing activities (e.g., M18 grenades and white phosphorus munitions), fuel oil and diesel storage, surface coating work, open burning/open detonation, and miscellaneous industrial processes. About 18 tons of VOCs were emitted in total from these sources in 2000 (Vestal 2001).

5.6.2 ACWA Facility Emissions

A summary of the estimated emissions of toxic air pollutants[6] that would result from operation of an ACWA pilot facility at PBA is given in Kimmell et al. (2001). Estimated emissions (including those from diesel generators and boilers) from a Neut/SCWO, a Neut/GPCR/TW-SCWO, and an Elchem Ox facility are provided in Tables 5.6-1 through 5.6-3. For the destruction facility stacks (SCWO vent, product gas burner vent, and catalytic oxidation unit [CatOx]/filter farm stack vent), emission estimates were based on demonstration test data and post-specific munitions inventories compiled by Mitretek Corp. (2001a–c). Estimates of emissions from diesel generators and boilers were based on standard algorithms that used fuel consumption estimates as input (Kimmell et al. 2001). For many substances (e.g., acetaldehyde, formaldehyde), the estimated emissions from boilers and diesel generators would exceed the emissions from destruction facility processes by many orders of magnitude (Tables 5.6-1 through 5.6-3).

---

[6] Many of the toxic air pollutants that would be emitted are HAPs as defined in Section 112, Title III, of the CAA. The term "toxic air pollutants" is broader in that it includes some pollutants that are not HAPs.

The estimates of air emissions from operating the pilot facilities were based on the assumption that organic substances from the filter farm stacks and the SCWO vent would be filtered from stack emissions by a series of six carbon filters, each having a removal efficiency of 95%. For PM (e.g., dioxins and furans on PM and metals), it was assumed that two high-efficiency particulate air (HEPA) filters, each with a removal efficiency of 99.97%, would be used for treatment. For the Neut/GPCR/TW-SCWO facility (Table 5.6-2), it was assumed that emissions from the product gas burner vent would not be further treated after release from the facility's scrubber system.

5.6.3 Impacts of the Proposed Action

5.6.3.1 Impacts of Construction

During construction, low-level emissions of potentially toxic air pollutants would result from the use of construction chemicals such as paints, thinners, and aerosols. These emissions would be expected to be minor and were not quantitatively estimated for this EIS. The main emissions from construction-related heavy equipment and from the commuter vehicles used by construction workers would consist of criteria pollutants (as summarized in Section 5.5); toxic air pollutant emissions were not quantified. The main emissions from construction-related heavy equipment and from the commuter vehicles used by construction workers would consist of criteria pollutants (Kimmell et al. 2001) and HAPs. HAP emissions were not quantified for this assessment because of insufficient data (e.g., whether the engine type is two-stroke, four-stroke, or diesel) (EPA 2000d). Although not quantified, the emission levels would be expected to be less than reportable quantities and similar across the technology systems evaluated.

5.6.3.2 Impacts of Operations

Estimates of emissions of toxic air pollutants that would result from the operation of pilot destruction facilities are provided in Tables 5.6-1 through 5.6-3. Many of the toxic air pollutants that would be emitted from the pilot test facility stacks are HAPs as defined in Title III, Section 112 of the *Clean Air Act* (CAA). However, a pilot test facility would not be a major source of HAP emissions and would not fall into any of the source categories regulated by EPA National Emission Standards for Hazardous Air Pollutants (NESHAP). Therefore, no regulatory action under NESHAPS would be necessary for the HAP emissions from a pilot test facility.

TABLE 5.6-1 Estimated Toxic Air Pollutant Emissions from Neutralization/SCWO Technology at PBA

	Emissions (µg/s)[b]			
			Nerve Agent Processing[c]	
Compound[a]	Diesel Generator	Boiler	SCWO Vent	Filter Farm Stack
1,3-Butadiene*	1.1	-	-	-
2-Methylnaphthalene	-	5.8×10^{-1}	-	-
3-Methylchloranthrene	-	4.3×10^{-2}	-	-
Acenaphthene	3.9×10^{-2}	4.3×10^{-2}	-	-
Acenaphthylene	1.4×10^{-1}	4.3×10^{-2}	-	-
Acetaldehyde*	2.1×10^{1}	-	1.0×10^{-6}	-
Acrolein*	2.6	-	-	-
Aldehydes	1.9×10^{3}	-	-	-
Anthracene	5.2×10^{-2}	5.8×10^{-2}	-	-
Antimony*	-	-	8.2×10^{-8}	-
Arsenic*	-	4.8	2.5×10^{-8}	-
Barium	-	1.1×10^{2}	-	-
Benz(a)anthracene	2.6×10^{1}	4.3×10^{-2}	-	-
Benzene*	4.7×10^{-2}	5.0×10^{1}	-	-
Benzo(a)pyrene	5.2×10^{-3}	2.9×10^{-2}	-	-
Benzo(b)fluoranthene	2.7×10^{-3}	4.3×10^{-2}	-	-
Benzo(g,h,i)perylene	1.4×10^{-2}	2.9×10^{-2}	-	-
Benzo(k)fluoranthene	4.3×10^{-3}	4.3×10^{-2}	-	-
Beryllium*	-	2.9×10^{-1}	4.9×10^{-9}	-
Butane	-	5.0×10^{4}	-	-
Cadmium*	-	2.6×10^{1}	1.3×10^{-7}	-
Chromium*	-	3.4×10^{1}	1.2×10^{-6}	-
Chrysene	9.8×10^{-3}	4.3×10^{-2}	-	-
Cobalt*	-	2.0	1.6×10^{-7}	-
Copper	-	2.0×10^{1}	-	-
Dibenzo(a,h)anthracene	1.6×10^{-2}	2.9×10^{-2}	-	-
Dichlorobenzene*	-	2.9×10^{1}	-	-
Dimethylbenz(a)anthracene	-	3.8×10^{-1}	-	-
Ethane	-	7.4×10^{4}	-	-
Fluoranthene	2.1×10^{-1}	7.2×10^{-2}	-	-
Fluorene	8.1×10^{-1}	6.7×10^{-2}	-	-
Formaldehyde*	3.3×10^{1}	1.8×10^{3}	1.3×10^{-7}	-
GB[d]	-	-	-	2.8
Hexane(n)*	-	4.3×10^{4}	-	-
Indeno(1,2,3-cd)pyrene	1.0×10^{-2}	4.3×10^{-2}	-	-
Lead*	-	1.2×10^{1}	1.3×10^{-6}	-
m,p-Xylene*	7.9	-	-	-
Manganese	-	9.1	1.2×10^{-6}	-

TABLE 5.6-1 (Cont.)

	Emissions (µg/s)[b]			
			Nerve Agent Processing[c]	
Compound[a]	Diesel Generator	Boiler	SCWO Vent	Filter Farm Stack
Mercury*	8.3×10^{-3}	6.2	1.0×10^{-7}	-
Methyl ethyl ketone/butyraldehydes*	-	-	2.6×10^{-8}	-
Molybdenum	-	2.6×10^{1}	-	-
Naphthalene*	2.3	1.5×10^{1}	8.4×10^{-10}	-
Nickel*	-	5.0×10^{1}	5.6×10^{-6}	-
Particulates	-	-	9.6×10^{-5}	-
Pentane(n)	-	6.2×10^{4}	-	-
Phenanthrene	8.1×10^{-1}	4.1×10^{-1}	-	-
Phosphorus*	-	-	2.9×10^{-5}	-
PCBs[e]	-	-	1.5×10^{-9}	-
PAHs*	4.7	-	-	-
Propane	-	3.8×10^{4}	-	-
Propylene	7.1×10^{1}	-	-	-
Pyrene	1.3×10^{-1}	1.2×10^{-1}	-	-
Selenium*	-	5.8×10^{-1}	2.0×10^{-7}	-
Toluene*	-	8.1×10^{1}	-	-
Vanadium	-	5.5×10^{1}	-	-
VX[d]	-	-		2.8

[a] Substances designated with an asterisk (*) are listed as HAPs under Title III, Section 112, of the CAA. PAHs = polycyclic aromatic hydrocarbons. PCBs = polychlorinated biphenyls.

[b] A hyphen indicates that the compound was not detected from this source during demonstration testing.

[c] For SCWO and filter farm stack emissions, organics are assumed to be treated by being passed through six carbon filters in series, each at 95% efficiency. PM is assumed to pass through two HEPA filters in series, each at 99.97% efficiency.

[d] The after-treatment emission rate from the filter farm stack for chemical agent (GB, VX) is a worst-case estimate; it assumes emissions at the detection limit (Kimmell et al. 2001). It is assumed that no agent would be emitted from the SCWO stack; none would be present after neutralization and SCWO treatment.

[e] Although PCB destruction was not included in demonstration testing, for these analyses, it is assumed that SCWO technology would have a destruction efficiency of 99.9999% and that further treatment, as described in footnote c, would be applied.

TABLE 5.6-2 Estimated Toxic Air Pollutant Emissions from Neutralization/GPCR/TW-SCWO Technology at PBA

	Emissions (μg/s)[b]					
			GB Processing[c]		VX Processing[c]	
Compound[a]	Diesel Generator	Boiler	Product Gas Burner	Filter Farm Stack	Product Gas Burner	Filter Farm Stack
1,1,1-Trichloroethane	-	-	8.7×10^{-2}	7.1×10^{-8}	6.6×10^{-2}	-
1,2,3,4,6,7,8-HpCDF	-	-	1.3×10^{-8}	-	1.0×10^{-5}	-
1,2,3,4,7,8-HxCDF	-	-	1.0×10^{-7}	-	8.0×10^{-5}	-
1,2,3,6,7,8-HxCDF	-	-	3.9×10^{-8}	-	3.0×10^{-5}	-
1,2,4-Trimethylbenzene	-	-	-	7.7×10^{-9}	-	2.0×10^{-6}
1,3-Butadiene*	1.1	-	-	-	-	-
1,4-Dichlorobenzene*	-	-	-	-	-	4.6×10^{-9}
1-Ethyl-2,2,6-trimethylcyclohexane	-	-	-	-	-	1.5×10^{-6}
1-Hexanol, 2-ethyl-	-	-	2.7×10^{1}	-	20	-
1H-Indene	-	-	6.6	-	5.1	-
1H-Indene, 2,3-dihydro-	-	-	-	4.6×10^{-8}	-	-
2-(2-Butoxyethoxy) ethanol	-	-	-	-	-	1.7×10^{-6}
2,3,7,8-TCDF	-	-	6.1×10^{-8}	-	4.7×10^{-5}	-
2,4-Dimethylphenol	-	-	2.6	-	2.0	-
2-Butanone (methyl ethyl ketone)*	-	-	9.2×10^{-1}	-	7.1×10^{-1}	-
2-Methylnaphthalene	-	9.1×10^{-2}	-	1.8×10^{-8}	-	7.4×10^{-7}
2-Nitrophenol	-	-	-	5.1×10^{-9}	-	-
3-Methylchloranthrene	-	6.8×10^{-3}	-	-	-	-
9H-Fluoren-9-one	-	-	-	2.7×10^{-6}	-	-
Acenaphthene	3.9×10^{-2}	6.8×10^{-3}	-	9.0×10^{-10}	-	-
Acenaphthylene	1.4×10^{-1}	6.8×10^{-3}	-	-	-	-
Acetaldehyde*	2.1×10^{1}	-	-	-	-	-
Acetic acid	-	-	-	-	-	5.6×10^{-7}
Acetone	-	-	2.4×10^{2}	-	1.8×10^{2}	-
Acrolein*	2.6	-	-	-	-	-
Aldehydes	1.9×10^{3}	-	-	-	-	-
Aluminum	-	-	8.9	-	6.8	-
Anthracene	5.2×10^{-2}	9.1×10^{-3}	-	1.0×10^{-8}	-	4.1×10^{-9}
Antimony*	-	-	3.0×10^{-2}	1.7×10^{-9}	2.3×10^{-2}	1.1×10^{-6}
Arsenic*	-	7.6×10^{-1}	4.2×10^{-1}	6.7×10^{-9}	3.2×10^{-1}	-
Barium	-	1.7×10^{1}	3.9×10^{-1}	-	3.0×10^{-1}	-
Benz(a)anthracene	4.7×10^{-2}	6.8×10^{-3}	7.0×10^{-2}	1.9×10^{-9}	5.4×10^{-2}	-
Benzaldehyde	-	-	9.3	2.8×10^{-8}	7.1	-
Benzaldehyde, 4-ethyl-	-	-	2.1	-	1.6	-
Benzaldehyde, ethyl-	-	-	1.3	-	9.8×10^{-1}	-
Benzaldehyde, ethyl- benzenemethanol, 4-(1-methylethyl)-	-	-	1.2	-	9.2×10^{-1}	-
Benzene*	2.6×10^{1}	8.0	6.5	1.2×10^{-6}	5.0	1.3×10^{-6}
Benzene, 1,2,3-trimethyl-	-	-	-	-	-	3.9×10^{-7}
Benzene, 1,2,4,5-tetramethyl-	-	-	-	-	-	1.8×10^{-6}
Benzene, 1-methyl-2-propyl-	-	-	-	-	-	1.8×10^{-6}
Benzene, 1-methyl-3-propyl-	-	-	-	-	-	4.4×10^{-7}
Benzo(a)pyrene	5.2×10^{-3}	4.6×10^{-3}	-	-	-	-
Benzo(b)fluoranthene	2.7×10^{-3}	6.8×10^{-3}	-	-	-	-
Benzo(g,h,i)perylene	1.4×10^{-2}	4.6×10^{-3}	-	-	-	-
Benzo(k)fluoranthene	4.3×10^{-3}	6.8×10^{-3}	-	-	-	-
Benzyl alcohol	-	-	1.6	-	1.3	1.7×10^{-6}
Beryllium*	-	4.6×10^{-2}	7.6×10^{-3}	7.2×10^{-10}	5.8×10^{-3}	-
Bis(2-ethylhexyl)phthalate*	-	-	1.9	6.6×10^{-9}	1.5	6.3×10^{-9}

TABLE 5.6-2 (Cont.)

	Emissions (µg/s)[b]					
			GB Processing[c]		VX Processing[c]	
Compound[a]	Diesel Generator	Boiler	Product Gas Burner	Filter Farm Stack	Product Gas Burner	Filter Farm Stack
Butanal	-	-	-	7.9×10^{-9}	-	2.9×10^{-8}
Butane	-	8.0×10^{3}	-	-	-	-
C3-Alkyl benzenes	-	-	-	4.8×10^{-7}	-	-
Cadmium*	-	4.2	1.2×10^{-1}	3.0×10^{-9}	9.2×10^{-2}	3.0×10^{-7}
Calcium	-	-	2.0×10^{1}	8.6×10^{-6}	15	6.9×10^{-5}
Carbon disulfide*	-	-	2.5×10^{-1}	-	2.0×10^{-1}	-
Chloroform*	-	-	3.9	-	3.0	-
Chromium*	-	5.3	1.1	-	8.3×10^{-1}	-
Chrysene	9.8×10^{-3}	6.8×10^{-3}	-	3.9×10^{-9}	-	-
Cobalt*	-	3.2×10^{-1}	3.5×10^{-2}	9.5×10^{-9}	2.7×10^{-2}	1.8×10^{-7}
Copper	-	3.2	2.0	-	1.5	-
Cyclododecane	-	-	2.8	-	2.2	-
Cyclohexane, 2-butyl-1,1,3-trimethyl-	-	-	-	-	-	3.5×10^{-7}
Cyclohexane, butyl-	-	-	-	5.7×10^{-9}	-	2.7×10^{-6}
Cyclohexane, hexyl-	-	-	-	-	-	4.0×10^{-7}
Cyclohexanol	-	-	-	-	-	8.8×10^{-7}
Cyclohexanone	-	-	-	3.8×10^{-8}	-	7.6×10^{-9}
Cyclotetrasiloxane, octamethyl-	-	-	2.8	-	2.2	-
Decane	-	-	-	6.2×10^{-8}	-	1.1×10^{-5}
Decane, 2,6,7-trimethyl-	-	-	-	5.2×10^{-9}	-	-
Decane, 2-methyl-	-	-	-	-	-	2.6×10^{-6}
Decane, 3-methyl-	-	-	-	-	-	1.9×10^{-6}
Decane, 4-methyl-	-	-	-	6.7×10^{-9}	-	1.4×10^{-6}
Decane, 5-methyl-	-	-	-	2.4×10^{-8}	-	-
Dibenzo(a,h)anthracene	1.6×10^{-2}	4.6×10^{-3}	-	-	-	-
Dibenzofuran*	-	-	1.0	5.9×10^{-8}	7.9×10^{-1}	6.8×10^{-8}
Dichlorobenzene*	-	4.6	-	-	-	-
Diethylene glycol	-	-	-	-	-	5.2×10^{-6}
Diethylphthalate	-	-	1.7	-	1.3	-
Dimethylbenz(a)anthracene	-	6.1×10^{-2}	-	-	-	-
Di-n-butylphthalate (bis-(2-ethylhexyl)phthalate)*	-	-	3.6	-	2.8	-
Diphenylmethane	-	-		5.0×10^{-9}	-	-
Dodecane	-	-	1.1	1.1×10^{-7}	8.6×10^{-1}	4.3×10^{-6}
Dodecane, 2,6,10-trimethyl-	-	-	-	7.2×10^{-9}	-	-
Dodecane, 4-methyl-	-	-	-	2.1×10^{-8}	-	-
Dodecane, 6-methyl-	-	-	-	1.3×10^{-8}	-	1.3×10^{-6}
Ethane	-	1.2×10^{4}	-	-	-	-
Ethanol, 2-(2-butoxyethoxy)-, acetate	-	-	-	2.4×10^{-8}	-	-
Ethanone, 1-(3-methylphenyl)-	-	-	-	7.6×10^{-9}	-	-
Ethanone, 1-phenyl-	-	-	-	5.5×10^{-8}	-	-
Ether	-	-	1.9×10^{2}	-	1.5×10^{2}	-
Ethylbenzene*	-	-	5.9	-	4.5	-
Ethylene glycol*	-	-	-	2.2×10^{-7}	-	1.8×10^{-6}
Fluoranthene	2.1×10^{-1}	1.1×10^{-2}	-	1.2×10^{-8}	-	8.3×10^{-9}
Fluorene	8.1×10^{-1}	1.1×10^{-2}	4.7×10^{-2}	2.2×10^{-8}	3.6×10^{-2}	2.4×10^{-8}
Formaldehyde*	3.3×10^{1}	2.9×10^{2}	-	-	-	-
GB[d]	-	-	-	3.7	-	-
Heptadecane	-	-	-	1.7×10^{-8}	-	-
Heptanal	-	-	-	2.8×10^{-7}	-	-

TABLE 5.6-2 (Cont.)

Compound[a]	Emissions (µg/s)[b]					
			GB Processing[c]		VX Processing[c]	
	Diesel Generator	Boiler	Product Gas Burner	Filter Farm Stack	Product Gas Burner	Filter Farm Stack
Heptane, 3-ethyl-2-methyl-	-	-	-	1.7×10^{-8}	-	8.5×10^{-7}
Hexadecane, 2,6,10,14-tetramethyl-	-	-	-	3.2×10^{-8}	-	-
Hexanal	-	-	-	1.0×10^{-7}	-	1.0×10^{-7}
Hexane(n)*	-	6.8×10^{3}	1.2×10^{2}	-	9.2×10^{1}	-
Hydrochloric acid*	-	-	7.6×10^{1}	4.5×10^{-6}	5.8×10^{1}	2.8×10^{1}
Hydrogen fluoride*	-	-	1.3	4.7×10^{1}	1.0	-
Hydrogen cyanide*	-	-	5.3	-	4.0	-
Hydrogen sulfide*	-	-	7.7×10^{3}	-	5.9×10^{3}	-
Indeno(1,2,3-cd)pyrene	1.0×10^{-2}	6.8×10^{-3}	-	-	-	-
Iron	-	-	1.3×10^{1}	8.4×10^{-7}	1.0×10^{1}	-
Isobutyl alcohol	-	-	-	8.9×10^{-8}	-	1.7×10^{-6}
Lead*	-	1.9	1.6×10^{-1}	3.7×10^{-8}	1.2×10^{-1}	1.1×10^{-5}
m,p-Xylene*	7.9	-	-	-	-	-
Magnesium	-	-	3.0	2.7×10^{-6}	2.3	1.9×10^{-5}
Malonic acid	-	-	-	2.1×10^{-5}	-	-
Manganese*	-	1.4	2.9×10^{1}	1.2×10^{-7}	22	6.1×10^{-5}
Mercury*	8.3×10^{-3}	9.9×10^{-1}	-	1.7×10^{-8}	-	-
Methylene chloride*	-	-	1.0×10^{1}	1.3×10^{-4}	8.0	7.0×10^{-7}
Molybdenum	-	4.2	8.5×10^{1}	4.4×10^{-8}	6.5×10^{1}	2.1×10^{-6}
m-Tolualdehyde	-	-	-	7.1×10^{-8}	-	4.9×10^{-8}
Naphthalene*	2.3	2.3	1.5×10^{-1}	1.2×10^{-7}	1.1×10^{-1}	5.9×10^{-7}
Naphthalene, 1,2,3,4-tetrahydro-	-	-	-	-	-	9.7×10^{-7}
Naphthalene, 1,2,3,4-tetrahydro-6-methyl-	-	-	-	-	-	5.1×10^{-7}
Naphthalene, 1,7-dimethyl-	-	-	-	-	-	5.5×10^{-7}
Naphthalene, 1-methyl-	-	-	-	1.9×10^{-8}	-	-
Nickel*	-	8.0	1.2	2.5×10^{-8}	9.5×10^{-1}	-
Nitrobenzene*	-	-	4.4×10^{-1}	6.3×10^{-8}	3.4×10^{-1}	-
Nonane, 2,6-dimethyl-	-	-	-	2.0×10^{-8}	-	4.7×10^{-6}
Nonane, 3,7-dimethyl-	-	-	-	-	-	6.9×10^{-7}
Nonane, 3-methyl-	-	-	-	-	-	3.6×10^{-7}
Octane, 3,6-dimethyl-	-	-	-	-	-	1.7×10^{-6}
Pentadecane	-	-	-	-	-	1.2×10^{-6}
Pentanal	-	-	-	1.3×10^{-7}	-	-
Pentane(n)	-	9.9×10^{3}	-	-	-	-
Phenanthrene	8.1×10^{-1}	6.5×10^{-2}	-	5.2×10^{-8}	-	5.5×10^{-8}
Phenol*	-	-	3.8	1.5×10^{-8}	2.9	-
Phosphorus*	-	-	5.7	1.3×10^{-5}	4.4	2.0×10^{-4}
PCBs[e]	-	-	9.6×10^{-2}	-	9.6×10^{-2}	-
PAHs*	4.7	-	-	-	-	-
Potassium	-	-	-	-	-	9.1×10^{-5}
Propanal (propionaldehyde)*	-	-	-	9.5×10^{-8}	-	9.2×10^{-8}
Propane	-	6.1×10^{3}	-	-	-	-
Propylene	7.1×10^{1}	-	-	-	-	-
Pyrene	1.3×10^{-1}	1.9×10^{-2}	-	6.5×10^{-9}	-	3.8×10^{-9}
Selenium*	-	9.1×10^{-2}	1.7×10^{-1}	-	1.3×10^{-1}	-
Silver	-	-	1.1×10^{-1}	8.6×10^{-9}	8.1×10^{-2}	6.5×10^{-8}
Sodium	-	-	2.6×10^{2}	-	2.0×10^{2}	6.7×10^{-5}
Styrene*	-	-	5.4×10^{-1}	-	4.1×10^{-1}	-
Tetrachloroethene*	-	-	7.8×10^{-2}	-	6.0×10^{-2}	-
Tetradecane	-	-	-	7.1×10^{-8}	-	5.4×10^{-6}

TABLE 5.6-2 (Cont.)

	Emissions (μg/s)[b]					
			GB Processing[c]		VX Processing[c]	
Compound[a]	Diesel Generator	Boiler	Product Gas Burner	Filter Farm Stack	Product Gas Burner	Filter Farm Stack
Thallium	-	-	3.8×10^{-2}	-	2.9×10^{-2}	-
Tin	-	-	1.5	-	1.2	-
Toluene*	1.1×10^{1}	1.3×10^{1}	8.7×10^{-1}	4.0×10^{-7}	6.6×10^{-4}	2.4×10^{-7}
Total HpCDF	-	-	1.5×10^{-9}	-	1.2×10^{-9}	-
Total HxCDD	-	-	7.7×10^{-7}	-	5.9×10^{-10}	-
Total HxCDF	-	-	1.6×10^{-6}	-	1.2×10^{-9}	-
Total PeCDD	-	-	4.4×10^{-7}	-	3.4×10^{-7}	-
Total PeCDF	-	-	5.5×10^{-7}	-	4.2×10^{-7}	-
Total TCDD	-	-	3.6×10^{-7}	-	2.8×10^{-7}	-
Total TCDF	-	-	7.8×10^{-7}	-	6.0×10^{-7}	-
Trichloroethene*	-	-	7.8×10^{-2}	-	6.0×10^{-2}	-
Tridecane	-	-	-	1.1×10^{-7}	-	2.4×10^{-6}
Tridecane, 2-methyl-	-	-	-	-	-	1.5×10^{-6}
Tridecane, 4-methyl-	-	-	-	-	-	6.9×10^{-7}
Tridecane, 6-propyl-	-	-	-	-	-	5.3×10^{-7}
Undecane	-	-	-	1.0×10^{-7}	-	7.1×10^{-6}
Undecane, 2,10-dimethyl-	-	-	-	3.2×10^{-8}	-	3.1×10^{-7}
Undecane, 2,6-dimethyl-	-	-	-	3.9×10^{-8}	-	-
Undecane, 2-methyl-	-	-	-	2.5×10^{-8}	-	-
Undecane, 3,6-dimethyl-	-	-	-	-	-	1.1×10^{-6}
Undecane, 4-methyl-	-	-	-	-	-	7.3×10^{-7}
VX[d]	-	-	-	-	-	3.7
Vanadium	-	8.8	1.1×10^{-1}	8.8×10^{-9}	8.8×10^{-2}	1.1×10^{-7}
Xylenes*	-	-	4.0×10^{-1}	3.1×10^{-1}	3.1×10^{-1}	-
Zinc	-	-	1.6	-	1.2	-

[a] Substances designated with an asterisk (*) are listed as HAPs under Title III, Section 112, of the CAA. PAHs = polycyclic aromatic hydrocarbons. PCBs = polychlorinated biphenyls. Polychlorinated dioxins/furans are as follows: HpCDF = heptachlorodibenzo-p-furan, HxCDD = hexachlorodibenzo-p-dioxin; HxCDF = hexachlorodibenzo-p-furan, PeCDD = pentachlorodibenzo-p-dioxin; PeCDF = pentachlorodibenzo-p-furan; TCDD = tetrachlorodibenzo-p-dioxin; TCDF = tetrachlorodibenzo-p-furan.

[b] A hyphen indicates that the compound was not detected from this source during demonstration testing.

[c] For the filter farm stack emissions, organics are assumed to be treated by being passed through six carbon filters in series, each at 95% efficiency. PM (metals, dioxins/furans) is assumed to pass through two HEPA filters in series, each at 99.97% efficiency. Product gas burner emissions are assumed not to receive further treatment after release from facility scrubbers.

[d] The after-treatment emission rate from the filter farm stack for chemical agent (GB, VX) is a worst-case estimate; it assumes emissions at the detection limit (Kimmell et al. 2001). It is assumed that no agent would be emitted from the product gas burner stack; none would be present after neutralization and SCWO treatment.

[e] Although PCB destruction was not included in demonstration testing, for these analyses, it is assumed that Neut/GPCR/TW-SCWO technology would have a destruction efficiency of 99.9999%.

TABLE 5.6-3 Estimated Toxic Air Pollutant Emissions from Electrochemical Oxidation Technology at PBA

	Emissions (µg/s)[b]			
			CatOx/Filter Farm Stack	
Compound[a]	Diesel Generator	Boiler	GB Processing[c]	VX Processing[c]
1,3-Butadiene*	1.1	-	-	-
1,5-Pentanediol, dinitrate	-	-	5.8×10^{-6}	4.4×10^{-6}
1-Butanol, 3-methyl-, nitrate	-	-	2.6×10^{-5}	2.0×10^{-5}
1-Hexanol, 2-ethyl-	-	-	3.3×10^{-7}	2.5×10^{-7}
2-Heptanone	-	-	6.0×10^{-7}	4.5×10^{-7}
2-Hexanone	-	-	5.4×10^{-6}	4.1×10^{-6}
2-Methylnaphthalene	-	4.4×10^{-2}	-	-
2-Octanone	-	-	9.7×10^{-7}	7.4×10^{-7}
2-Pentanol, nitrate	-	-	3.6×10^{-5}	2.7×10^{-5}
3-Methylchloranthrene	-	3.3×10^{-3}	-	-
4-Methyl-2-pentanone	-	-	2.0×10^{-7}	1.8×10^{-7}
4-Octene, (E)-	-	-	9.0×10^{-8}	7.8×10^{-8}
Acenaphthene	3.9×10^{-2}	3.3×10^{-3}	-	-
Acenaphthylene	1.4×10^{-1}	3.3×10^{-3}	-	-
Acetaldehyde*	2.1×10^{1}	-	-	-
Acetamide, N,N-dimethyl-	-	-	2.0×10^{-6}	1.5×10^{-6}
Acetic acid	-	-	2.6×10^{-6}	2.2×10^{-6}
Acetone	-	-	1.5×10^{-8}	1.3×10^{-8}
Acrolein*	2.6	-	-	-
Aldehydes	1.9×10^{3}	-	-	-
Anthracene	5.2×10^{-2}	4.4×10^{-3}	-	-
Arsenic*	-	3.7×10^{-1}	-	-
Barium	-	8.0	-	-
Benz(a)anthracene	4.7×10^{-2}	3.3×10^{-3}	-	-
Benzene*	2.6×10^{1}	3.8	2.1×10^{-6}	1.6×10^{-6}
Benzo(a)pyrene	5.2×10^{-3}	2.2×10^{-3}	-	-
Benzo(b)fluoranthene	2.7×10^{-3}	3.3×10^{-3}	-	-
Benzo(g,h,i)perylene	1.4×10^{-2}	2.2×10^{-3}	-	-
Benzo(k)fluoranthene	4.3×10^{-3}	3.3×10^{-3}	-	-
Beryllium*	-	2.2×10^{-2}	-	-
Bis(2-ethylhexyl)phthalate*	-	-	9.1×10^{-7}	6.9×10^{-7}
Butane	-	3.8×10^{3}	-	-
Cadmium*	-	2.0	-	-
Carbon disulfide*	-	-	7.7×10^{-5}	5.8×10^{-5}
Chromium*	-	2.6	-	-
Chrysene	9.8×10^{-3}	3.3×10^{-3}	-	-
Cobalt*	-	1.5×10^{-1}	-	-
Copper	-	1.6	-	-
Cyclohexane, 1,2,3-trimethyl-	-	-	3.1×10^{-7}	2.7×10^{-7}

TABLE 5.6-3 (Cont.)

	Emissions (µg/s)[b]			
			CatOx/Filter Farm Stack	
Compound[a]	Diesel Generator	Boiler	GB Processing[c]	VX Processing[c]
Decane	-	-	5.2×10^{-6}	4.0×10^{-6}
Decanenitrile	-	-	8.8×10^{-7}	6.7×10^{-7}
Dibenzo(a,h)anthracene	1.6×10^{-2}	2.2×10^{-3}	-	-
Dichlorobenzene*	-	2.2	-	-
Dimethylbenz(a)anthracene	-	2.9×10^{-2}	-	-
Dodecane	-	-	7.1×10^{-6}	5.4×10^{-6}
Ethane	-	5.7×10^{3}	-	
Ethylbenzene*	-	-	1.4×10^{-7}	1.1×10^{-7}
Fluoranthene	2.1×10^{-1}	5.5×10^{-3}	-	-
Fluorene	8.1×10^{-1}	5.1×10^{-3}	-	-
Formaldehyde*	3.3×10^{1}	1.4×10^{2}	-	-
GB[d]	-	-	3.4	-
Heptanal	-	-	1.3×10^{-6}	9.9×10^{-7}
Heptanenitrile	-	-	7.7×10^{-7}	5.9×10^{-7}
Hexadecane	-	-	1.3×10^{-6}	9.8×10^{-7}
Hexane(n)*	-	3.3×10^{3}	-	-
Hexanenitrile	-	-	6.9×10^{-7}	5.3×10^{-7}
Indeno(1,2,3-cd)pyrene	1.0×10^{-2}	3.3×10^{-3}	-	-
Isopropyl nitrate	-	-	1.6×10^{-4}	1.2×10^{-4}
Lead*	-	9.1×10^{-1}	-	-
m,p-Xylene*	7.9	-	-	-
Manganese*	-	6.9×10^{-1}	-	-
Mercury*	8.3×10^{-3}	4.8×10^{-1}	-	-
Molybdenum	-	2.0	-	-
Naphthalene*	2.3	1.1	3.0×10^{-5}	2.6×10^{-5}
Nickel*	-	3.8	-	-
Nitric acid esters	-	-	6.2×10^{-6}	4.7×10^{-6}
Nitric acid, butyl ester	-	-	2.9×10^{-5}	2.2×10^{-5}
Nitric acid, decyl ester	-	-	2.4×10^{-6}	1.8×10^{-6}
Nitric acid, ethyl ester	-	-	1.6×10^{-5}	1.2×10^{-5}
Nitric acid, hexyl ester	-	-	1.6×10^{-5}	1.2×10^{-5}
Nitric acid, nonyl ester	-	-	5.3×10^{-6}	4.1×10^{-6}
Nitric acid, pentyl ester	-	-	1.7×10^{-5}	1.3×10^{-5}
Nitric acid, propyl ester	-	-	1.7×10^{-5}	1.3×10^{-5}
Nonanal	-	-	8.4×10^{-7}	7.3×10^{-7}
Nonanenitrile	-	-	1.5×10^{-6}	1.1×10^{-6}
Octanal	-	-	1.5×10^{-6}	1.2×10^{-6}
Octanenitrile	-	-	1.7×10^{-6}	1.3×10^{-6}
Pentadecane	-	-	2.6×10^{-6}	1.9×10^{-6}
Pentane(n)	-	4.8×10^{3}	-	-

TABLE 5.6-3 (Cont.)

	Emissions (µg/s)[b]			
			CatOx/Filter Farm Stack	
Compound[a]	Diesel Generator	Boiler	GB Processing[c]	VX Processing[c]
Phenanthrene	8.1×10^{-1}	3.1×10^{-2}	-	-
PCBs[e]	-	-	1.5×10^{-9}	1.5×10^{-9}
PAHs*	4.7	-	-	-
Propane	-	2.9×10^{3}	-	-
Propylene	7.1×10^{1}	-	-	-
Pyrene	1.3×10^{-1}	9.1×10^{-3}	-	-
Selenium*	-	4.4×10^{-2}	-	-
Tetradecane	-	-	8.3×10^{-6}	6.3×10^{-6}
Toluene*	1.1×10^{1}	6.2	5.4×10^{-7}	4.1×10^{-7}
Tridecane	-	-	7.5×10^{-6}	5.7×10^{-6}
Undecane	-	-	6.3×10^{-6}	4.8×10^{-6}
VX[d]	-	-	-	3.4
Vanadium	-	4.2	-	-
Xylenes*	-	-	7.2×10^{-7}	5.7×10^{-7}

[a] Substances designated with an asterisk (*) are listed as HAPs under Title III, Section 112, of the CAA. PAHs = polycyclic aromatic hydrocarbons. PCBs = polychlorinated biphenyls.

[b] A hyphen indicates that the compound was not detected from this source during demonstration testing.

[c] For the CatOx/filter farm stack emissions, organics are assumed to be treated by being passed through six carbon filters in series, each at 95% efficiency. PM (metals, dioxins/furans) is assumed to pass through two HEPA filters in series, each at 99.97% efficiency.

[d] The after-treatment emission rate from the filter farm stack for chemical agent (GB, VX) is a worst-case estimate; it assumes emissions at the detection limit (Kimmell et al. 2001).

[e] Although PCB destruction was not included in demonstration testing, for these analyses, it was assumed that Elchem Ox technology would have a destruction efficiency of 99.9999% and that further treatment, as described in footnote c, would be applied.

Polychlorinated biphenyls (PCBs) have been identified as a constituent in the firing tubes of M55 rockets (see Section 5.4.2.2). PCBs were not tested as part of the ACWA demonstration project, since doing so would have triggered regulatory requirements under the TSCA that would have added considerably to the cost and difficulty of the demonstration. Demonstration tests were conducted by using wood spiked with pentachlorophenol (PCP, a chlorinated substance similar to PCBs). Results showed degradation of the PCP in the test systems, indicating that PCBs would also likely be destroyed. For pilot testing of M55 rocket destruction systems, appropriate TSCA regulations on monitoring PCBs and limiting them in effluents would be followed, and a permit with treatment standards would be obtained before rocket pilot testing. For the purposes of this assessment, it was assumed that the technology systems evaluated would achieve a PCB destruction efficiency of 99.9999. For filtered stacks, further removal by carbon filtration was also assumed.

In order to assess health risks associated with toxic air pollutant emissions (Section 5.7), the locations of maximum on-post and off-post concentrations of the emitted compounds listed in Tables 5.6-1 through 5.6-3 were identified through air modeling. The ISCST3 model (EPA 1995) was used in the same way as it was used for assessing criteria air pollutant emissions in Section 5.5. Details on the modeling conducted are presented in Appendix C.

The main emissions from commuter vehicles and delivery trucks are criteria pollutants (as summarized in Section 5.5); toxic air pollutant emissions have not been quantified.

5.6.3.3 Impacts of Fluctuating Operations

To account for possible fluctuations in operations that could occur during pilot testing, it was assumed that levels of organic compounds would be 10 times higher than the estimated annual average for 5% of the time and that levels of inorganic compounds would be 10 times higher than the estimated annual average for 20% of the time. These assumptions were based on EPA guidance (National Research Council 1997b) and were used to generate ambient annual concentrations for exposure estimates, as detailed in Appendix C.

During fluctuating operations, it is possible that agent could be released from the filter farm stack, which is the ventilation stack for the Munitions Demilitarization Building (MDB) process area. Regardless of the ACWA technology selected for implementation at PBA, the filter farm stack would be equipped with multiple carbon filter banks and with agent monitoring devices between banks. These devices would ensure that, in the unlikely event that some agent was not destroyed in the neutralization process and subsequent treatment, it would be detected and the causes mitigated immediately.

For the purpose of estimating the maximum potential emissions of chemical agent, only the MDB process area was assumed to be a potential source. The filter systems would be designed to remove agent from the ventilation air stream to a level below the detectable level

(Kimmell et al. 2001). Therefore, if any agent were detected in the exhaust stream, alarms would sound, the cause would be identified and mitigated, and the emission of agent (if any) would be short-term and at low levels. Since no estimates of potential chemical agent emission levels were made on the basis of demonstration test results, it was conservatively assumed for this assessment that an agent could hypothetically be emitted continuously from the stack at the detection limit level for that agent. Modeling dispersion from the source at these levels resulted in the maximum hypothetical on-post and off-post agent concentrations presented in Table 5.6-4. All these values are less than 1% of the allowable concentrations for general public exposure established by the Centers for Disease Control and Prevention (CDC 1988). In practice, the facility stacks would have continuous agent monitoring devices that would sound if any agent were detected in the stacks. The reasons for the presence of the agent would thus be identified, and the agent would be eliminated.

5.6.4 Impacts of No Action

Activities associated with continued storage at PBA would include inspecting, monitoring, and conducting an annual inventory of all munitions; overpacking any leaking munitions discovered during inspections; and transporting overpacked leakers to a separate RCRA-permitted storage igloo. All chemical munition storage igloos would continue to be routinely inspected and monitored in accordance with strict U.S. Army regulations. All of the permitted igloos containing the overpacked leakers would continue to be inspected and monitored in accordance with applicable State of Arkansas-issued RCRA permit conditions. Upon discovery of a leaker, a filter would be installed, and the entry door would be sealed. The amount of agent that might spill from a leaking munition would likely be small, and any vapor that might form as a result of the spill would likely be contained within the igloo. These statements are especially true for VX, which has a very low volatility (10 mg/m^3 at 25°C [77°F]). Liquid that could leak from a munition would tend to spill slowly over the munition(s) and onto the igloo floor. A VX liquid spill would evaporate very slowly because of the still air conditions inside the igloo and the low volatility of the agent. Because of GB's greater volatility (21,000 mg/m^3), a liquid spill would more readily evaporate. However, because of the still air conditions inside igloos and the small spill areas that typically occur, spilled liquid and vapors coming from a GB munition leak would probably remain contained inside the igloo long enough for inspection crews to detect and remediate them. If the munition leak were from an M55 rocket, the shipping and handling containers for these munitions would contain any GB or VX liquid that might leak from the rocket. During Chemical Stockpile Emergency Preparedness Program (CSEPP) exercises, maximum credible events (MCEs) involving the spill of agent onto the igloo floor have been simulated with the D2PC model. These exercises have shown that the hazard zone from such an event would be contained within the PBCA at PBA.

TABLE 5.6-4 Maximum Annual Average Estimated On-Post and Off-Post Concentrations of Agent during ACWA Pilot Facility Operations at PBA[a]

Technology	Maximum Annual Average Off-Post Concentration ($\mu g/m^3$)	Maximum Annual Average On-Post Concentration ($\mu g/m^3$)	Percent of Limit Off Post[b]	Percent of Limit On Post[b]
Neut/SCWO	5.6×10^{-7}	7.2×10^{-7}	0.02	0.024
Neut/GPCR/TW-SCWO	7.0×10^{-7}	8.1×10^{-7}	0.02	0.03
Elchem Ox	6.4×10^{-7}	7.9×10^{-7}	0.01	0.03

[a] Estimated concentrations account for fluctuating operations. Agents considered are the nerve agents GB and VX.

[b] The general population exposure limits for 72-hour time-weighted average exposures, as estimated by CDC (1988), are as follows: GB and VX = 0.003 $\mu g/m^3$.

5.7 HUMAN HEALTH AND SAFETY — ROUTINE OPERATIONS

Impacts on human health from routine operations are generally assessed by estimating exposures to the toxic substances that are emitted from a facility on a routine basis and by estimating the potential for those exposures to cause adverse health effects. Because the degree of exposure is partially determined by where the human population is located with respect to the emission points, this section gives data on the locations of workers and the general public around the proposed facilities. Guidance for the estimation of exposure and risk from routine low-level exposures is available from the EPA. The assessment for this EIS generally followed the principlesals of the EPA's Risk Assessment Guidance for Superfund, which includes the estimation of risk for a reasonably maximally exposed individual (MEI) (EPA 1989, 1997). For example, the risk for the off-site public would be assessed by assuming that the MEI resided in the area of off-site maximum contaminant concentrations (generally but not always the fence line). Other assumptions on intake levels and susceptibility are made to ensure that, whenever possible, that exposures and risks will be overestimated rather than underestimated. The reasoning is that if the MEI risk is found to be within acceptable limits, then the risk to the general public will be lower and also generally acceptable.

In addition to risks from exposures to facility emissions, occupational hazard risks of injury and fatality are presented for the facility workers. Some risk of on-the-job injury or fatality is associated with any industry, and a screening estimation of this risk is presented. The main determinanttion of this type of risk is the type of work (construction or facility operation) being done and the number of employees who are doing it.

5.7.1 Current Environment

5.7.1.1 Existing Environmental Contamination and Remediation Efforts

Contamination of groundwater in the near-surface aquifer has been detected at PBA as a result of past operations of the munitions facilities. Remedial action has been completed to remove or isolate areas that previously caused contamination. Environmental cleanup is being addressed in other environmental compliance documentation and is beyond the scope of this EIS. No past contamination has been identified at the sites being considered for an ACWA pilot test facility.

5.7.1.2 On-Post Workers and Residents

Employment at PBA currently stands at about 1,900, including 1,000 arsenal employees, 100 employees working at the CLA, approximately 30 military personnel, and about 800 employees for the PBCDF (Atkinson 2000). Next to the installation there are also a number of commercial and industrial tenants occupying land and buildings formerly used by the military. Employment in these activities is currently about 700 employees, including 600 employees at the NCTR.

The types of workers currently employed at PBA include industrial workers, environmental protection specialists, fire and emergency services specialists, facility management and maintenance workers, and administrative and office workers. The hazards associated with these jobs vary; workers receive training to address their specific job hazards. Although occupational hazards exist for all types of work (rates for various industry classifications are published, e.g., in National Safety Council 1999), hazards can be minimized when workers adhere to safety standards and use protective equipment as necessary.

On-post workers and residents at the PBA installation could be exposed to chemicals released to air, water, or soil. As discussed in Section 5.6.1, VOCs are emitted from various installation operations, but not at levels that require reporting of individual substance emissions. The only release at PBA that is reportable under TRI regulations is about 1,900 lb (862 kg) of hydrochloric acid released annually at the CIC. The CIC is located almost 2 mi (3.2 km) from the closest on-post residential area. On-post manufacturing facilities and workers are closer (about 0.5 mi [0.8 km]). Although health risks from ongoing operations at PBA have not been quantitatively estimated, the above information suggests that risks for PBA workers and on-post residents from toxic air emissions would be minimal.

Contaminant levels in PBA releases to water are subject to applicable NPDES regulations. Nonhazardous solid waste is sent to off-post landfills, and hazardous solid waste is stored in approved facilities (see Section 5.4), so that any contamination of water or soil at PBA from routine operations should be minor and should not result in increased health risk to workers or on-post residents.

5.7.1.3 Off-Post Public

Demographic information for the off-post public is contained in Section 5.18. No increased health risks to the off-post public are associated with normal PBA operations. Procedures are in place to minimize risks associated with accidents (see Section 5.7.1.4).

5.7.1.4 Emergency Response

Procedures for on-post emergency response actions involving toxic chemical munitions are contained in PBA's Chemical Accident or Incident Response and Assistance Plan (SBCCOM 2000a). This plan establishes policies and procedures that ensure adequately trained personnel and appropriate equipment are present on the installation at all times to respond to emergency situations.

The Chemical Stockpile Emergency Preparedness Program (CSEPP) has further enhanced PBA's ability to respond to a chemical accident by providing facilities and equipment and by supporting a framework for exchanging information and coordinating assistance with the state and county. As part of CSEPP, PBCA runs a 24 h/d, 7 d/wk operations center. This facility enables PBA to respond expeditiously to any accident that might occur. In the unlikely event of a chemical accident or incident, operations center staff can readily run plume projections by using the Emergency Management Information System (EMIS), determine the protective action recommendation (PAR), alert the off-post response community, signal PBA staff to respond, and activate the outdoor/indoor warning systems (made up of 58 warning sirens and 10,200 tone alert radios capable of emitting several tones and voice messages); many of these activities would occur simultaneously. The sirens and tone alert radios are part of the Jefferson County CSEPP warning system and can be activated by Jefferson County.

CSEPP has also encouraged cooperation among PBA, the county, and the state with regard to communications, event classification and notification, exercises, public affairs, and planning. Joint communication links include telephones, radios, e-mail, and microwave transmissions. A memorandum of agreement (MOA) for notification allows for the rapid exchange of information and sounding of warning devices. Jefferson County provides emergency information to employees, tenants, contractors, and on-post residents. Joint exercises have been held annually since 1989. Public affairs efforts are coordinated and include a joint information center (formalized by an MOA) and annual calendars. Finally, emergency response plans are currently being updated and synchronized.

PBA also has plans for responding to other potential spill hazards. Procedures for responding to spills of oil or a hazardous substance are contained in PBA's Installation Spill Contingency Plan. Controls designed to prevent spills of oil or hazardous substances and minimize the impact of spills on the environment are described in PBA's Oil and Hazardous Substance Spill Prevention, Control, and Countermeasure Plan (Appendix 1 to Annex G of the disaster control plan). Emergency response plans establish policies and procedures that ensure adequately trained personnel and appropriate equipment are present on the installation at all times to respond to emergency situations.

The PBA Fire and Emergency Services Department is staffed at all times. Equipment present on the installation for use in emergency situations includes fire-fighting equipment and vehicles, an emergency response vehicle, heavy equipment, and spill kits.

PBA has mutual aid agreements with local fire departments and medical facilities to augment its emergency services. These local fire departments have agreed to provide emergency response assistance to PBA, upon request, when it is possible to do so. In return, the PBA Fire Department has agreed to do the same for these local entities. PBA and PBCA also have memorandums of understanding (MOUs) and MOAs with the following organizations for the treatment of casualties, illness, and injuries requiring off-post assistance: Ambulance Transport Service of Arkansas, Ron Lusby's Paramedic Services, Baptist Medical Center, and Jefferson Regional Medical Center. They have an MOU with the U.S. Army Medical Department at Fort Sill, Oklahoma, to augment the on-post medical response force in the event of a major chemical incident.

5.7.2 Impacts of the Proposed Action

This section discusses the potential environmental consequences on human health and safety from constructing and operating a pilot test facility for the destruction of ACWs at PBA. Factors affecting human health and safety include occupational hazards to workers during continued storage and construction and operations and potential release of chemical agent or other hazardous materials during routine operations.

5.7.2.1 Impacts of Construction

Facility Workers. Impacts from construction would include occupational hazards to workers. While such hazards from can be minimized when workers adhere to safety standards and use protective equipment, as necessary, injuries associated with construction work can still occur.

The expected number of worker fatalities and injuries associated with the construction of an ACWA facility was calculated on the basis of estimates of total worker hours required for construction activities for each option as given in Kimmell et al. (2001) and rate data from the U.S. Bureau of Labor Statistics (BLS) as reported by the National Safety Council (1999). Construction of the Neut/SCWO, Neut/GPCR/TW-SCWO, or Elchem Ox facility is estimated to require approximately 511, 518, or 550 FTEs per year, respectively, and could require up to 34 months. Annual construction fatality and injury rates used were as follows: 13.9 fatalities per 100,000 full-time workers and 4.4 injuries per 100 full-time workers. Fatality and injury risks were calculated as the product of the appropriate incidence rate (given above) and the number of FTE employees.

The annual fatality and injury rates for construction of ACWA facilities are shown in Table 5.7-1. No distinctions were made among categories of workers (e.g., supervisors, laborers), because the available fatality and injury statistics by industry are not refined enough to warrant analysis of worker rates in separate categories. The estimated number of fatalities for all the ACWA technologies assessed is less than 1; the estimated annual number of injuries for construction of a Neut/SCWO facility is 22, a Neut/GPCR/TW-SCWO facility is 23, and an Elchem Ox facility is 24.

The calculation of risks of fatality and injury from industrial accidents was based solely on historical industrywide statistics and therefore did not consider a threshold (i.e., it was assumed that any activity would result in some estimated risk of fatality and injury). Whatever technology is implemented will be accompanied by best management practices, which should reduce fatality and injury incidence rates.

Other On-Post Workers and Residents. The main pollutant emissions associated with construction of an ACWA facility would be PM (see Section 5.5). The on-post administrative and residential areas are located more than 1 mi (1.6 km) from the proposed ACWA facility sites. PM_{10} and $PM_{2.5}$ levels associated with ACWA facility construction at the off-post boundaries nearest to the proposed areas for the ACWA facilities were estimated (see Table 5.5-9); these locations are 1.2 mi (2.0 km) north and 0.9 mi (1.4 km) west of the areas. PM concentrations at the on-post administrative and residential areas would presumably be lower because of the greater distance. The incremental PM levels estimated varied between 2% and 34% of the health-based 24-hour or annual NAAQS levels; therefore, adverse health impacts to on-post workers and residents would not be expected in association with inhalation of construction-related emissions. However, the background level for $PM_{2.5}$ is already at 93% of the annual NAAQS standard level, so that the $PM_{2.5}$ level would be very close to the standard during construction.

TABLE 5.7-1 Annual Occupational Hazard Rates Associated with Continued Munitions Maintenance (No Action) and ACWA Facility Construction and Operations at PBA

Impact to Workers[a]	Neut/SWCO	Neut/GPCR/ TW-SCWO	Elchem Ox	No Action
Fatalities				
Construction	0.07	0.07	0.08	NA[b]
Systemization	0.01	0.01	0.01	NA
Operations	0.02	0.02	0.02	0.003
Injuries				
Construction	22	23	24	NA
Systemization	14	14	14	NA
Operations	35	35	35	5

[a] Impacts are based on the projected work force over the lifetime of the project. Fatality estimates of less than one should be interpreted as "no expected fatalities." For the ACWA technologies, construction is estimated to require up to 34 months, and operations are conservatively estimated to require a maximum of about 2 years. Under the terms of the CWC, the no action alternative could not extend beyond 2012, or about 11 years.

[b] NA = not applicable; i.e., construction and systemization phases are not associated with the no action alternative.

Off-Post Public. The main pollutant emissions associated with construction of an ACWA facility would be PM. PM_{10} and $PM_{2.5}$ levels associated with ACWA facility construction at the off-post boundaries nearest to the proposed areas for an ACWA facility were estimated (see Table 5.5-7; these locations are 1.2 mi (2.0 km) north and 0.9 mi (1.4 km) west of the areas). The incremental PM levels estimated varied between 2% and 34% of the health-based 24-hour or annual NAAQS levels; therefore, adverse health impacts to the off-post public would not be expected in association with the inhalation of construction-related emissions. However, the background level for $PM_{2.5}$ is already at 93% of the annual NAAQS standard level, so that the $PM_{2.5}$ level would be very close to the standard during construction.

5.7.2.2 Impacts of Operations

Facility Workers

Occupational Hazards. Occupational hazards associated with systemization and operation of an ACWA pilot test facility at PBA were estimated by using the same method as that discussed for construction (Section 5.7.2.1). The expected number of worker fatalities and injuries was calculated on the basis of rate data from the BLS as reported by the National Safety Council (1999) and estimates of total worker hours required for systemization and operational activities for each option as given in Kimmell et al. (2001). Operation of any of the ACWA technology systems is estimated to require approximately 720 FTE/yr, and systemization testing would require 12 months with a peak work force of 300 FTEs. Annual fatality and injury rates used were as follows: 3.2 fatalities per 100,000 full-time workers and 4.8 injuries per 100 full-time workers. Annual fatality and injury rates for the manufacturing sector were used because that sector was assumed to be the most representative for systemization and operational work at an ACWA facility. The annual fatality and injury rates for systemization and operation of ACWA facilities are shown in Table 5.7-1. The estimated number of injuries is the same for each technology: 14 per year for systemization and 35 per year for operations.

Inhalation Risks. For routine operations, inhalation exposures and risks for facility workers would depend in part on detailed facility designs that are not yet available. In this EIS, facility workers are generally excluded from health risk evaluation for occupational exposures because such exposures are covered by other guidance and regulations (EPA 1998b). Although quantitative estimates of risks to ACWA facility workers from inhalation of substances emitted during facility operations were not generated for this EIS, the workplace environment would be monitored to ensure that airborne chemical concentrations were below applicable occupational exposure limits. Health risks from occupational exposure through all pathways would be minimized because operations would be enclosed as much as possible and because protective equipment would be used if remote handling of munitions was not possible during processing.

Other On-Post Workers and Residents

Inhalation of Toxic Air Pollutants. Estimated maximum on-post and off-post concentrations of toxic air pollutants from the destruction technologies are discussed in Appendix C. The maximum on-post concentrations were found to occur close to the chemical storage area at PBA; therefore, people most likely to be exposed would be on-post workers. (The residential area at PBA is more than 1 mi (1.6 km) from the location of maximum modeled air concentrations). On-post exposures were modeled on the basis of exposure assumptions typical for the maximum exposed individual (MEI). This person would be a worker assumed to be present at the location of maximum on-post air concentration for 8 hours per day and 250 days per year, for the duration of the pilot test operations for each technology. Exposure estimates generated on the basis of these assumptions were compared with cancer and noncancer toxicity values to generate estimates of increased cancer risk and of the potential for noncancer health impacts. A summary of the results of this assessment is shown in Table 5.7-2. Details of the assessment are provided in Appendix C.

As shown in Table 5.7-2, estimated hazard indexes and carcinogenic risks from exposure to toxic air pollutants estimated for the on-post MEI were well below the benchmarks considered

TABLE 5.7-2 Toxic Air Pollutant Emissions and Impact on Human Health and Safety during Normal Operations at PBA[a]

Emissions and Impacts	Neut/SCWO	Neut/GPCR/ TW-SCWO	Elchem Oxidation
Hazardous air emissions			
Number of chemicals detected	56	172	93
Number of chemicals with quantitative data on toxic, noncarcinogenic effects[b]	32	77	35
Number of chemicals with quantitative data on carcinogenic effects[c]	20	36	22
***Impacts*[d]**			
Hazard index (*hazard index of <1 means adverse health impacts are unlikely*)			
For MEI[e] in off-post general public	7×10^{-3}	5×10^{-3}	7×10^{-4}
For MEI in on-post population	6×10^{-4}	6×10^{-4}	5×10^{-5}
Increased lifetime carcinogenic risk *(risk of 10^{-6} is generally considered negligible)*			
For MEI in off-post general public	2×10^{-8}	4×10^{-9}	2×10^{-9}
For MEI in on-post population	2×10^{-9}	2×10^{-10}	2×10^{-10}

[a] Based on emission estimates from demonstration testing (Kimmell et al. 2001) and model estimates of maximum on-post and off-post concentrations and adjusted to account for fluctuating operations. ISCST3 model was used. Estimates for general public assumed 24-h/d exposures for the duration of operations. Estimates for the on-post population assumed 8-h/d exposures and 250-d/yr of the duration of operations. See Appendix C for details.

[b] Potential noncarcinogenic impacts from some detected chemicals could not be evaluated quantitatively because toxicity data were not available (see text discussion). For Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox, 14, 92, and 48 chemicals, respectively, could not be quantitatively evaluated for either noncarcinogenic or carcinogenic effects (see text).

[c] All known carcinogens were evaluated for carcinogenic risk.

[d] Carcinogenic risks are less than 10^{-6} and hazard indexes are less than 0.01 for all technologies; thus, they are in the negligible range. Although calculated cancer risks range from approximately 10^{-10} to 10^{-7}, and calculated hazard indexes range from 10^{-4} to 10^{-2}, there is no significant difference in risk among the technologies. Thus, for all the technologies, increased cancer and noncancer risks from inhalation of emissions are in a range considered to be negligible.

[e] MEI = maximum exposed individual.

representative of negligible risk levels. The typical benchmark indicator for significant noncarcinogenic hazards is a hazard index of greater than 1, and for carcinogenic hazards, it is an increased lifetime carcinogenic risk level of greater than 1×10^{-6}. Hazards for the three technologies were very comparable, generally on the same order of magnitude. Almost all of the estimated noncarcinogenic and carcinogenic risks were associated with boiler emissions and not with destruction facility processes. Note that exposures and risks are slightly higher for the off-post MEI than for the on-post MEI because the annual exposure duration for the off-post MEI is assumed to be longer (see next subsection on off-post public).

There are some uncertainties in the demonstration test data used to estimate emissions of toxic air pollutants that should be considered in interpreting the results. Some unit operations were not characterized in demonstration testing, so trace effluents were not estimated for all unit operations that would make up the complete systems. Generally, data were available for unit operations that would be expected to generate the most gaseous emissions during actual operations (Mitretek 2001a–c). However, the emission levels and health risk estimates provided here should be considered only indicative of likely levels. They may need to be revised as technology designs near completion and as estimates of process efficiencies become more reliable (Kimmell et al. 2001). Nevertheless, the values used for the risks from operations presented in this EIS were designed to be very conservative (i.e., potentially resulting in overestimates of risk) and to bound minor variations in the way that the ACWA destruction systems would be engineered.

Many of the substances detected in demonstration testing do not have established (i.e., peer-reviewed) toxicity benchmark levels to allow quantitative risk of exposures to be evaluated. For Neut/SCWO operations, 14 of the detected chemicals (25%) did not have noncarcinogenic or carcinogenic toxicity benchmark levels (see Appendix C). For Neut/GPCR/TW-SCWO operations, 92 of the detected chemicals (53%) did not have established toxicity benchmark levels. For Elchem Ox operations, 48 of the detected chemicals (52%) did not have established toxicity benchmark levels. For most of the substances for which toxicity could not be quantitatively evaluated, emission levels were very low (e.g., less than 10 g/d). Although not quantitatively assessed, toxic effects would be highly unlikely in association with these very low emission levels. For several substances emitted from boilers and diesel generators (aldehydes, propane, butane, pentane, and ethane), emission levels were somewhat higher (up to about 1 kg/d). Although potential health effects from inhalation of these substances could not be quantitatively evaluated because of the lack of toxicity benchmark levels, such data would not distinguish among risks associated with the alternate technologies, because each of the technologies evaluated uses boilers and diesel generators.

Per Executive Order 13045 (1997), it is also necessary to consider whether sensitive subpopulations, such as children or the elderly, could be more affected by the estimated exposures to toxic air pollutants than could the general population. The reference concentrations used to evaluate the noncarcinogenic toxicity of the emitted substances already include factors to account for the possible added sensitivity of certain subpopulations. Chemical-specific potency estimates for carcinogens also include conservative uncertainty factors and so can be used to assess risks for sensitive subpopulations. However, the exposure parameters used to estimate intake (i.e., 154 lb [70 kg] body weight; 20 m^3/d inhalation rate) are typical for adults. To consider intake for young children (less than 1 year old), an inhalation rate of 4.5 m^3/d and a body weight of 20 lb (9 kg) (EPA 1997) could be assumed. Use of these assumptions would result in an estimate of inhalation dose (in mg/kg/d) for a young child that would be 1.7 times greater than the dose assumed for an adult, and overall hazard indices and cancer risks would also increase by a factor of 1.7. Since the hazard indices and cancer risks estimated for toxic air pollutant emissions during normal operations were low (Table 5.7-4), risk levels for children would still be far less than benchmark levels.

Inhalation of Chemical Agent. Maximum potential concentrations from emissions of agent (including consideration of fluctuating operations) were discussed in Section 5.6.3.3. For the nerve agents stored at PBA, modeling dispersion from the estimated maximum emissions resulted in a maximum estimated on-post concentration less than 1% of the allowable concentration for general public exposures. In practice, the facility stacks would have continuous agent monitoring devices that would sound if any agent were detected in the stacks, so that the source could be identified and eliminated quickly. Emissions would not be allowed to continue at the detection limit level, as was assumed in the modeling exercise.

Exposures from Other Pathways. Other potential exposure pathways to be considered are water (if effluent from the pilot facilities was released to nearby waterways) and soil and food (if soil became contaminated by releases to air and subsequent deposition). For pilot testing of each of the ACWA technologies, plans are to recycle all process water through the system. The facilities are not expected to generate any aqueous effluent except for the sanitary wastewater generated by employees. Also, exposure through soil and food chain pathways from deposition onto soil and/or water is expected to be very low, since the level of air emissions that would result from routine operations is expected to be very low and since the duration of operations would be short. All facility releases would be in conformance with applicable local and state permit requirements. Therefore, exposures through water, soil, or foodchain pathways would result in very minimal, if any, additional risk to on-post workers and residents.

Off-Post Public

Inhalation of Toxic Air Pollutants. Maximum off-post concentrations of toxic air pollutants that would result from the ACWA technologies are discussed in Appendix C. Off-post exposures were modeled by using exposure assumptions typical for the MEI in the off-post residential population. This hypothetical person is considered to be an individual who is present at the location of the maximum off-post concentration of a pollutant in air for 24 hours per day and 365 days per year, for the duration of the pilot test operations for each technology. Exposure estimates generated on the basis of these assumptions were compared with cancer and noncancer toxicity values to generate estimates of increased cancer risk and of the potential for noncancer health impacts. A summary of the results of this assessment is shown in Table 5.7-2. Details of the assessment are provided in Appendix C.

This assessment was limited to the estimation of risks associated with inhalation of emitted substances. For some of the emitted substances (e.g., PCBs, dioxins, and furans), exposure to the off-post public through the food-chain pathways could be as large or larger than exposure through inhalation, because these substances are bioaccumulative. Estimates of exposure through these alternate pathways can be highly uncertain and are beyond the scope of this EIS. However, for all the technologies, the emission rates for these substances are quite low (less than 0.00001 lb/yr for all forms of dioxins and furans and 0.005 lb/yr or less for PCBs). For the purpose of this assessment (i.e., to compare the risks associated with pilot testing the alternate ACWA technology systems), estimation of the risk associated with inhalation should be indicative of the risk from all pathways.

As shown in Table 5.7-2, estimated hazard indexes and carcinogenic risks from exposure to toxic air pollutants estimated for the off-post MEI were well below levels considered to be hazardous. The typical benchmark indicator for significant noncarcinogenic risks is a hazard index of greater than 1, and for carcinogenic hazards, it is an increased lifetime carcinogenic risk level of greater than 1×10^{-6}. Hazards for the three technologies were very comparable, generally on the same order of magnitude. Almost all of the estimated noncarcinogenic and carcinogenic risks were associated with boiler emissions and not with destruction facility processes. Note that exposures and risks were slightly higher for the off-post MEI than for the on-post MEI because the annual exposure duration was assumed to be longer for the off-post MEI (see previous subsection regarding on-post workers and residents). Even if it is assumed that sensitive subpopulations, such as children, have an exposure risk up to 1.7 times greater than that of adults, risks would still remain well below levels of concern. A more detailed discussion of assumptions and data limitations for this assessment is provided in Appendix C.

Inhalation of Chemical Agent. Maximum potential off-post concentrations from emissions of agent (including consideration of fluctuating operations) were discussed in Section 5.6.3.3. For the nerve agents stored at PBA, modeling dispersion from the estimated maximum emissions resulted in a maximum estimated off-post concentration of less than 1% of the allowable concentration for general public exposures (CDC 1988). In practice, the facility stacks would have continuous agent monitoring devices that would sound if any agent was detected in the stacks, so that the source would be identified and eliminated quickly. Emissions would not be allowed to continue at the detection limit level, as was assumed in the modeling exercise.

Exposures from Other Pathways. Exposures through water, soil, or food chain pathways would result in very minimal, if any, additional risk to off-post residents (see previous discussion for on-post workers and residents).

5.7.3 Impacts of No Action

Activities associated with continued storage (no action) at PBA would include inspecting and conducting an annual inventory of all munitions, overpacking any leaking munitions discovered during inspections, and transporting the overpacked leakers to a separate storage igloo. Before a worker can enter into any igloo, the air inside is monitored for the presence of agent. Workers are required to wear respiratory protection and protective clothing while in the storage igloos. Therefore, during normal operations under the no action alternative, no worker would be exposed to chemical agent. Routine use of other chemicals would not be required for continued storage operations, so exposure to other chemicals would be limited. A potential hazard would be heat stress associated with the heavy protective clothing and equipment required for the work. However, workers are trained to control this hazard. For the other on-post workers and residents and for the general public, no impacts on human health are expected in association with the no action alternative.

Risk calculations for occupational fatalities and injuries resulting from the no action alternative (i.e., continued storage and maintenance of the PBA stockpile) are presented in Table 5.7-1. The expected number of worker fatalities and injuries associated with continued maintenance of the munitions stockpile at PCD was calculated on the basis of rate data from the BLS as reported by the National Safety Council (1999) and an estimate of 100 FTE employees required for munitions maintenance activities each year (Atkinson 2000). Annual fatality and injury rates for the manufacturing sector were used because this sector was assumed to be the most representative for munitions maintenance work. The specific rates were as follows: fatality rate of 3.2 per 100,000 full-time workers and injury rate of 4.8 per 100 full-time workers. Annual fatality and injury risks were calculated as the product of the appropriate incidence rate (given above) and the number of FTE employees. No distinctions were made among categories of workers (e.g., supervisors, inspectors, security personnel), because the available fatality and injury statistics by industry are not refined enough to warrant analysis of worker rates in separate categories. The estimated number of fatalities was less than one; the estimated total number of injuries was five.

5.7.4 Impacts from Transportation

Chemical agent would not be transported on or off post for any of the alternative technologies evaluated. However, transportation can have adverse impacts on human health because of the associated emission of toxic air pollutants such as benzene, 1,3-butadiene, and formaldehyde. Emissions consist of engine exhaust from diesel- and gasoline-powered vehicles and fugitive dust raised from the road by transport vehicles. Increased incidence of lung cancer has been associated with prolonged occupational exposure to diesel exhaust (Dawson and Alexeeff 2001); toxic air pollutants are also emitted from gasoline-burning vehicles (EPA 2000e). Also, transportation results in some increased risk of injuries and fatalities from mechanical causes; that is, the transport vehicles may be involved in accidents. This type of risk is termed “vehicle-related.” Both the chronic health hazard from inhalation of emissions from transport vehicles and the injury risk are directly proportional to the number of vehicle miles traveled.

For the transportation impacts in this EIS, the annual number of vehicle miles traveled by delivery vehicles (used for delivery of construction materials) and commuter vehicles (used to transport construction and operation workers) was compared for each of the alternative technologies and for the no action alternative. In addition, the annual number of shipments of raw materials and waste required for each alternative was tabulated. It was assumed that the distances for shipping raw materials and waste would be similar for each of the alternatives. This assumption was necessary because actual origination and destination locations had not been determined. Therefore, the data did not support risk calculations using diesel emission factors. The comparison of the number of vehicle miles traveled and the number of shipments by alternative is useful for an overall comparison of the potential transportation impacts to human health from each alternative.

The transportation impacts for PBA are summarized in Table 5.7-3. The number of miles traveled annually by construction and operations worker commuter vehicles is similar for each technology. The Neut/SCWO technology would require the greatest number of shipments annually; approximately 30% more than Neut/GPCR-TW-SCWO and more than twice the number required for Elchem Ox. The amount of transportation required for the no action alternative is very small.

5.8 NOISE

The Noise Control Act of 1972, along with its subsequent amendments (*Quiet Communities Act* of 1978, *United States Code*, Title 42, Parts 4901-4918 [42 USC 4901-4918]), delegates to the states the authority to regulate environmental noise and directs government agencies to comply with local community noise statues and regulations. The State of Arkansas and Jefferson County, where PBA is located, have no quantitative noise-limit regulations.

The EPA guideline recommends a day-night sound level (L_{dn}[7] or DNL) of 55 dBA,[8] which is sufficient to protect the public from the effect of broadband environmental noise in typically quiet outdoor and residential areas (EPA 1974). This levels is not a regulatory goal, but

---

[7] L_{dn} is the day-night A-weighted equivalent sound level, averaged over a 24-hour period, as defined in EPA (1974).

[8] dBA is a unit of weighted sound-pressure level, measured by the use of the metering characteristics and the A-weighting specified in ANSI S1.4-1983 (the American National Standards Institute specification for sound level meters) and in ANSI S1.4A-1985, the amendment to S1.4-1983 (Acoustical Society of America 1983, 1985).

TABLE 5.7-3 Comparison of Annual Transportation Requirements for Construction and Routine Operations for Alternative Technology Systems at PBA[a]

Parameter	Neut/SCWO	Neut/GPCR/ TW-SCWO	Elchem Ox	No Action[b]
Number of vehicle miles traveled[c]				
Construction delivery vehicle	200,000	200,000	200,000	NA[d]
Construction worker commuter vehicle	4,900,000	5,000,000	5,300,000	NA
Operations worker commuter vehicle	8,000,000	7,900,000	8,000,000	1,100,000
Number of shipments[e]				
Mustard agent				
Raw materials	450	279	132	NA
Waste	388	362	188	NA
Total	838	641	320	<1

[a] Number of vehicle miles traveled and number of shipments are used as indicators of potential transportation-associated health impacts, since emissions and vehicle-related risks increase with increasing transportation.

[b] No action alternative assumes 100 employees would be required for continued storage maintenance.

[c] Annual miles are calculated as the number of workers × 276 work days per yr × 40 mi per round trip.

[d] NA = not applicable.

[e] Raw material and waste shipments for nerve agent are the maximum annual for either GB or VX.

Input data sources: Kimmell et al. (2001).

is "intentionally conservative to protect the most sensitive portion of the American population" with "an adequate margin of safety." For protection against hearing loss in the general population from nonimpulsive noise, the EPA guideline recommends an L_{eq}[9] of 70 dBA or less over a 40-year period.

5.8.1 Current Environment

PBA is located approximately 8 mi (12.9 km) northwest of Pine Bluff, Arkansas, in Jefferson County (Figure 5.1-1). U.S. Highway 79 (US 79) and Interstate 530 (I 530) run around the PBA installation. State Route 365 parallels PBA to the west. Immediately west of PBA lie the Missouri-Pacific Railroad right-of-way and a sparse number of residential properties. Along the northern boundary is a county road. Undeveloped industrial property and the Mid-Atlantic Packaging Facility are located south of PBA. The eastern boundary of the installation lies along the Arkansas River.

[9] L_{eq} is the equivalent steady sound level that, if continuous during a specific time period, would represent the same total acoustic energy as the actual time-varying sound. For example, L_{eq}(1-h) is the 1-hour equivalent sound level.

Until the 1980s, the primary noise-producing activities within the PBA used to be open burning and open detonation (OB/OD) activities in the southeastern part of the installation (Neel 2000). However, these activities were discontinued, and, accordingly, no major noise-producing activities exist on post.

No sensitive noise receptors (e.g., hospital, schools) are located near the installation. The Red Cockaded Woodpecker Reserve is approximately 0.6 mi (1 km) from the installation. Ambient sound level measurements around the PBA installation are not currently available. The nearest off-post residence is located along the northern and western boundaries. In the general PBA area, the background environment is typical of rural areas, and residual sound levels are approximately 30 to 35 dBA (Liebich and Cristoforo 1988). Near the western boundary of the PBA installation, the background acoustic environment may be higher, about 40 to 45 dBA, because of the highway and railroad traffic.

5.8.2 Noise Sources from the ACWA Pilot Test Systems

Noise sources during construction of an ACWA pilot facility would include standard commercial and industrial activities for moving earth and erecting of concrete and steel structures. Noise levels generated from these activities would be comparable to those from any construction site of similar size.

Pilot facility operations would involve a variety of equipment that would generate noise. Some equipment, such as fans and pumps for conveying and handling treatment residues (e.g., pollution abatement systems), heating and air conditioning units, electrical transformers, and in-plant public address systems might be located outside the buildings. However, most of the equipment used in ACWA pilot testing operations would be housed inside buildings designed to prevent the release of chemical agents and to contain potential explosions. The walls, ceiling, and roofing materials used in these buildings would attenuate noise generated by the activities inside the buildings.

During both construction and operation, the commuter and delivery traffic in and around the ACWA facility would also generate noise. However, the contribution of noise from these intermittent sources would be minor in comparison to that from the continuous noise sources during construction or operation.

As it was in the air quality modeling presented in Section 5.5, Area A, which is located closer to the site boundary in the direction of neighboring residences, was selected as the receptor for the analysis of potential noise impacts. Regardless of the technology selected, it is assumed that noise levels from both construction and operations would be similar, since detailed information on noise from construction and operational activities associated with an ACWA facility was not available.

5.8.3 Impacts of the Proposed Action

5.8.3.1 Impacts of Construction

Operation of equipment and vehicles during construction and associated activities would typically generate noise levels in the 77–90 dBA range at a distance of about 50 ft (15 m) from the source (EPA 1979). Noise levels decrease about 6 dB for every doubling of distance from the source because sound spreads over an increasing area (geometrical divergence). Thus, construction activities at the pilot test facility location would result in maximum estimated noise levels of about 50 dBA at the PBA boundary closest to Area A, about 0.9 mi (1.2 km) southwest of the facility. The noise level would be lower than 50 dBA at residences located further away from the eastern site boundary.

This 50-dBA estimate is likely to be an upper bound because it does not account for other types of attenuation, such as air absorption and ground effects. This level is below the EPA guideline of 55 dBA for residential zones (see Section 5.8.1) and is in the range found within a typical residential community at night (Corbitt 1990). If other attenuation mechanisms were considered, noise levels at the nearest residence would decrease to near background levels typical of rural environments. In particular, tall vegetation between the proposed facility and the site boundary would contribute to additional attenuation. Thus, potential noise impacts from construction activities at the pilot test facility location are expected to be minor to negligible at the nearest residence. The resulting noise levels would be well within the EPA guidelines, which were established to prevent activity interference and annoyance or hearing impairment.

5.8.3.2 Impacts of Operations

At the baseline incinerator facility in Tooele, Utah, the highest sound levels during operations were measured in the vicinity of the pollution abatement system (Andersen 2000), which is similar in design to pollution abatement systems being considered for use in an ACWA pilot facility. These sound levels were less than 73 dBA within 100 ft (30 m) of the abatement equipment. When only the geometrical divergence discussed in Section 5.8.3.1 is applied, estimated noise levels would be less than 39 dBA at the nearest site boundary. This noise level at the site boundary is comparable to the ambient background level typical of a rural environment and would be hardly distinguishable from the background level, considering other attenuation effects. In conclusion, noise levels generated by plant operations should have negligible impacts on the residence located nearest to the proposed facility and would be well within the EPA guideline limits for residential areas.

5.8.4 Impacts of No Action

The levels of noise generated by current stockpile maintenance activities are part of the current background noise levels, which reflect the operations of the installation. These levels are not expected to change under the no action alternative; therefore, the conditions described in Section 5.8.1 (affected environment) will continue to exist.

5.9 VISUAL RESOURCES

5.9.1 Current Environment

PBA is located in a rural, wooded environment. Privately owned farms and timberland lie north of the installation. To the west is the Union-Pacific Railroad right-of-way and a sparse number of residential properties. The land south of PBA consists primarily of undeveloped industrial property and the Mid-Atlantic Packaging Facility. The Arkansas River runs along the eastern boundary of PBA. Viewing distances on PBA are short, restricted by heavy vegetation and gently rolling hills. The proposed areas for an ACWA facility are not visible from off post and only minimally visible on post because of the heavy vegetation and small hills. Within 5 mi (8 km) to the northwest of PBA is the town of Redfield. To the west, adjacent to the boundary, lies the town of Whitehall, and 2 mi (3 km) to the south is the city of Pine Bluff.

The industrial and other developed areas on the installation, including utility corridors, are generally consistent with a Visual Resources Management (VRM) Class IV designation (activities that lead to major modification of the existing character of the landscape). The remainder of the installation fits a VRM Class III or IV designation (hosting activities that, at most, only moderately change the existing character of the landscape) (U.S. Department of the Interior [DOI] 1986a,b).

5.9.2 Site-Specific Factors

Much of PBA is industrial and similar to the visual characteristics of the proposed ACWA facility. The general visual aesthetic character of PBA could be affected by these factors:

1. The appearance of the ACWA facility itself and its supporting components (other facilities, transmission lines, roads, parking areas),

2. The placement of the ACWA facility (its elevation, adjacent land use, resulting viewshed, etc.), and

3. Visibility impacts due to fugitive dust emissions from construction or due to steam emissions from the operating stacks.

5.9.3 Impacts of the Proposed Action

5.9.3.1 Impacts of Construction

During construction, the visual character of PBA could be affected as a result of the increased construction traffic. However, the current construction of the PBCDF is similar to the construction of an ACWA facility, so construction of the ACWA facility would not require any new access structures (such as roads, gates, parking lots, etc.) that would be visible from off post. During construction, utility access corridors and the construction area would be disturbed, but the line of sight to these areas is limited, and impacts would be short-lived. Utility construction would generally follow existing roadways to minimize impacts. Impacts on visual resources from construction of the proposed ACWA facility would be negligible.

5.9.3.2 Impacts of Operations

The visual elements of the ACWA facility would remain constant. Lines of sight to the facility would be limited, and the facility would not be visible from off post. None of the support utilities (e.g., power lines) would be visible from off post. On-post views would be limited to the immediate vicinity of the facility. During cold weather, steam from the facility might be visible both on- and off-post. However, PBA is an industrial area, as are many of the areas surrounding PBA, and steam plumes are not unusual. Impacts on visual resources from operation of the proposed ACWA facility would be negligible.

5.9.4 Impacts of No Action

Under the no action alternative, there would be no change to the current visual character of PBA.

5.10 GEOLOGY AND SOILS

5.10.1 Current Environment

5.10.1.1 Geology

PBA is located in the western part of Jefferson County near the Arkansas River in the Gulf Coastal Plain Physiographic Province (Haley et al. 1993). The topography is fairly flat, ranging in elevation from about 80 ft (24 m) above mean sea level (MSL) across most of the installation to about 70 ft (21 m) above MSL near the river (USGS 1985).

The installation stratigraphy is characterized by well-consolidated Cretaceous deposits dipping gently to the east that are unconformably overlain by nearly horizontal strata of unconsolidated Tertiary and Quaternary sediments. In the western part of Jefferson County, the thickness of the Tertiary and Quaternary sediments is approximately 2,000 ft (840 m) and increases to as much as 4,000 ft (1,680 m) toward the east (U.S. Army 1997).

Outcrops near PBA consist of Pleistocene terrace and Holocene alluvial deposits, as well as sediments of the Tertiary Jackson Group (Haley et al. 1993; U.S. Army 1997). The Quaternary deposits vary in thickness from approximately 3 ft (1 m) where they join the Jackson Group outcrop to 250 ft (76 m) near Pine Bluff. From a base of gravelly sands, the Quaternary deposits grade upward through a central section of sand overlain by silts and clays. The Jackson Group consists of a fairly even composition of marine sediments that include clays, silty clays, and clayey sands overlain by silts and sands of continental origin. The bluffs overlooking the Arkansas River floodplain are composed of Jackson Group sediments and are overlain by Pleistocene terrace deposits (U.S. Army 1997).

A survey of potential economic mineral resources at PBA has not been conducted. A general map of economic minerals in Arkansas indicates major producing areas of vermiculite, sand, and gravel in Jefferson County; however, this map is not detailed enough to determine whether these resources are present at PBA (Arkansas Geological Commission and USGS 1998).

5.10.1.2 Seismicity

PBA lies within the Ouachita Seismic Zone (U.S. Army 1997). There are no known faults at or near PBA (U.S. Army 1997). The nearest known fault is not active and is seen in Paleozoic rocks (2,300 to 570 million years old) near Little Rock, Arkansas.

The nearby New Madrid Seismic Zone is the dominant source of major earthquakes in the area. It is located about 120 mi (190 km) northeast of the installation. The largest known earthquakes in the region surrounding PBA were associated with this zone. These earthquakes occurred in southeast Missouri and northeast Arkansas in 1811 and 1812. They are generally known as the New Madrid Earthquake (Jackson 1979). Between December 16, 1811, and May 5, 1812, 1,874 separate seismic events were detected. The largest event occurred on February 7, 1812. It had a maximum Modified Mercalli Intensity of XI (magnitude 7.4) at its epicenter near New Madrid, Missouri (U.S. Army 1997). An earthquake of this intensity produces extreme damage to masonry with nearly total destruction of some buildings, broad fissures, earth slumps, and land slips. Approximately one million square miles were affected by this earthquake, which was felt at a distance of up to 564 mi (908 km) (Branner and Hansell 1932).

Although there have been no large earthquakes in the immediate vicinity of PBA, there have been clusters or swarms of small earthquakes in the area (J.R. Benjamin and Associates 1996). The largest of these occurred in January 1982 near the town of Enola, Arkansas, which is located about 50 mi (80 km) north of Little Rock. It had a magnitude of 4.5.

The maximum earthquake that could occur at PBA would be a repetition of the New Madrid Earthquake discussed above. It is estimated that this event would produce a Modified Mercalli Intensity of IX at the installation, with a peak ground acceleration of 0.34 G (U.S. Army 1997). Such an earthquake would produce heavy damage to masonry with some to partial collapse of buildings and conspicuous cracks in the ground. The same peak ground acceleration would be produced at PBA by the maximum earthquake predicted for the Wichita-Ouachita Seismic Province (magnitude = 6.2). The duration of the event is estimated to be 20 seconds.

A recent probabilistic analysis was performed for PBA (J.R. Benjamin and Associates 1996). According to this analysis, a seismic event resulting in a peak horizontal acceleration of more than 0.1 G would occur at PBA once in about 750 years. An event resulting in a peak horizontal acceleration of more than 0.18 G would occur once in 10,000 years, and an event resulting in a peak horizontal acceleration of more than 0.34 G would occur once in 100,000 years.

According to the nuclear power station seismic hazard curves for the eastern United States, the Pine Bluff installation is located in Seismic Probability Zone 1 (Staub 1991). Within this zone, minor earthquake damage may be expected to occur at least once in 500 years (or a 10% probability of occurring once in 50 years). The peak ground acceleration for this event is 0.075 G.

5.10.1.3 Soils

The soils at PBA consist predominantly of soils belonging to the Pheba-Savannah-Amy and Calloway-Grenada-Henry Associations; soils from the Crevasse-Oklared, Ouachita, Smithdale, Rilla-Herbert-McGehee, and Perry-Portland Associations also are present locally (U.S. Department of Agriculture [USDA] 1980) (see Table 5.10-1). Soils from the Pheba-Savannah-Amy and Calloway-Grenada-Henry Associations, which formed mainly on uplands, tend to be loamy, level to gently sloping, and poorly to moderately well drained. As shown in Figure 5.10-1, the soils present at Areas A and B are from the Pheba-Savannah-Amy Association. The engineering properties of these soils are variable and must be accounted for in the design of any facilities built in these areas. The soils within Areas A and B are largely undisturbed except along the courses of minor roadways.

5.10.2 Site-Specific Factors

Because the proposed action would entail only shallow excavation and require only standard building materials, it was concluded that there is no potential for impacts on the geologic resources at or near PBA. With respect to the soils at PBA, potential impacts might result from excavation, erosion, or accidental spills and releases of a variety of hazardous materials, including chemical agents. These potential impacts are discussed in the following sections on impacts from construction, operations, and no action. Potential impacts on soils associated with a major accident resulting in catastrophic releases of agent are discussed in Section 5.21.

5.10.3 Impacts of the Proposed Action

5.10.3.1 Impacts of Construction

Approximately 25 acres (10 ha) of ground could be affected to some degree from construction of the pilot facilities in either Area A or B (Table 5.3-1). Additional ground would also be disturbed during the development of the necessary site infrastructure (e.g., electric transmission line, gas pipeline, water pipeline, access road). For Area A, infrastructure-related construction is expected to disturb about 5 acres (2 ha); for Area B, it is expected to disturb about 12 acres (5 ha) (Table 5.3-1). Soil disturbance could increase the potential for erosion, which could affect surface water bodies and biological resources. Best management practices (e.g., use of soil fences, berms, and liners; revegetation of disturbed land following construction) would be employed to minimize the potential for soil erosion.

TABLE 5.10-1 Soil Associations at PBA

Association	Soil Type	Characteristics
Pheba-Savannah-Amy	Loamy soils on uplands and stream terraces	Poorly drained to moderately drained Level to gently sloping, mainly wooded Low to medium potential for urban uses Wetness and erosion are main limitations to use
Calloway-Granada-Henry	Loamy soils on uplands formed in predominantly wind-laid sediment	Moderately well-drained to poorly drained Level to gently sloping, mainly wooded Low to medium potential for urban uses Wetness and erosion are main limitations to use
Crevasse-Oklared	Loamy and sandy soils on bottom lands formed in alluvial sediment deposited by the Arkansas River	Well-drained and excessively well-drained Level to gently undulating Mainly used for pasture Flooding is a severe hazard Low potential for urban uses due to flooding
Ouachita	Undifferentiated soils on flood plains of local drainage ways; some areas predominantly silt loam	Well drained Level Inundated 2 to 3 times per year Moderate fertility High available water capacity Moderately slow permeability Runoff is slow Low potential for urban uses due to flooding
Smithdale	Line sandy loam (3 to 8% slope)	Well drained Gently sloping on uplands Moderate fertility Medium potential for farming High available water capacity Moderate permeability Runoff is medium High potential for urban uses
Rilla-Herbert-McGehee	Loamy soils on bottom lands formed in alluvial sediment deposited by the Arkansas River	Well drained and somewhat poorly drained Level to undulating Mainly used for cultivated crops Medium potential for urban uses Wetness is main limitation to use
Perry-Portland	Clayey soils on bottom lands formed in alluvial sediment deposited by the Arkansas River	Poorly drained and somewhat poorly drained Level High seasonal water table Mainly used for cultivated crops High potential for woodland Low potential for urban uses

Source: USDA (1980).

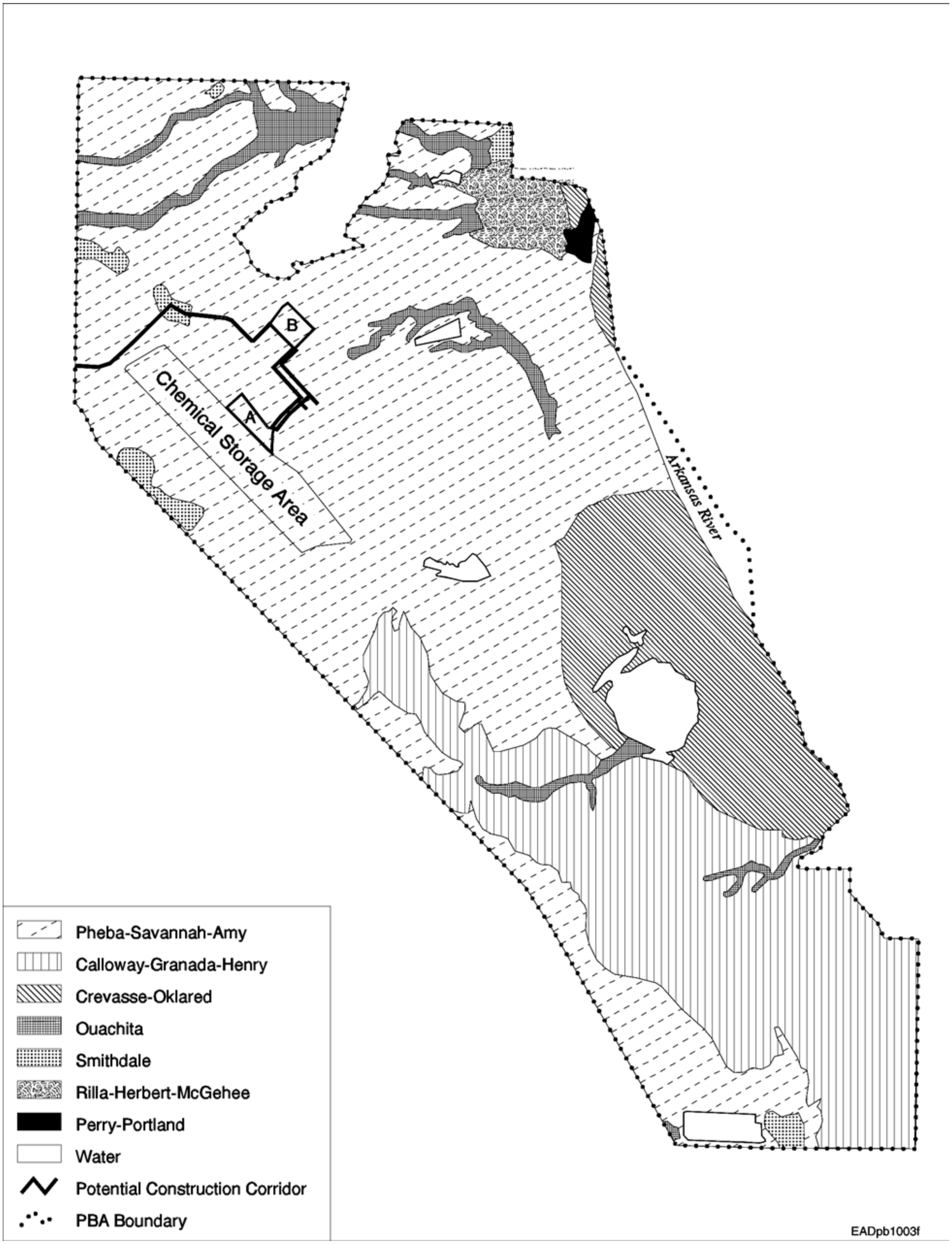

FIGURE 5.10-1 Soil Types at PBA

In addition, soils could be affected during the construction of a pilot facility if there was an accidental spill or release of a hazardous material. Effects would be primarily limited to those from spills of hazardous materials (e.g., paints, solvents) transported to the site and used during construction of the pilot facility and leaks of petroleum-based products (e.g., fuel, hydraulic fluid) from construction vehicles. In such an event, actions would be taken to contain and limit the migration of spilled materials, Any contaminated soils would be excavated and disposed of in accordance with applicable requirements.

5.10.3.2 Impacts of Operations

Impacts on soils from the operation of a pilot facility could occur if there was an accidental spill or release of a hazardous material. Such accidents could involve spills of any chemical transported to and used in the ACWA pilot facility, spills of chemical agent during the transport of chemical munitions from the storage bunker to the pilot facility, and leaks of petroleum-based products from vehicles. In such an event, actions would be taken to contain and limit the migration of spilled materials. Any contaminated soils would be excavated and disposed of in accordance with applicable requirements.

Although operations would result in air emissions of a variety of contaminants, the concentrations of these contaminants would be so low (see Sections 5.5 and 5.6) that they would not have a significant impact on surface soils.

5.10.4 Impacts of No Action

Under the no action alternative for PBA, which is defined as future incineration of the chemical munitions, potential impacts on soils would be equivalent to those assessed previously in the EIS prepared for the incineration activities (U.S. Army 1997).

5.11 GROUNDWATER

5.11.1 Current Environment

The principal aquifers in Jefferson County are the Quaternary alluvial deposits near the surface, the upper sands of the Cockfield/Jackson Formation, and the Sparta Sand Formation. Most water use in Jefferson County Arkansas is from groundwater sources. Table 5.11-1 summarizes water use from the three main aquifers (U.S. Army 1997). Other deeper aquifers exist but have not been developed because of low yield and poor quality (U.S. Army 1990). The

TABLE 5-11.1 Groundwater Resources of Jefferson County

Aquifer	Consumption (gal/d)	Quality	Principal Use	Approximate Depth (ft)
Quaternary	51,600,000	Variable	Agriculture	Surficial
Cockfield/Jackson	360,000	Good	Domestic	150 to 300
Sparta Sand	49,800,000	Excellent	Municipal	700 to 1,100

Source: Modified from U.S. Army (1997).

deep aquifers are not hydraulically connected with the developed surface aquifers because of an intervening thick clay formation called the Porters Creek Formation.

The Sparta Formation is the major groundwater source at and near PBA. The City of Pine Bluff General Water Works withdraws approximately 7.8 million gal/d (29,500 m^3/d) for the municipal water supply, while industry withdraws approximately 42 million gal/d (159,000 m^3/d) (U.S. Army 1988). The on-post water supply for PBA is also from the Sparta Aquifer. Water at PBA is supplied by 12 on-post wells (U.S. Army 1997). Average water use at PBA is about 980 acre-ft/yr (1,200,000 m^3/yr). These 12 wells have a combined maximum short-term production of 20.7 million gal/d (79,000 m^3/d) and withdraw water from a depth of between 700 and 1,100 ft (200 and 330 m) (U.S. Army 1997). Water table declines in the Pine Bluff area are large, up to 160 ft (50 m), and have been caused by the large withdrawals in the area (U.S. Army 1990).

Water quality in the surface Quaternary Aquifer is variable and, in some cases, low enough to be undesirable for most uses (U.S. Army 1997). In areas near the Arkansas River, where the aquifer is influenced by infiltration from the surface water features, dissolved solids are lower and water quality is better (U.S. Army 1997). Water quality in the Cockfield-Jackson Aquifer is moderately hard and mineralized (U.S. Army 1997), but water from this aquifer is suitable for most uses. Water quality in the Sparta Aquifer is excellent.

On post at PBA, groundwater of the surficial Quaternary Aquifer and possibly the underlying Cockfield-Jackson Aquifer has been contaminated as a result of past operations. Sources for this contamination have been removed (U.S. Army 1997), and monitoring continues at 11 inactive and 3 active areas. Contaminants of concern at these areas include metals and various organic compounds. Downgradient from PBA, these aquifers are not used, and the Cook Formation prevents contaminants from migrating to the Sparta Aquifer (U.S. Army 1997).

5.11.2 Site-Specific Factors

Annual water resource needs during construction would be essentially the same for all the ACWA technologies being considered and are estimated to be approximately 7 million gal/yr (26,000 m^3/yr) over approximately three years (see Chapter 3). Construction activities are estimated to generate 4.5 million gal (17,000 m^3) of sanitary waste over the same time period (Kimmell et al. 2001).

Annual water resource needs during operations (which include both process and potable water) range from 7.3 million gal/yr (28,000 m^3/yr) for Elchem Ox to 24 million gal/yr (91,000 m^3/yr) for Neut/GPCR/TW-SCWO. Neut/SCWO uses approximately 11.6 million gal/yr (44,000 m^3/yr) of water. Potable water needs are essentially the same for all the ACWA technologies being considered and are approximately 6 million gal/yr (23,000 m^3/yr). None of the ACWA technologies discharge any process wastewater. Domestic wastewater generation is related to the number of workers, which is essentially the same for the all technologies being considered at 4.6 million gal/yr (17,000 m^3/yr).

5.11.3 Impacts of the Proposed Action

5.11.3.1 Impacts of Construction

Construction-related impacts on groundwater would be none to negligible, and, if impacts did occur, they would exist for only a short period. During incident-free construction activities, no contamination of groundwater would be expected. Standard precautions during equipment fueling and maintenance and other activities should be followed to prevent spills or leaks.

Water use during construction is estimated to be 7 million gal (26,500 m^3 or 21.5 acre-ft) over approximately three years (approximately 7 acre-ft/yr). This use represents an increase of less than 0.05% of the on-post well capacity and an approximate 0.7% increase in water usage above the current average annual water usage of 980 acre-ft/yr. Existing water supply wells are capable of meeting this increase in demand. Impacts on the Sparta Aquifer from this additional withdrawal over a 36-month period would be negligible. Construction activities would be expected to generate 4.5 million gal (17,000 m^3) of sanitary waste over the same time period.

5.11.3.2 Impacts of Operations

The foreseeable impacts on water resources would result from the use of potable water, process water, and fire control water and from the generation of sanitary sewage. During normal operations, estimated water usage by the proposed ACWA technologies would range from

7.3 million gal/yr (28,000 m^3/yr) for Elchem Ox to 24 million gal/yr (91,000 m^3/yr) for Neut/GPCR/TW-SCWO. These amounts equal approximately 22 to 74 acre-ft per year.

Potable water use of 22 acre-ft/yr would be an increase of approximately 2% over the current average annual usage of 980 acre-ft/yr, while use of 74 acre-ft/yr would be an increase of approximately 7% over current average annual use. These are not significant increases in water use, and the existing water supply wells have the capacity to meet this additional need. This additional demand would not significantly increase the drawdown at the water supply wells and would not be permanent. Once ACWA facility operations ceased, groundwater levels would rebound. Impacts on groundwater resources from operating an ACWA facility would be negligible.

5.11.4 Impacts of No Action

Continued storage of chemical weapons at PBA would not adversely affect groundwater. Procedures exist to preclude chemical spills and to address them if they do occur to prevent contamination of groundwater resources. Facilities exist to handle generated sanitary waste.

5.12 SURFACE WATER

5.12.1 Current Environment

Surface water flow at PBA is typified by sluggish, meandering streams, abandoned meanders, and oxbow lakes (U.S. Army 1997). The gentle topography and slow stream flow result in numerous wetland areas or bayous. A large number of wetlands have been designated at PBA (see Section 5.16).

PBA is located within the Caney Bayou-Arkansas River watershed that surrounds the arsenal. Caney Bayou and the Arkansas River form the southwestern and northeastern boundaries of PBA, respectively (U.S. Army 1997). Lock and Dam Numbers 4 and 5 are located east and northwest of PBA, respectively, on the Arkansas River. These locks and dams provide for transportation on the river and regulate the river flow near PBA. Flow in the Arkansas River equals or exceeds 20,000 ft^3/s (570 m^3/s) 50% of the time (U.S. Army 1997).

PBA drains generally in a southeast direction toward and into the Arkansas River (U.S. Army 1988). Drainage occurs in several major creeks and several smaller creeks that cross PBA. Eastwood Bayou, Triplett, and Tully Creeks drain the majority of the arsenal (see Figure 5.12-1). Production and White Creeks drain the production areas in the southern portion

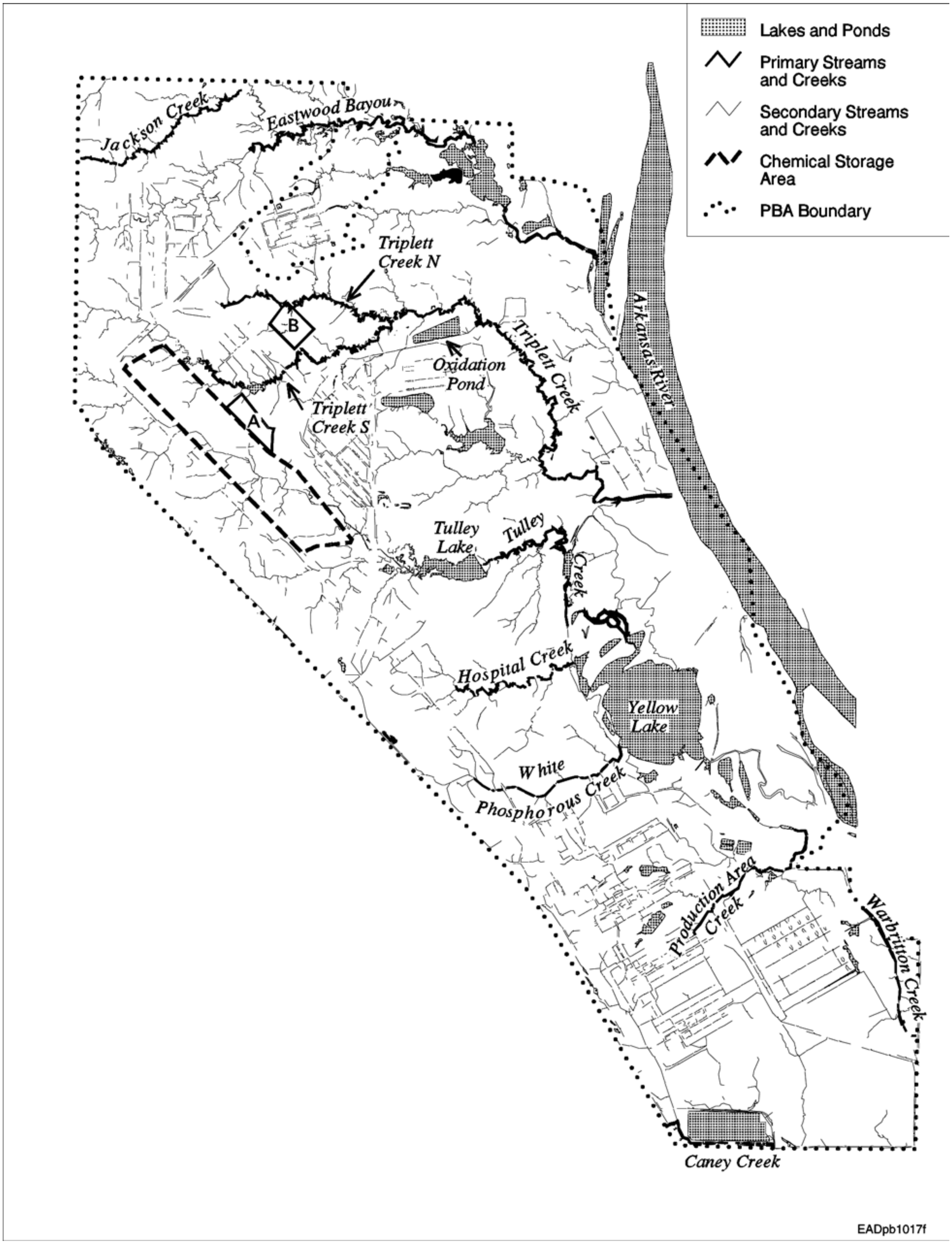

FIGURE 5.12-1 Surface Water Features at PBA

of PBA, and Warbritton Creek and Caney Bayou drain the southern tip of PBA. Eastwood Bayou is located north of PBA and drains some of the north and northeastern areas.

The chemical storage areas and proposed ACWA facility construction areas are located within the area drained by Triplett Creek.

Tulley, Hospital, and White Phosphorous Creeks empty into Yellow Lake, located in the southeast portion of PBA on an abandoned meander of the Arkansas River that was created by the U.S. Army Corps of Engineers [COE] in the 1930s (U.S. Army 1997). Discharge from Yellow Lake flows through swampy lowlands to the Arkansas River. Tulley Creek and Tulley Lake are human-made impoundments immediately upstream from Yellow Lake and drain part of the old manufacturing and storage areas. Hospital Creek drains the headquarters, administration, and hospital areas. Drainage from the maintenance shop and white phosphorous production area enters Yellow Lake through White Phosphorous Creek.

The bomb storage area and pyrotechnic production area are drained by Production Area Creek (U.S. Army 1997). Production Area Creek also receives treated sanitary and industrial wastewater discharge. Production Area Creek meanders through swampy wetlands and joins the discharge from Yellow Lake before entering the Arkansas River along McGregor’s Reach (U.S. Army 1997).

PBA contains a large number of small lakes and ponds (Table 5.12-1). South of PBA are the Pine Bluff city sewage oxidation lagoons, Black Dog Lake, and Lake Pine Bluff Lake, a 500-acre (200-ha) impoundment (U.S. Army 1997).

No known springs on PBA discharge groundwater to the surface water regime (U.S. Army 1997).

The water quality of the streams on PBA is generally fair, and the quality of the surface waters is generally good. Some of the surface water areas were contaminated by historic production activities before pollution control technology was installed in the early 1980s (U.S. Army 1988). However, long-term monitoring of the surface water system shows that water quality is improving, and impacts from contamination have not been noted (U.S. Army 1997). The major contaminants included the pesticide DDT and its degradation products, elemental phosphorous, phosphates, and metals (U.S. Army 1997).

At Caney Bayou, Bayou Bartholomew, Brumps Bayou, and Black Dog Lake, the water quality is generally poor, with low dissolved oxygen. In addition, phosphorous, total nitrogen, biochemical oxygen demand, and fecal bacteria are high. Contact recreation in these waters could be unsafe (U.S. Army 1997).

TABLE 5.12-1 Ponds and Lakes at PBA

Pond or Lake	Surface Area (acres [ha])
Yellow Lake	200 (80.9)
Tulley Lake	35 (14.2)
Duck Reservoirs (2)	20 (8.1) total
Clear Pond	2 (0.8)
Dilly Pond	3 (1.2)
Gibson Pond	2 (0.8)
Big Transportation Pond	2 (0.8)
Big Area 3 Pond	4 (1.6)
Grassy Pond	3 (1.2)
Arkla Pond	2 (0.8)
Bomb Storage Pond	1 (0.4)
Little Transportation Pond	1 (0.4)
Horseshoe Pond	1 (0.4)
Dexter Pond	1 (0.4)
Bunker Pond	1 (0.4)
King Pond	1 (0.4)
Thompson Pond	1 (0.4)
Staff Pond	2 (0.8)
Total	282 (114)

Source: U.S. Army (1997).

No developed areas on PBA are subject to flooding (U.S. Army 1997). However, undeveloped areas, such as Yellow Lake and the lowlands adjacent to the Arkansas River, are subject to periodic flooding. Historically, minor flooding has occurred in developed areas during high rainfall events (U.S. Army 1997). The proposed locations for an ACWA facility are above historically flooded areas.

There are a number of public water intakes located on the Mississippi River downstream from PBA, but none on the Arkansas River. In Jefferson County, no surface water sources are used for the public water supply. The water supply for both Pine Bluff and PBA is from groundwater sources (U.S. Army 1997).

5.12.2 Site-Specific Factors

Impacts on surface water resources would be essentially the same for all the ACWA technologies being considered, because the source of both the process and potable water supply is groundwater resources. None of the technologies would discharge any process wastewater.

The only outfall to surface waters would be treated domestic sewage. As a result, wastewater generation would be related to the number of workers, which would be essentially the same for all the technologies being considered.

Annual surface water discharges during construction would range from 7.4 million gal (28,000 m^3) to 8.1 million gal (31,000 m^3) over approximately three years (see Table 5.4-2). This water would be treated to applicable standards and released to the surface water environment.

Annual surface water discharge during operations would be essentially the same for all the technologies being considered, with an estimated range of 7.4 to 8.1 million gal (28,000 to 31,000 m^3) over the entire construction period.

5.12.3 Impacts of the Proposed Action

5.12.3.1 Impacts of Construction

Construction-related impacts on overland water flow would be none to negligible, and, if impacts did occur, they would exist only for a short period. During incident-free construction activities, no contamination of surface water would be expected. Standard precautions during equipment fueling and maintenance and other activities should be followed to prevent spills or leaks. Berms and other devices should be placed to restrict surface runoff from the construction site. If spills or leaks did occur, procedures should exist to quickly remove contaminants before they could be transported to existing surface or groundwater resources.

There would be no impacts on off-post surface water from construction.

5.12.3.2 Impacts of Operations

Impacts on surface water would be negligible. Sewage would be treated to regulatory required limits and discharged. The estimated sewage discharge of 4.6 million gal/yr (0.002 ft^3/s) would be small when compared with surface water flows and would not significantly change flow conditions.

There would be no impacts on off-post surface water from normal operations. The estimated sewage discharge of 4.6 million gal/yr (0.002 ft^3/s) would be small when compared with surface water flows and would not significantly change flow conditions.

5.12.4 Impacts of No Action

Continued storage of chemical weapons at PBA would not adversely affect surface waters. Controls are in place to minimize soil erosion, although some erosion is expected to occur in areas kept clear of vegetation for security purposes and in dirt roadways within the storage block. Facilities exist to handle sanitary waste, and procedures are in place to preclude chemical spills and to address them if they do occur.

5.13 TERRESTRIAL HABITATS AND VEGETATION

5.13.1 Current Environment

Vegetation on PBA is representative of native plant communities found within the West Gulf Coastal Plain Physiographic Province. Some community types of the Mississippi Alluvial Plain Province occur in low elevation areas near the Arkansas River on PBA. PBA covers about 15,000 acres (6,000 ha), of which more than 9,000 acres (3,500 ha) is classified as forest (Campbell et al. 1997). Other vegetated areas on PBA include lawns, other mowed areas, wildlife food plots, and grasslands, some with isolated pine trees. Determinations made by using a geographic information system (GIS) indicated that cover types for PBA are as follows:

Open/other areas	6,000 acres	(2,500 ha)
Hardwood/pine	3,000 acres	(1,000 ha)
Pine/hardwood	2,500 acres	(1,000 ha)
Hardwood forest	1,000 acres	(500 ha)
Bottomland forest	1,000 acres	(500 ha)
Pine forest	800 acres	(300 ha)

Natural plant communities were classified into one of 15 vegetation types based on topographic and soil moisture conditions at PBA (Campbell et al. 1997) from forested communities in the Arkansas River floodplain to upland, drier forest and grassland areas. Plant communities have been described at six representative locations on PBA (Campbell et al. 1997) and are summarized in the Integrated Natural Resources Management Plan (PBA 1998).

Both the alternative areas for an ACWA pilot test facility are located on upland areas (see Figure 5.1-2). No quantitative data on vegetative communities at the areas being evaluated exist. Area A is covered with a dense hardwood/pine forest community that is typical of upland forest areas at PBA. The Campbell et al. (1997) survey identifies the following common trees on upland areas at PBA that support mixed hardwood/pine forest stands: loblolly pine (*Pinus taeda*), red maple (*Acer rubrum*), mockernut hickory (*Carya tomentosa*), sweetgum (*Liquidambar styraciflua*), black cherry (*Prunus serotina*), water oak (*Quercus nigra*), post oak (*Q. stellata*), and sassafras (*Sassafras albidum*). Area B is located in a grassland savanna community and mixed hardwood area. The grassland savanna community consists mostly of isolated loblolly pine trees generally less than 20 ft (6.1 m) tall. This area shows signs of previous surface disturbance. The mixed hardwood portion of Area B supports the following common tree species: loblolly pine, white oak (*Q. alba*), southern red oak (*Q. fulcata*), and sweetgum.

5.13.2 Site-Specific Factors

The disturbance of land for both the ACWA pilot test facility and the new infrastructure needed to operate the facility was considered in the scope of the construction impact analysis. The impacts from routine operations on ecological resources were considered for the three proposed ACWA technologies. Impacts addressed included those from traffic, atmospheric releases, and exposure to elements and compounds and were based on concentrations predicted by the D2PC model.

5.13.3 Impacts of the Proposed Action

5.13.3.1 Impacts of Construction

The construction of an ACWA pilot test facility would disturb up to 25 acres (14 ha) for the complex and another 5–12 acres (2–5 ha) for the infrastructure. The total area likely to be disturbed for utility requirements during construction is shown in Table 5.3-l. If Area A is chosen for the facility, up to 25 acres (10 ha) of dense hardwood/pine forest community would be disturbed during construction. An additional 5 acres (2 ha) would be disturbed to construct water, sewer, and gas lines, and the 69-kV transmission line. The area disturbed for the water, sewer, and gas pipeline assumes that all three lines would be placed in the same 66-ft (20-m) wide right-of-way. If Area B is selected, up to 25 acres (10 ha) of grassland savanna community composed of loblolly pine trees and grasses would be disturbed by construction. An additional area of up to 12 acres (5 ha) would be disturbed for infrastructure construction, including a 0.2-mi (0.3-km) long access road.

Some clearing or trimming of trees would be required to install the 69-kV transmission line along a right-of-way to either Area A or B. Disturbance for installation of gas and water supply lines and sewer lines would likely occur along road rights-of-way, affecting vegetation that was previously disturbed during roadway construction.

5.13.3.2 Impacts of Operations

Because routine operations would not involve the release of significant quantities of typical air pollutants (Kimmell et al. 2001), impacts on vegetation are expected to be negligible. Vegetation at PBA would not be affected from air concentrations downwind from an ACWA facility. Deposition levels on soils and vegetation downwind of the ACWA facility from such low stack release levels would be negligible. A soil screening-level ecological risk assessment was conducted to evaluate the potential impacts from air emissions expected from each of the three ACWA technologies. This analysis showed that impacts to ecological receptors would be unlikely (Section 5.14.3.2).

5.13.4 Impacts of No Action

Continued storage of chemical agent at PBA would not adversely affect plant communities or wildlife habitats under normal maintenance and monitoring of the storage bunkers, vegetated areas, and cleared areas. Periodic mowing of vegetation between the bunkers has precluded establishment of shrub and tree species. This type of vegetation control would likely continue into the future.

5.14 WILDLIFE

5.14.1 Current Environment

5.14.1.1 Mammals

Wildlife species at PBA are typical of eastern deciduous forest communities. Recent mammal surveys recorded 20 species from representative habitats on PBA (Phelps 1997). Surveys were conducted in the same areas where plant communities were described. The areas included the Eastern Bayou area located north of Areas A and B; Triplett Creek, Yellow Lake, and Triplett Bluff located east and southeast of Areas A and B; Refuge Woods located on the southwest corner of PBA; and railroad grasslands along the western perimeter of PBA. The most common small mammalian species recorded from trapping surveys was the cotton mouse (*Peromyscus gossypinus*). The cotton mouse was recorded in five of six study areas surveyed. Other small mammals recorded in two or more study areas included the white-footed mouse

(*Peromyscus leucopus*), deer mouse (*P. maniculatus*), cotton rat (*Sigmodon hispidus*), fulvous harvest mouse (*Reithrodontomys fulvescens*), golden mouse (*Ochrotomys nuttalli*), and short-tailed shrew (*Blarina carolinensis*). Common carnivores observed included the armadillo (*Dasypus novemcinctus*), raccoon (*Procyon lotor*), and coyote (*Canis latrans*). The river otter (*Lutra canadensis*) and beaver (*Castor canadensis*) were observed in aquatic habitats on PBA.

Bat surveys conducted in 1997 at PBA yielded five species totaling 58 captures in mist nets. Surveys were conducted at all areas of PBA except the chemical storage area (Saugey 1997) The most commonly captured species included the red bat (*Lasiurus borealis*), eastern pipistrelle (*Pipistrellus subflavus*), and evening bat (*Nycticeius humeralis*).

A more detailed discussion of the mammals documented from field observations at PBA and suggested management practices to support mammal populations is presented in the Integrated Natural Resources Management Plan and in a report on field surveys at PBA (PBA 1998; Phelps 1997).

5.14.1.2 Birds

Bird species at PBA are typical of eastern deciduous forest and open grassland habitats of the south-central United States. Peacock and Zollner (1998) conducted avian surveys at PBA during 1996 and 1997, classifying species occurrences into one of seven habitat types. A total of 155 species were observed either as permanent residents, migrants, or summer residents (i.e., breeding species). The upland forest matrix, together with bottomland hardwood forest, riparian areas, and water bodies on PBA, provide a diversity of habitats for resident and migratory species. Upland forests are considered the most important habitat for breeding birds at PBA (Peacock and Zollner 1998).

Forty-five of the 155 species observed at PBA are breeding species. Common breeding birds of upland forest habitats include the red-bellied woodpecker (*Melanerpes erythrocephalus*), downy woodpecker (*Picoides pubescens*), northern cardinal (*Cardinalis cardinalis*), indigo bunting (*Passerina amoena*), red-eyed vireo (*Vireo olivaceous*), song sparrow (*Melospiza melodia*), and blue jay (*Cyanocitta cristata*). Six warbler species are confirmed breeding species of upland forests, although none are classified as common. The pine warbler (*Dendroica pinus*) and black-and-white warbler (*Mniotilta varia*) were frequently observed during the 1996–1997 surveys. The great blue heron (*Ardea herodias*) is the most common of four wading bird species that inhabit wetland habitats at PBA. Seventeen waterfowl species have been observed at PBA (Peacock and Zollner 1998**)**. Only the Canada goose (*Branta canadensis)* and mallard (*Anas paltyrhynchos*) are permanent residents at PBA. Raptors known to breed at PBA include the red-tailed hawk (*Buteo jamaciensis)*, broad-winged hawk (*Buteo platypterus*), and red-shouldered hawk (*Buteo lineatus*). The red-tailed hawk and the kestrel (*Flaco sparverius*) are relatively common at PBA.

5.14.1.3 Reptiles and Amphibians

The herpetofauna of PBA are representative of southern deciduous forested ecosystems with a diverse landscape of aquatic and terrestrial habitats. Field surveys conducted in 1997 documented the presence of 45 species of amphibians and reptiles on PBA (Robison 1997). Twenty-four species were observed in hardwood/pine forests typical of Areas A and B. Fourteen amphibian species were observed at PBA. The most commonly observed amphibians included the cricket frog (*Acris crepitans blanchardi*), Fowler's toad (*Bufo woodhousei fowleri*), and leopard frog (*Rana utricularia*). The most abundant lizard species of the five species recorded at PBA is the fence lizard (*Sceloporus undulatus*), occurring in three of the seven habitat types delineated during the herpetofaunal surveys. Seventeen snake species have been observed at PBA. The most common species documented during the surveys in 1997 (Robison 1997) included three species of water snake (*Nerodia spp.*), the eastern hognose snake (*Heterodon platirhinos*), black rat snake (*Elaphe obsoleta*), speckled kingsnake (*Lampropeltis getula*), cottonmouth (*Agkistrodon piscivorus*), and midland brown snake (*Storeria dekayi*). The three water snakes and cottonmouth were typically observed in aquatic and riparian habitats, while the black rat snake, eastern hognose, and midland brown snake occurred in open fields and forested habitats. Ten turtle species were documented in the herpetofaunal surveys. The most common species was the three-toed box turtle (*Terrapene carolina*), observed only in terrestrial habitats. Other common turtle species included the Ouachita map turtle (*Graptemys pesudogeographica*), red-eared slider (*Trachemys scripta*), common musk turtle (*Sternotherus odoratus*), and common snapping turtle *(Chelydra serpentina*).

5.14.2 Site-Specific Factors

The disturbance of land for both the ACWA pilot test facility and the new infrastructure needed to operate the facility was included in the scope of the construction impact analysis. The impacts of routine operations on ecological resources were considered. Impacts addressed included those from traffic, atmospheric releases, and exposure to elements and compounds and were based on concentrations predicted by the D2PC model.

5.14.3 Impacts of Proposed Action

5.14.3.1 Impacts of Construction

Loss of habitat, increased human activity during construction, increased traffic on local roads, and noise are the most important factors that would affect wildlife species. The presence of construction crews and increased traffic would cause some wildlife species to avoid areas adjacent to the construction site during the 30-month construction period. Wildlife species inhabiting the construction area rely on upland hardwood/pine forest habitat and pine savanna for food, cover, and nesting and would be affected by vegetation clearing. Less mobile and burrowing groups, such as amphibians, some reptiles, and small mammals, would be killed during vegetation clearing and other preparation activities. The loss of grassland habitat would displace small mammals and songbirds from the construction areas. The loss of about 25 acres (10 ha) of upland forest habitat at Area A and about 35 acres (14 ha) of pine savanna habitat at Area B during construction would not be expected to eliminate any wildlife species from PBA, since similar habitat is relatively common elsewhere on the installation. Mammalian species likely to be affected by loss of grassland and forest habitat include the white-footed mouse, short-tailed shrew, cotton rat, and golden mouse.

Clearing of upland hardwood/forest habitat at Area A would potentially affect a greater number of summer resident bird species than would vegetation clearing at Area B. Area A is part of a larger dense upland forest that would become partially fragmented by clearing of up to a 25-acre (10-ha) area for construction of an ACWA facility. Upland forests are the most important habitat for breeding birds at PBA (Peacock and Zollner 1998). Breeding birds of upland forest habitats that would be affected by loss of forest habitat include the red-bellied woodpecker, downy woodpecker, red-eyed vireo, indigo bunting, song sparrow, blue jay, and six warbler species. Observations during 1996-1997 surveys indicated that the pine warbler and black-and-white warbler are relatively common (Peacock and Zollner 1998).

Reptiles likely to experience loss of habitat or mortality during construction activities at Areas A and B include the fence lizard, three-toed box turtle, black rat snake, eastern hognose snake, and midland brown snake. Relatively common amphibian species inhabiting moist forested habitats adjacent to drainage ways that could be affected during construction include the cricket frog, Fowler's toad, and leopard frog.

Noise levels generated by construction equipment are expected to range from 85 to 90 dBA at the proposed ACWA facility (see Section 5.8). Noise would diminish to background levels at the northern and western boundaries of PBA. Published results in numerous studies indicate that small mammals can be adversely affected by the maximum noise levels produced by construction equipment (Manci et al. 1988; Luz and Smith 1976; Brattstrom and Bondello 1983); Manci et al. (1988), in a review of the effects of noise on wildlife and domestic animals, reported that sudden sonic booms of 80 to 90 dBA startled seabirds, causing them to temporarily abandon nest sites. The startle response of birds to abrupt noise and continuous noise and their ability to acclimate seems to vary with species (Manci et al. 1988). Some songbirds within about 330 ft (100 m) of construction equipment may abandon existing habitat because of noise levels. Also, white-tailed deer and other larger mammals would not use areas near the construction area because of noise and the presence of workers. Noise from construction vehicle traffic might adversely affect wildlife species in areas adjacent to access roads. No long-term impacts on the hearing ability of wildlife species would be expected from construction-generated noise.

Some unavoidable impacts on wildlife would occur from increased vehicle traffic. Approximately 4,500 truck shipments of construction materials are expected during the construction period (Kimmell et al. 2001). Construction traffic would increase the potential for roadkills to species such as the eastern cottontail, gray and eastern fox squirrels, opossum, and raccoon along the new access road and existing roads. Birds of prey at PBA would not likely be adversely affected by the loss of prey base that would be associated with the loss of up to 40 acres (16 ha) of vegetation from clearing, but they might avoid foraging in areas next to construction sites because of increased human activity. Species such as the red-tailed hawk and kestrel might benefit from the single wood poles constructed for the transmission line, by using them as perch sites.

Raptor electrocution from simultaneous wing contact with two conductors or a conductor and ground wire on the 69-kV transmission line would not be expected if appropriate design features were incorporated into the system. The red-tailed hawk, the largest raptor occurring at PBA, has a maximum wing span of 54 in. (132 cm). The wings of a red-tailed hawk could make simultaneous contact with two conductors or a conductor and ground wire when it attempted to land, and if the conductor(s) were not properly shielded, the hawk would be electrocuted. This situation could occur at the transmission pole regardless of whether a crossarm design or a single pole design without a crossarm was selected. Also, in cases where a single pole structure has been built to support 69-kV conductors, raptors have been electrocuted when landing on an insulator and making simultaneous contact with a conductor and ground wire (Avian Power Line Interaction Committee 1996). To avoid raptor electrocution, the 69-kV transmission line would have to be designed by following suggested practices for raptor protection (Avian Power Line Interaction Committee 1996).

5.14.3.2 Impacts of Operations

Operation of the test facility would increase human activity in the northern portion of PBA. An increase in traffic along access roads from worker vehicles and periodic delivery of chemicals and other supplies would increase the number of roadkills of rodents and reptiles.

The maximum noise next to facilities is expected to be 72 dBA and decrease to about 50 dBA at a distance of 1,000 ft (300 m). Anticipated noise levels of 55–60 dBA near the facility boundary would have only minor impacts on birds and mammals. Noise generated by vehicles traveling to an ACWA facility might affect wildlife inhabiting areas adjacent to roadways. Any abrupt noise levels would startle birds and might cause temporary nest abandonment. These levels would not likely interfere with the auditory function of birds and mammals next to an ACWA facility.

A soil screening-level ecological risk assessment was conducted for each of the three technologies considered for ACWA pilot testing at PBA to determine potential impacts to biota from routine emissions. The overall approach for the risk assessment was the same as that used at PCD (see Section 6.13.3.2). Details of the risk assessment are provided elsewhere (Tsao 2001c). Table 5.14-1 shows the number of chemicals evaluated from the air emissions for each ACWA technology. Chloroform in emissions from Neut/GPCR/TW-SCWO pilot testing was the

TABLE 5.14-1 Chemical Emissions of Potential Concern Based on a Screening-Level Ecological Risk Assessment of Air Emissions from Routine Operation of an ACWA Pilot Facility at PBA

Technology	No. of Chemicals Evaluated	Chemicals of Potential Concern from Stack Emissions[a]
Neut/SCWO	41	None
Neut/GPCR/TW-SCWO	782	Chloroform
Elchem Ox	45	None

[a] Chemical emitted from the destruction of GB and VX with an HQ of >1 based on 12-h/d, 6-d/wk operation.

only chemical that resulted in an HQ of >1 of the 73 chemicals evaluated that exceeded the soil screening benchmark value of 1×10^{-3} mg/kg (EPA 2001). The HQ for this compound is 7.2. The emission of chloroform occurs during the destruction of VX and GB. Chloroform would likely be dispersed over a large geographical region and would probably not be deposited on soil because of its volatility and low solubility in water. With a vapor pressure of 197 mm Hg and a melting point of −63°C, most of this volatile compound would remain in a gaseous state and ultimately be degraded by hydroxyl radicals in the atmosphere.

Because chloroform would be released as a gas from the emission stacks, the primary route of exposure to agricultural and ecological receptors would be via inhalation and, to a lesser extent, air deposition. Inhalation toxicity studies on rats during gestation indicated that, at air concentrations of 150, 500, and 1,500 mg/m^3 for 7 h/d, chloroform inhibited the development of fetuses and was fetotoxic. Another study found that exposure to chloroform by pregnant female mice caused an accumulation of chloroform in newborn mice (Hazardous Substances Data Bank 2001). The “no observed effect” atmospheric concentration for rats is unknown. It is important to note that the ground-level air concentration of chloroform from the emission stacks would be about 1.4×10^{-8} mg/m^3, which is a small fraction of the exposure concentrations for rats in the laboratory.

Although chloroform emitted during pilot testing would likely persist as a gas, some amount could be deposited onto soil by mixing with water droplets during precipitation. Tests showed that chloroform, even at the highest tested concentration of 1,000 mg/kg had no effect on the respiration of native soil microflora (Efroymson et al. 1997). During ACWA pilot testing, if it is assumed that all chlorofom would be deposited on site and that no loss would occur, the highest soil concentration of chloroform would be expected to occur in the northeast quadrant, at a maximum value of 7.2×10^{-8} mg/kg (Tsao 2001c).

Food-chain transfer via plants would be minimal. On the basis of the most recent uptake model developed by the EPA (EPA 2000), the potential for chloroform to bioaccumulate in terrestrial food chains from soil is low (log $BAF_{soil\text{-}to\text{-}plant} = 1.9$). The potential for air-to-plant transfer has been determined to be moderate, given a log $K_{air\text{-}to\text{-}cuticle}$ of 0.26 (Welke et al. 1998). If chloroform were to be deposited onto soil, most of it would most likely volatilize and be dispersed into the atmosphere (Hazardous Substances Data Bank 2001). The half-life of chloroform in the air is about 151 days (Hazardous Substances Data Bank 2001), suggesting that it would be slowly degraded by photochemically produced hydroxyl radicals. No information is available on the toxicity of plants from exposure to gaseous chloroform.

In conclusion, it is unlikely that chloroform concentrations would reach levels that would be harmful to soil microorganisms or wildlife, on the basis of the results of this risk assessment and the results of toxicological studies. The risk assessment assumed that all emissions would be deposited on the PBA site, an assumption that is highly conservative, because prevailing winds would disperse and transport gaseous emissions such as chloroform over a large geographic area, extending well beyond the PBA boundaries.

5.14.4 Impacts of No Action

Continued storage of chemical agent at PBA would not adversely affect wildlife populations.

5.15 AQUATIC HABITATS AND FISH

5.15.1 Current Environment

Five aquatic habitat types have been identified at PBA (Robison 2000): small woodland streams, sluggish bayous, big river (Arkansas River), ponds, and lakes. The two largest lakes on PBA are Yellow Lake (260 acres [105 ha]) and Tulley Lake (30 acres [12 ha]). Yellow Lake is about 2.8 mi (4.5 km) southeast of Area A and 2 mi (3.2 km) southeast of Area B. These lakes, several small human-made ponds, and numerous streams provide habitat for many invertebrate and fish species. Perennial and intermittent streams of the Triplett Creek and Tulley Creek Watersheds occur within the vicinity of Area A and B. Small woodland streams at PBA typically are relatively clear, shallow, tannin-stained with mud and sand substrates, and lacking in vegetation along stream margins (Robison 2000). Eastwood Bayou, located north of Areas A and B, was categorized as having deeper water than woodland streams and is generally devoid of vegetation, with mud and sand substrates.

An inventory of fishes at PBA conducted in 1999 recorded 59 native species from 81 sampling locations (Robison 2000). The most common species recorded are categorized by habitat type in Table 5.15-1. Yellow Lake supported the largest number fish species (34) of any aquatic habitat on PBA. Ponds on PBA supported only eight species. Eastwood and Chaney Bayous provided deeper water bodies than woodland streams that supported 23 fish species. Nineteen species were collected from small, woodland streams. Surveys of the Arkansas River

TABLE 5.15-1 Common Fish Species Occurring at PBA[a]

	Habitat Type				
Species	Streams	Bayous	Lakes	Ponds	Arkansas River
Gizzard shad (*Dorosoma cepedianum*)	-	x	x	-	x
Threadfin shad (*Dorosoma petenense*)	-	x	x	-	x
Red shiner (*Cyprinella lutrensis*)	-	-	-	-	x
Blacktail shiner (*Cyprinella venusta*)	-	x	-	-	x
Golden shiner (*Notomigonus crysoleucas*)	x	x	x	x	-
Emerald shiner (*Notropis atherinoides*)	-	-	-	-	x
Redfin shiner (*Lythrurus umbratilis*)	x	x	-	-	-
Fathead minnow (*Pimephales promelas*)	-	-	x	x	x
Bullhead minnow (*Pimephales vigilax*)	-	-	x	-	x
Yellow bullhead (*Ameiurus natalis*)	x	x	x	x	-
Blue catfish (*Ictalurus furcatus*)	-	-	-	-	x
Channel catfish (*Ictalurus punctatus*)	-	x	x	x	x
Tadpole madtom (*Noturus gyrinus*)	-	-	-	x	-
Pirate perch (*Aphredoderus sayanus*)	x	x	-	-	-
Blackspotted topminnow (*Fundulus notatus*)	x	x	x	-	-
Mosquitofish (*Gambusia affinis*)	x	x	x	x	x
Brook silverside (*Labidesthes sicculus*)	x	x	x	-	-
Inland silverside (*Menidia beryllina*)	-	-	-	-	x
Green sunfish (*Lepomis cyanellus*)	x	x	-	x	x
Orangespotted sunfish (*Lepomis humilis*)	-	-	x	-	x
Bluegill (*Lepomis macrochirus*)	x	x	x	x	-
Dollar sunfish (*Lepomis marginatus*)	x	x	x	-	x
Redear sunfish (*Lepomis microlophus*)	-	-	x	-	-
Largemouth bass (*Micropterus salmoides*)	x	x	x	x	x
White crappie (*Pomoxis annularis*)	-	-	x	-	-
Cypress darter (*Etheostoma proeliare*)	x	x	x	-	-

[a] Based on 81 samples during surveys on 16 dates during 1999 (Robison 2000). Species were categorized as common if more than 11 individuals were collected during the surveys.

along the PBA eastern boundary recorded 24 species. The most common species collected at PBA, in order of decreasing abundance, were the threadfin shad (*Ddorsoma* petenense), western mosquitofish (*Gambusia affinis*), brook silverside (*Labidesthes sicculus*), golden shiner (*Notemigonus crysoleucas*), and dollar sunfish (*Lepomis marginatus*). The western mosquitofish and largemouth bass were found in all habitat types. Four sampling locations in streams near Areas A and B yielded six species: black bullhead (*Ameiurus melas*), bluegill (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), brook silverside, black-spotted topminnow (*Fundulus olivaceus*), and western mosquitofish.

Recreational fishing occurs at several locations on PBA. Two of the most important are Tulley Lake and Yellow Lake. Tulley Lake has been stocked with largemouth bass, bluegill, and channel catfish (U.S. Army 1997). Yellow Lake typically receives floodwaters from the Arkansas River two to three times each year and exhibits naturally occurring eutrophication. Yellow Lake and the creek outfall receive heavy fishing pressure for white crappie (*Pomoxis annularis*), largemouth bass, bluegill, channel catfish (*Ictalurus punctatus*), and redear sunfish (*Lepomis microlophus*).

5.15.2 Site-Specific Factors

It is expected that impacts on aquatic habitats and fish resulting from construction would be the same regardless of the technology evaluated, given the similarity in space requirements, construction activities, and time requirements for constructing the pilot test facilities. Construction activities that would release sediments to on-post tributaries of streams could affect stream water quality and fish species. Any impacts from routine operations would be a result of emissions deposited in water bodies downwind of the pilot test facility.

5.15.3 Impacts of the Proposed Action

5.15.3.1 Impacts of Construction

Aquatic habitats and fish species would not likely be affected by construction activities. During construction of an ACWA facility and water, sewer, and gas pipelines, siltation fences or other mechanical erosion control measures would be used to control runoff where surface disturbance could potentially affect aquatic habitats in drainage areas downslope of Area B or along on-post roadways. Avoiding construction along a tributary of Triplett Creek (see Figure 5.17-1 in Sections 5.17 on wetlands) that runs through the middle portion of Area B would lessen the potential impacts on aquatic biota located downstream.

5.15.3.2 Impacts of Operations

Aquatic habitats and fish species would not be affected by releases of trace metals and organic compounds from an ACWA pilot test facility. During routine operations, emission rates of all trace constituents (Kimmell et al. 2001) and particulates from an ACWA facility would be well below levels that would affect ecosystems through biouptake and biomagnification in the food chain. A screening-level ecological risk assessment of aquatic species at PBA was not warranted on the basis of such low emissions. Releases of organic compounds during the processing of nerve agents would also be very low and would not result in any adverse impacts on aquatic ecosystems located downwind of the facilities.

5.15.4 Impacts of No Action

Continued storage of chemical agent at PBA would not adversely affect aquatic habitats and fish.

5.16 PROTECTED SPECIES

5.16.1 Current Environment

The Arkansas Natural Heritage Commission identified 97 species of concern within a 30-mi (50-km) radius of the proposed areas for an ACWA pilot test facility at PBA (Osborne 2000). Table 5.16-1 lists species of concern that are categorized as state endangered or threatened and federal listed threatened and endangered species and that the Arkansas Natural Heritage Commission believes could occur in the project area. The U.S. Fish and Wildlife Service (USFWS), however, reported that no federal listed species are known to occur at PBA (Tobin 2000). Records on the Florida panther (*Felis concolor coryi*) for Jefferson County are likely based on the historic distribution of the species in Arkansas (Becker 2000), because no recent sightings have occurred in the project area. Since the early 1980s, the federal threatened bald eagle (*Haliaeetus lecuocephala*) has been a transient species every year at PBA. Eagles attempted to nest at a snag near Yellow Lake in 1994, 1996, and 1997, but no young were fledged. In 1997, the nest fell from the snag tree, and no new nests have been observed since that time (PBA 1998).

TABLE 5.16-1 Species of Concern and Federal Protected Species within 30 Miles (50 Kilometers) of PBA

	Status[a]		Rank[b]	
Species	Federal	State	State	Counties[c]
Arkansas fatmucket *(Lampsilis powellii)*	LT	-	S2	Saline
Florida panther *(Felis concolor coryi)*	LE	-	S1	Jefferson
Bald eagle *(Haliaeetus lecuocephala)*	LT	-	S2B,S3N	Grant, Cleveland, Jefferson, Lonoke, Pulaski, Saline
Red-cockaded woodpecker *(Picoides borealis)*	LE	-	S2	Grant, Pulaski, Saline
Geocarpon *(Geocarpon minimum)*	LT	SE	S2	Cleveland
Winterberry holly *(Ilex verticillata)*	-	ST	S2	Saline
Prairie evening primrose *(Oenothera pilosella sessilis)*	-	ST	S2	Arkansas, Prairie
Aster *(Aster pratensis)*	-	ST	S2	Cleveland
Southern rein-orchid *(Platanthera flava)*	-	ST	S1,S2	Uncertain distribution
Purple fringeless orchid *(Platanthera peramoena)*	-	ST	S2	Pulaski
Rose pogonia *(Pogonia ophioglossoides)*	-	ST	S2	Jefferson, Saline
White-top sedge *(Rhynchospora colorata)*	-	SE	S1	Uncertain distribution
Slender marsh pink *(Sabatia campanulata)*	-	SE	S1	Lonoke, Pulaski
Texas sunnybell *(Schoenolirion wrightii)*	-	ST	S2,S3	Cleveland
Pineywoods dropseed *(Sporobolus junceus)*	-	ST	S1,S2	Arkansas
Small-headed pipewort *(Eriocaulon loernickianum)*	-	SE	S2	Pulaski, Saline

[a] Federal status: LE = endangered, LT = threatened. State status: SE = state endangered, native taxa in danger of extirpation; ST = state threatened, native taxa likely to become endangered in Arkansas in the near future as determined by the Arkansas Natural Heritage Commission (Osborne 2000).

[b] S1= extremely rare; typically five or fewer estimated occurrences in the state, especially vulnerable to extirpation. S2 = very rare; typically 5–20 estimated occurrences or many individuals in fewer occurrences; often susceptible to extirpation. S3 = Rare to uncommon; typically 20–100 estimated occurrences in the state, may be susceptible to extirpation. B = breeding status. N = nonbreeding status.

[c] Counties where sensitive species are known to occur or were present in recent historic periods. Source for counties: U.S. Army (1997).

The federal endangered red-cockaded woodpecker (*Picoides borealis*) is known to occupy old-growth pine forests in Grant, Pulaski, and Saline Counties located northwest of PBA and within the 30-mi (50-km) radius of Areas A and B. The federal threatened Arkansas fatmucket (*Lampsilis powelii)* is known to exist in Saline County about 13 mi (20 km) from PBA (U.S. Army 1997). A federal listed threatened plant species with no common name (*Geocarpon minimum*) occurs in Cleveland County, about 19 mi (30 km) south of PBA.

5.16.2 Site-Specific Factors

It is expected that impacts on protected species resulting from construction would be the same regardless of the technology evaluated, given the similarity in space requirements, construction activities, and time requirements for constructing the pilot test facilities. Impacts on protected species might result from the clearing of vegetation during construction of an ACWA pilot test facility and associated infrastructure. Increased human activity from the presence of the on-post work force during both construction and operations and increases in vehicle traffic might also affect federal- and state-protected or sensitive species.

5.16.3 Impacts of the Proposed Action

5.16.3.1 Impacts of Construction

No impacts on protected species are anticipated from the construction of an ACWA facility at PBA. No federal endangered or threatened species are known to occur at PBA. Species determined by the Arkansas Natural Heritage Commission as state threatened or endangered have not been documented from wildlife and plant surveys of PBA.

5.16.3.2 Impacts of Operations

No impacts on protected species are anticipated from the operation of an ACWA pilot test facility at PBA. No federal endangered or threatened species are known to occur at PBA. Species determined by the Arkansas Natural Heritage Commission as state threatened or endangered have not been documented from wildlife and plant surveys of PBA.

5.16.4 Impacts of No Action

Continued storage of chemical agent at PBA would not adversely affect threatened, endangered, or sensitive species.

5.17 WETLANDS

5.17.1 Current Environment

Palustrine forested wetlands (hardwood bottomland forests) occur extensively along streams near PBA, such as Caney Bayou, Bayou Bartholomew, and Derrieusseaux Creek, along tributaries to the west of the installation, and along Barnes Creek and Eastwood Bayou to the north (USFWS 1990, 1995, 1998b). The predominant hydrologic regimes in these wetland communities are seasonally flooded and temporarily flooded. The dominant species of the forest canopy along Eastwood Bayou include southern red oak, cow oak, Shumard oak, water oak, and willow oak. Palustrine scrub/shrub, palustrine forested, and lacustrine littoral unconsolidated shore wetlands (unvegetated sandy shore) occur along the perennial Arkansas River to the east of the installation (USFWS 1990, 1998b). Numerous palustrine forested and palustrine emergent (shallow marsh) wetlands occur within old ox-bow stream channels near tributaries of the Arkansas River, such as Plum Bayou to the east (USFWS 1990, 1998b).

Approximately 2,500 acres (1,000 ha) of wetland occur on the PBA installation (USFWS 1998a). In addition, approximately 600 acres (240 ha) of deep-water habitat (lakes more than 6.6-ft [2-m] deep) occur on the installation. Wetland types range from permanently flooded ponds to intermittent streams. Forested wetlands supporting broad-leaved deciduous trees (palustrine forested broad-leaved deciduous) total 1,500 acres (600 ha); forested wetlands predominantly composed of evergreen trees total 150 acres (60 ha); and mixed (deciduous and evergreen) forested wetlands total 460 acres (180 ha). Forested wetlands make up nearly 84% of all wetlands on PBA. Unvegetated ponds (palustrine unconsolidated bottom) cover 160 acres (60 ha); wetlands with predominantly herbaceous vegetation (palustrine emergent) total 120 acres (50 ha); and wetlands supporting shrubby vegetation communities total 85 acres (34 ha). About 17 mi (27 km) and 13 acres (5 ha) of perennial streams (riverine upper and lower perennial) and about 10 mi (16 km) of intermittent streams (riverine intermittent, that are seasonally flooded) occur on PBA.

Yellow Lake is the largest body of water on the PBA installation. Yellow Lake is a shallow, natural oxbow lake, modified into a 260-acre (105-ha) impoundment that typically is flooded several times a year by the Arkansas River (PBA 1998). A large area of tree and shrub swamp (palustrine forested and palustrine scrub/shrub wetlands) occurs along the north and northwest sides of the lake. Common species include black willow, cottonwood, and American lotus. Tulley Lake is a 30-acre (12-ha) human-made reservoir (lacustrine littoral wetland) located on Tulley Creek.

Area A contains one small palustrine emergent wetland that is temporarily flooded. This wetland is located along the southwest margin of Area A, next to the road bordering the Chemical Demilitarization Area. The dominant species of this wetland type on PBA is soft rush. Downstream of this wetland, to the southwest, is a broadleaf deciduous forested wetland within a tributary of Tulley Creek, a perennial stream. To the north and downgradient of Area A lie broadleaf deciduous forest wetlands and scrub/shrub wetlands along Triplett Creek, a perennial stream. These wetlands are temporarily flooded, with portions flooded seasonally as a result of beaver activity. Several small isolated wetlands occur within the Tulley Creek and Triplett Creek watersheds near Area A. They include palustrine unconsolidated bottom, scrub/shrub, and forested wetlands. They range from permanently and semipermanently flooded to temporarily flooded.

The northern and western portions of Area B contain broadleaf deciduous forested wetlands that are temporarily flooded. The dominant species associated with this type of wetland on PBA are red maple/southern red oak, willow oak/cottonwood, box elder/sugarberry, sassafras, willow oak/southern red oak, box elder/cottonwood, sweet gum/water oak, black willow, and ironwood. Both wetlands are part of larger wetland areas associated with a tributary of Triplett Creek, which intersects Area B. The northern wetland is part of a larger forested wetland area along Triplett Creek. Small areas of emergent wetland, both temporarily flooded and seasonally flooded, also occur along nearby portions of Triplett Creek. Most of the wetlands along Triplett Creek near Area B are temporarily flooded broadleaf deciduous forested wetlands, with a small area of seasonally flooded forested wetland. The southern portion of Area B lies within the watershed of the southern branch of Triplett Creek, which supports large areas of palustrine forested (and a smaller area of scrub/shrub) wetlands. An excavated, permanently flooded, palustrine unconsolidated bottom wetland is located near the southeast boundary of Area B. A temporarily flooded scrub/shrub wetland lies along the tributary, near the southwest boundary of Area B. Several small, isolated wetlands occur within the Triplett Creek watershed near Site B. These include palustrine unconsolidated bottom and emergent wetlands. They range from permanently to temporarily flooded.

5.17.2 Site-Specific Factors

Various factors associated with siting, constructing, and operating an ACWA pilot test facility and also with no action might result in environmental impacts on wetlands. Impacts on wetlands might result from land disturbances due to construction-related activities or other modifications of the landscape. Landscape modifications generally involve large-scale soil disturbances due to facility construction. Such disturbances may eliminate particular wetlands or cause one type to replace another. Landscape modifications may displace or eliminate wildlife that use the area as breeding or foraging habitat or for protection from predators. Landscape modifications might also increase the amount of impervious surface within a watershed or alter drainage patterns, resulting in indirect impacts on wetlands. Impacts could include mortality of individual organisms, habitat loss, or changes in biotic communities resulting from changes in surface water or groundwater quality or flow rates. Erosion of exposed soil at construction areas could reduce the effectiveness of restoration efforts and create downgradient sedimentation. The implementation of standard erosion control measures, installation of storm-water retention ponds, and immediate replanting of disturbed areas with native species would help minimize impacts on wetlands.

Impacts on wetlands might result from the release to the environment of substances known to cause toxic effects in biota. Construction or operation of a pilot facility might result in the release of organic or inorganic compounds, including agent or processing by-products. Releases might occur as a single event (a spill, for example) or as continual low-level releases. Exposure of biota might result from the airborne transmission and deposition of materials, surface water contamination, groundwater contamination (which can affect seeps or springs), or contaminants released to soils. Atmospheric releases of contaminants might result in the widespread deposition of contaminants on surface waters, including wetlands. Exposure routes might include dermal contact with contaminants in sediment or water, ingestion (including ingestion of contaminated sediments, water, or food), plant root uptake, or foliar exposure. Exposures may result in lethal effects, reduced growth or other limiting effects, or no observable effect.

5.17.3 Impacts of the Proposed Action

5.17.3.1 Impacts of Construction

Impacts on wetlands from construction were considered to be the same for all of the technologies evaluated, given their similarity in space requirements, construction activities, and construction durations. The following discussion of construction-related impacts identifies the potential impacts from building a facility within Areas A and B (Figure 5.17-1) and those from developing the associated infrastructure (e.g., electric power supply, gas and water pipelines, access roads). It also identifies mitigation measures that could minimize or prevent impacts on ecologically sensitive areas.

The pilot facility would disturb up to 25 acres (10 ha) of land at Area A or Area B. Approximately 200 tons/yr (178,000 kg/yr) of PM would be dispersed atmospherically during construction. The implementation of best management practices for erosion and sedimentation control, installation of storm-water retention ponds, and immediate replanting of disturbed areas with native species would help minimize impacts on wetlands.

Wetlands could be affected by filling or draining during construction. Impacts could include the elimination of entire wetlands or portions of wetlands or the reduction of wetland functions. Impacts on wetlands from soil compaction or alteration of surface water runoff patterns or groundwater flow could occur if the facility were located immediately next to wetland areas. Maintaining a buffer area around wetlands during construction of the facility could minimize impacts on wetlands.

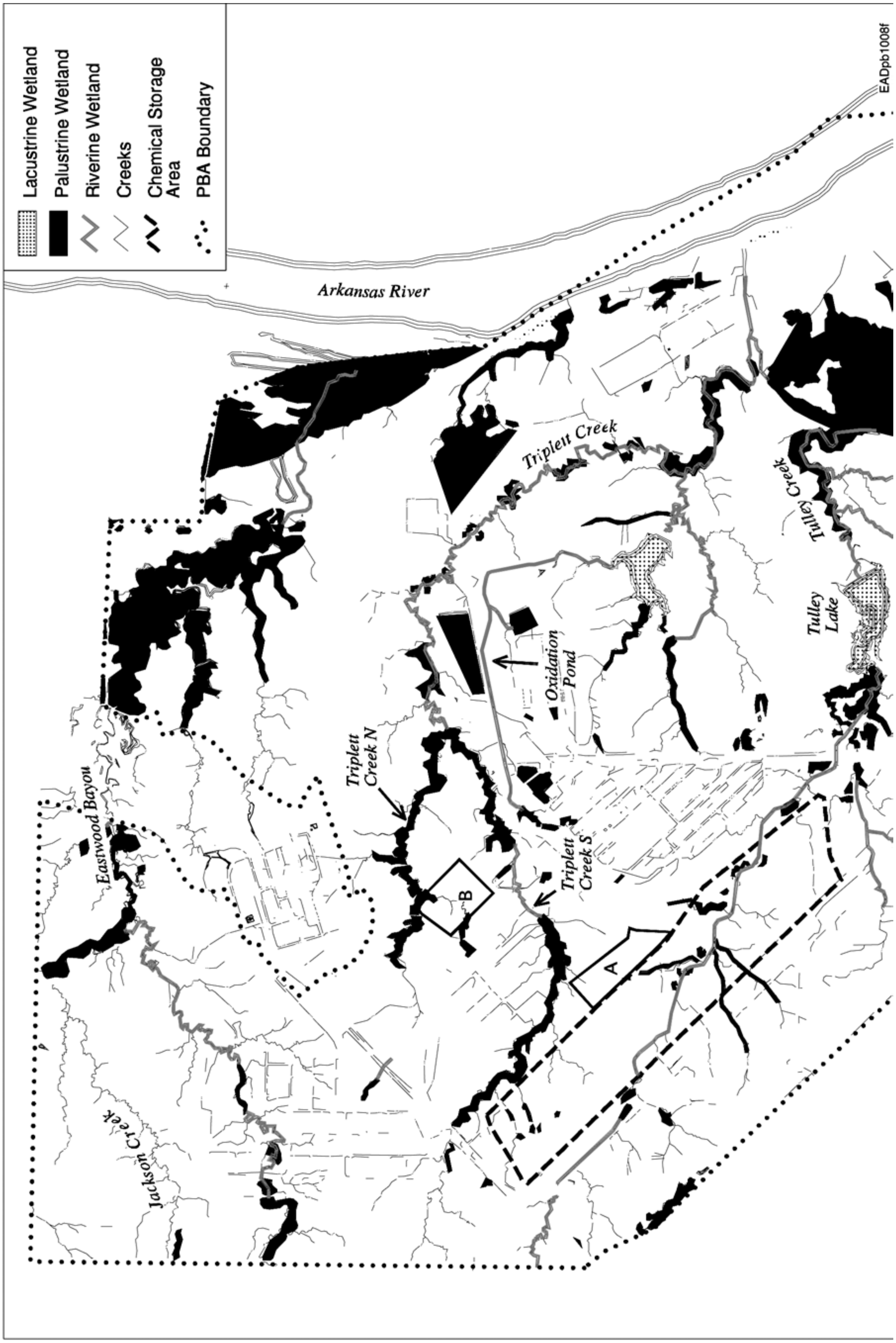

FIGURE 5.17-1 Wetlands at PBA

Construction of the pilot facility at Area A might eliminate the small palustrine wetland located on its southwest margin. The wetland could be affected directly by filling or excavation or indirectly by alteration of hydrology if the facility were located immediately next to the wetland. Activities that result in impacts on wetlands are regulated by the COE. A permit from COE would be required for discharges of fill material into the wetland. This temporarily flooded palustrine emergent wetland is approximately 0.4 acre (0.2 ha) in size, representing about 0.3 % of the emergent wetland type on PBA. Although this wetland type is not rare on PBA, emergent wetlands account for only about 5 % of the total wetland area on the PBA installation.

Sedimentation might occur in palustrine and riverine wetlands downstream from Area A as a result of grading for the facility. Construction activities might also result in accidental releases of contaminants into surface waters in downstream portions of the watershed. Forested wetlands downstream of Area A, such as along Triplett Creek immediately to the north and Tulley Creek to the south, would be adversely affected by uncontrolled runoff from the construction area. Such impacts could be minimized by the implementation of storm-water runoff control measures. Fugitive dust during construction might become dispersed by wind and deposited on wetlands in the vicinity, such as the forested wetlands, streams, or nearby ponds.

At Area B, grading during preparations for construction of a pilot facility could disturb wetlands and alter drainage patterns. Construction of the pilot facility at Area B could potentially eliminate the two wetlands located on Area B. These wetlands are palustrine forested wetlands that are temporarily flooded. The wetland associated with Triplett Creek, in the northern quadrant of Area B, is 1.2 acres (0.5 ha) in size, while the other, along a tributary on the southwest margin of Area B, is 1.0 acres (0.4 ha). These wetlands represent 0.15% of the forested wetlands and 0.09% of all wetlands on PBA. Facility construction may also require the alteration or re-routing of the stream on Area B and may subsequently alter flow patterns. A permit from COE would be required for discharges of fill material into wetlands.

In addition to impacts from facility construction, impacts might result from construction for infrastructure components. The proposed access road to Area B would cross a palustrine wetland and the intermittent stream associated with it. Approximately 0.04 acre (0.02 ha) of a 0.9 acre (0.4 ha) scrub/shrub temporarily flooded wetland would be directly eliminated by filling due to road construction. Additional indirect impacts from hydrological alteration of the wetland and immediate vicinity might also occur. The proposed gas, water, and sewer corridors to Area B would cross the south branch of Triplett Creek, a perennial stream, and its riparian wetland. This lower perennial riverine wetland has an unconsolidated bottom. Approximately 60 ft (18 m) of the stream and wetland would be included within the corridor. The implementation of best management practices for erosion control and immediate replanting of disturbed areas with native species would help minimize impacts on this wetland and wetlands in downstream areas. The corridors are also located immediately adjacent to a pond (palustrine unconsolidated bottom wetland), which could be indirectly affected by the installation of utility lines. The corridor for electric transmission lines to Area B also would cross the south branch of Triplett Creek and be located adjacent to a palustrine scrub/shrub wetland immediately upstream. Placement of the transmission towers could likely avoid the wetland areas. However, impacts on wetland vegetation might result from corridor preparation, conductor stringing, and maintenance activities.

Surface water quality in palustrine and riverine wetlands downstream of Area B might be adversely affected by construction. Forested wetlands downstream, such as along Triplett Creek immediately to the north, would be adversely affected by uncontrolled runoff from the construction area. Such impacts could be minimized by the implementation of storm-water runoff control measures. Fugitive dust from construction activities might be dispersed by wind and deposited on wetlands in the vicinity, such as the forested wetlands, streams, or nearby ponds.

5.17.3.2 Impacts of Operations

A portion of the materials released from the ACWA pilot facility stacks would be deposited on the vegetation, soils, and surface waters, including wetlands, surrounding the facility. The types of organic compounds and the quantities of trace metals released would be slightly different for the three technologies. Deposition from atmospheric emissions, for all the technologies included in this analysis, would result in very low concentrations of trace metals and organic compounds, well below levels known to be harmful to biota. Consequently, routine operations of a pilot test facility would cause only negligible impacts on wetlands.

5.17.4 Impacts of No Action

Under the no action alternative, an ACWA pilot test facility would not be constructed. Continued storage of chemical agents at PBA, including routine maintenance and monitoring operations, would not adversely affect wetlands.

5.18 CULTURAL RESOURCES

5.18.1 Current Environment

5.18.1.1 Archaeological Resources

A comprehensive cultural resources survey was conducted at PBA in 1990 (Bennett et al. 1993). Landscape analysis, remote sensing, cartographic analysis, and field sampling techniques were employed to identify areas with the greatest potential for containing archaeological resources. The collected data were used to generate a model for the distribution of prehistoric archaeological sites. Field testing was completed to validate the model and examine the locations of historic period sites identified by cartographic sources. A combination of pedestrian survey and subsurface testing was conducted in undisturbed areas of PBA at various intervals, depending on whether the area was predicted to contain clusters of prehistoric sites or a diffuse scatter of sites. Ninety locations were identified at PBA during the inventory; 18 locations contained prehistoric artifacts and 72 contained historic artifacts. Forty-six of the 90 locations were designated as archaeological sites by the Arkansas Archaeological Survey; seven sites were determined to be potentially significant. (Appendix F has additional details on the prehistoric and historic context of PBA.)

No archaeological resources have been identified within the proposed construction areas for an ACWA pilot test facility. Area B was surveyed, and no archaeological sites were recorded there (Bennett et al. 1993; Bennett and Stewart-Abernathy 1982). One prehistoric cultural artifact was recorded in the vicinity of Area B during subsurface testing and was designated Site 3JE331. However, no additional cultural material was located in the vicinity of that site, and no chronological indicators were present to gauge its age. Therefore, Site 3JE331 was considered not eligible for listing on the *National Register of Historic Places* (NRHP), and no further work was recommended (Bennett et al. 1993). Area A was reported as a location with evidence of prior disturbance and waste disposal and was consequently not surveyed for cultural resources (Bennett et al. 1993). An archaeological survey of Area A might be required if sufficient confirmation of the level of disturbance cannot be provided.

5.18.1.2 Traditional Cultural Properties

A traditional cultural property is defined as a property that is “eligible for inclusion in the National Register because of its association with the cultural practices or beliefs of a living community that (a) are rooted in that community’s history, and (b) are important in maintaining the continuing cultural identity of the community” (Parker 1995). No traditional cultural properties are known to occur within the proposed construction areas.

5.18.1.3 Historic Structures

Construction of PBA began in 1941. It was the first of three chemical munitions production plants to be designed and constructed since the Edgewood Arsenal during World War I. The principal function of PBA at that time was the manufacture of magnesium- and aluminum-based incendiary munitions, but the work was expanded for a short time during World War II to include war gases, smoke munitions, and napalm bombs. Because of PBA’s potential significance with regard to the U.S. arms buildup in preparation for World War II, an evaluation of PBA architecture was conducted in 1984. All facilities were surveyed except for those in high-security areas that could not be accessed. No PBA structures were found to meet Army criteria for designation as important historical structures or to meet eligibility criteria for the NRHP at that time (Hess 1984).

5.18.2 Site-Specific Factors

Factors that need to be considered with regard to significant archaeological sites, traditional cultural properties, and historic structures under the ACWA Program include these:

1. Destruction or disturbance of cultural resources could occur during construction activities.

2. Contamination of cultural resources could occur during an accidental chemical release or spill. This might lead to the establishment of temporary restrictions on access to the property or possibly to the destruction or disturbance of cultural resources if soils would need to be removed during cleanup.

3. Secondary impacts could be associated with the construction or operation of a proposed facility, such as these:

    a. Increased pedestrian or vehicle traffic in the area could increase the potential for inadvertent or intentional damage to cultural resources by casual passerbys or amateur collectors or

    b. Increased erosion potential as a result of construction activities could disturb archaeological sites next to the construction area.

5.18.3 Impacts of the Proposed Action

5.18.3.1 Impacts of Construction

Archaeological Resources. The probability of adverse effects on cultural resources as a result of the construction of any of the proposed facilities is small. Area A, northeast of and adjacent to the chemical demilitarization area, has not been surveyed; however, there appears to be considerable disturbance and waste disposal within that area (Bennett et al. 1993). The potential for finding intact cultural deposits that would meet significance criteria for listing on the NRHP in this location appears low. Area B was investigated as part of an arsenalwide survey in 1990; no archaeological sites were recorded within Area B boundaries (Bennett et al. 1993).

An isolated find[10] (Site 3JE331) was recorded within approximately 0.25 mi (0.4 km) of Area B during the inventory from subsurface testing, but the site is not considered eligible for listing on the NRHP, and no further work was recommended (Bennett et al. 1993). The potential utility and access road corridors, for the most part, follow existing rights-of-way; therefore, little impact on archaeological resources is expected. Although further intensive survey might be required, possibly at Area A and along potential corridors, before the Arkansas State Historic Preservation Officer (SHPO) concurs on a “no adverse effects” determination for this project, the chances of encountering additional significant archaeological resources in areas of possible construction appear small.

If cultural material was unexpectedly encountered during ground-disturbing activities at previously disturbed or surveyed areas of PBA, construction would cease immediately, and the Arkansas SHPO and a qualified archaeologist would be consulted to evaluate the significance of the cultural artifacts.

Traditional Cultural Properties. No traditional cultural properties are known to occur within the proposed construction areas for an ACWA facility; therefore, no impacts on traditional cultural properties are expected.

Historic Structures. No standing structures are located within Area A or Area B. The structures within the chemical storage area at PBA were recommended as not being eligible for the NRHP (Hess 1984). It is unclear whether the Arkansas SHPO has concurred with this recommendation. However, none of these structures would be demolished or modified during construction of an ACWA pilot test facility at PBA. Therefore, no adverse impacts on structures are anticipated.

5.18.3.2 Impacts of Operations

Archaeological Resources. Routine operation of an ACWA pilot facility would have no impact on eligible archaeological resources at PBA. No known significant resources that could be affected by increased use of the area are located near the proposed locations for an ACWA facility, and no ground-disturbing activities would be involved in operating the facility.

---

[10] An isolated find is defined as one stone tool, five or fewer pieces of lithic debris, a single historic artifact type (e.g., glass, ceramic), or a scatter of glass or ceramics where all the sherds appear to be from the same vessel.

Traditional Cultural Properties. No traditional cultural properties are known to occur within the area for an ACWA facility; therefore, no impacts on traditional cultural properties are expected.

Historic Structures. The structures within the chemical storage area used to store the weapons stockpile from which munitions would be removed during operation of an ACWA pilot facility have been recommended as being not eligible. Regardless of their eligibility status, routine removal of the munitions from these structures would not affect their integrity; therefore, no adverse effect is expected.

5.18.4 Impacts of No Action

5.18.4.1 Archaeological Resources

The no action alternative (i.e., continued storage of chemical weapons that might otherwise be destroyed by pilot testing until destruction by other means) would not directly affect archaeological resources. No ground-disturbing activities are currently planned for the area should an ACWA pilot test facility not be constructed at PBA. Archaeological resources might be affected if there were an accident while munitions were in storage (see Section 5.21).

5.18.4.2 Traditional Cultural Properties

No known traditional cultural properties are known to occur within PBA; therefore, the no action alternative (i.e., continued storage of chemical weapons that might otherwise be destroyed by pilot testing until destruction by other means) would have no impact on properties of this type. Nearby resources might be affected if there were an accident while munitions were in storage (see Section 5.21).

5.18.4.3 Historic Structures

The no action alternative (i.e., continued storage of chemical weapons that might otherwise be destroyed by pilot testing) would not affect historic structures. Chemical munitions that might otherwise be removed and destroyed during pilot testing would continue to be stored in the designated chemical storage area structures. Such use is compatible with the history and the origin of the storage bunkers. If the SHPO has concurred with the recommendation that they are not eligible for listing on the NRHP, these structures would also not be affected if there were an accident while munitions were in storage (see Section 5.21).

5.19 SOCIOECONOMICS

5.19.1 Current Environment

Socioeconomic data for PBA describe a region of influence (ROI) surrounding the installation that is composed of four counties: Grant County, Jefferson County, Lincoln County, and Pulaski County (Figure 5.19-1). The ROI is based on the current residential locations of government workers at PBA and captures the area in which these workers spend their wages and salaries. Ninety percent of PBA workers currently reside in these counties (Atkinson 2000). The following sections present data on each of the counties in the ROI. However, since the majority of PBA government workers live in Jefferson County and in the city of Pine Bluff, and since the majority of impacts from an ACWA facility would be expected to occur in these locations, more emphasis is placed on describing the ROI in these two locations.

5.19.1.1 Population

The population of the ROI in 2000 stood at 476,708 (U.S. Bureau of the Census 2001b) and was expected to increase to 478,000 by 2001 (Table 5.19-1). In 2000, 84,278 people (18% of the ROI total) resided in Jefferson County, with 55,085 in the city of Pine Bluff itself (U.S. Bureau of the Census 2001b). During the 1980s, Jefferson County experienced a small decline in its annual average population growth rate of –0.5%, while the population in Grant, Lincoln, and Pulaski Counties grew slightly. Pine Bluff itself experienced a small average annual increase of 0.1%. The ROI average annual growth rate during this period was 0.1%. Over the period 1990–2000, population in Jefferson County and in Pine Bluff fell slightly, with small increases elsewhere in the ROI. The average annual growth rate for the ROI was 0.3%. Over the same period, population in the state grew at a rate of 1.3%. Other incorporated places in Jefferson County near PBA are Altheimer (population 1,192 in 2000), Redfield (1,157), Wabbaseka (323), and White Hall (4,732) (U.S. Bureau of the Census 2001b).

5.19.1.2 Employment

In 1999, total employment in Jefferson County stood at 28,384 (U.S. Bureau of the Census 2001a); it was expected to reach 29,100 by 2001 (Allison 2001). The economy of the county is dominated by the trade and service industries, with employment in these activities currently contributing almost 60% to total employment in the county in 1999 (Table 5.19-2). The manufacturing sector is also a significant employer in the county, representing 28% of total county employment in 1999. Average annual employment growth in the county was 1.3% during the 1990s (U.S. Bureau of the Census 1992c, 2001a).

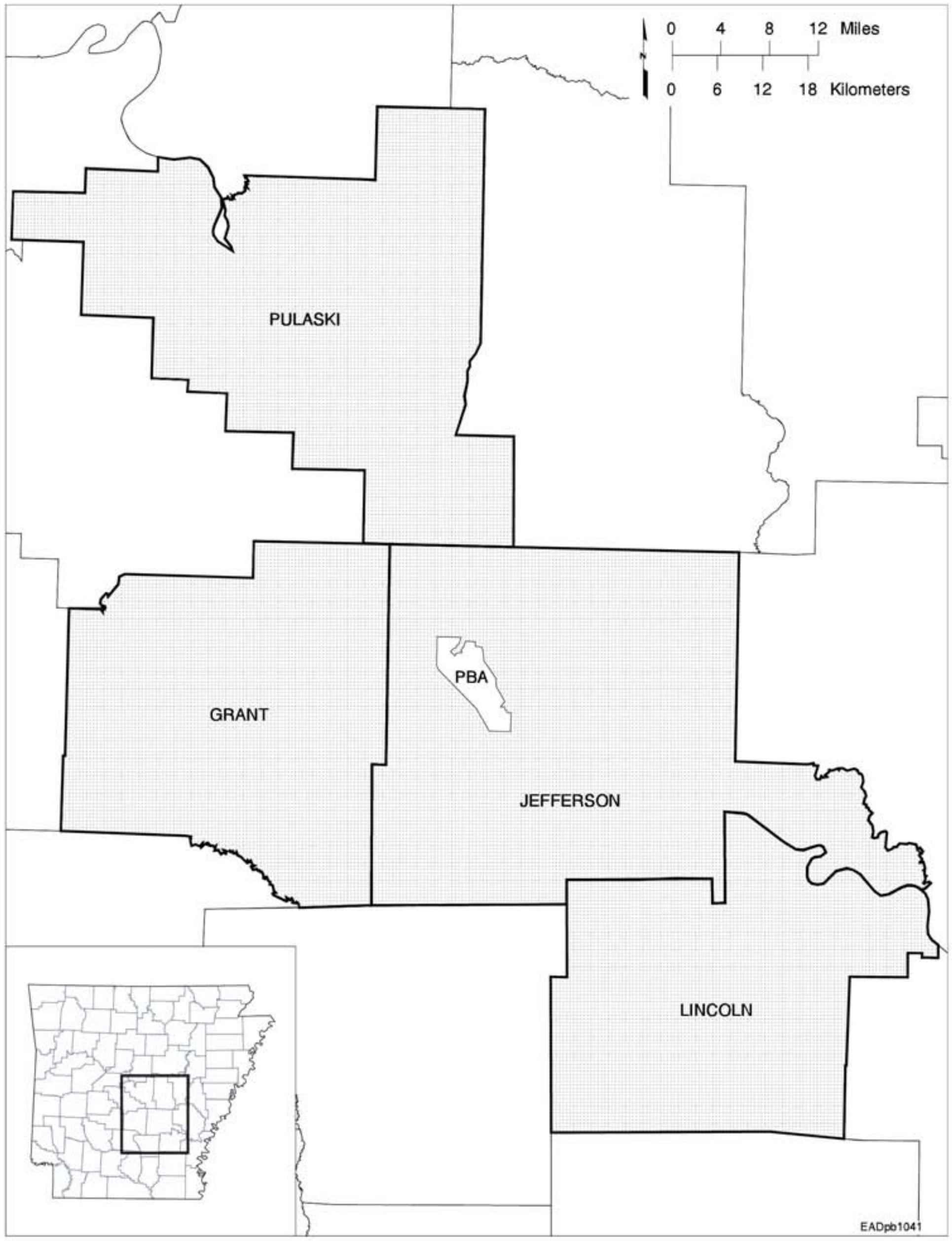

FIGURE 5.19-1 PBA Region of Influence

TABLE 5.19-1 Population in the PBA Region of Influence in Selected Years

Location	1980[a]	1990[a]	Average Annual Growth Rate (%) 1980–1990	2000[b]	Average Annual Growth Rate (%) 1990–2000	2001[c] (Projected)
City of Pine Bluff	56,636	57,140	0.1	55,085	–0.4	54,900
Jefferson County	90,718	85,487	–0.5	84,278	–0.1	84,200
Grant County	13,008	13,948	0.6	16,464	1.7	16,700
Lincoln County	13,369	13,690	0.2	14,492	0.6	14,600
Pulaski County	340,597	349,660	0.2	361,474	0.3	363,000
ROI total	457,692	462,785	0.1	476,708	0.3	478,000
Arkansas	2,286,357	2,350,725	0.3	2,673,400	1.3	2,710,000

[a] U.S. Bureau of the Census (1994).

[b] U.S. Bureau of the Census (2001b).

[c] Allison (2001).

TABLE 5.19-2 Employment in Jefferson County by Industry in 1999

Employment Sector	Number Employed	% of County Total
Agriculture	1,011[a]	3.6
Mining	10	0.0
Construction	952	3.4
Manufacturing	7,832	27.6
Transportation and public utilities	664	2.3
Trade	5,666	20.0
Finance, insurance, and real estate	1,227	4.3
Services	10,962	38.6
Total	28,384	

[a] 1997 data.

Sources: U.S. Bureau of the Census (2001a); USDA (1999).

In 1999, total employment in the PBA ROI stood at 254,401 (U.S. Bureau of the Census 2001a). It was expected to reach 265,000 by 2001 (Allison 2001). The economy of the ROI is dominated by the trade and service industries, with employment in these activities currently contributing 69% to total employment in the ROI (Table 5.19-3). Annual average employment growth in the ROI was 2.0% during the 1990s (U.S. Bureau of the Census 1992c, 2001a).

Employment at PBA currently stands at about 1,900, including 1,000 arsenal employees, 100 employees working at the PBCA. Approximately 30 military personnel, and about 800 employees for the PBCDF (Atkinson 2000). A number of commercial and industrial tenants occupy land and buildings formerly used by the military, and employment in these activities is currently about 700 employees, including 600 employees at the NCTR.

Unemployment in Jefferson County steadily declined during the late 1990s from a peak rate of 11.4% in 1992 to the current rate of 7.9% (Table 5.19-4) (U.S. Bureau of Labor Statistics 2001). Unemployment in the ROI currently stands at 4.7%, compared with 4.5% for the state.

5.19.1.3 Personal Income

Personal income in Jefferson County stood at $1.6 billion in 1999 and was expected to reach $1.7 billion in 2001. The annual average rate of growth was 3.6% over the period 1990–1999 (Table 5.19-5). County per capita income also rose in the 1990s. It was expected to reach $20,800 in 2001, compared with $13,797 at the beginning of the period.

The annual average growth rate in personal income was higher in the ROI than in Jefferson County. Total personal income in the ROI grew at an annual average rate of 5.4% over the period 1990–1999 and was expected to reach $14.1 billion by 2001. ROI per capita income rose from $17,033 in 1990 to an expected $29,500 in 2001, an average annual rate of 5.1%.

5.19.1.4 Housing

Housing stock in Jefferson County grew at an annual average rate of 0.3% over the period 1990–2000 (Table 5.19-6). The total number of housing units was expected to reach 34,500 in 2001, despite a decline in county population. Housing growth in the city of Pine Bluff was negative over this period at –0.3%, with 22,400 total housing units expected in 2001. Vacancy rates currently stand at 11.2% in the city and 11.0% in the county as a whole for all types of housing. Based on annual average growth rates between 1990 and 2000, there would be 3,850 vacant housing units in the county in 2001, of which 970 would be rental units available to construction workers at the proposed facility.

TABLE 5.19-3 Employment in the PBA Region of Influence by Industry in 1999

Employment Sector	Number Employed	% of County Total
Agriculture	2,516[a]	1.0
Mining	578	0.2
Construction	12,396	4.9
Manufacturing	30,267	11.9
Transportation and public utilities	16,013	6.3
Trade	46,507	18.3
Finance, insurance, and real estate	16,773	6.6
Services	129,163	50.8
Total	254,401	

[a] 1997 data.

Sources: U.S. Bureau of the Census (2001a); USDA (1999).

TABLE 5.19-4 Unemployment Rates in Jefferson County, PBA Region of Influence, and Arkansas

Location and Period	Rate (%)
Jefferson County	
1990–2000 average	8.8
2001 (current rate)	7.9
ROI	
1990–2000 average	5.2
2001 (current rate)	4.7
Arkansas	
1990–2000 average	5.7
2001 (current rate)	4.5

Source: U.S. Bureau of Labor Statistics (2001).

TABLE 5.19-5 Personal Income in Jefferson County and PBA Region of Influence

Location and Personal Income	1990[a]	1999[b]	Average Annual Growth Rate (%) 1990–1999	2001[c] (Projected)
Jefferson County				
Total (millions of $)	1,180	1,627	3.6	1,750
Per capita ($)	13,797	19,278	3.8	20,800
Total ROI				
Total (millions of $)	7,882	12,684	5.4	14,100
Per capita ($)	17,033	26,688	5.1	29,500

[a] U.S. Bureau of the Census (1994).

[b] U.S. Department of Commerce (2001).

[c] Allison (2001).

TABLE 5.19-6 Housing Characteristics in Pine Bluff, Jefferson County, and PBA Region of Influence

Location and Type of Housing	1990[a]	2000[b]	2001[c] (Projected)
City of Pine Bluff			
Owner occupied	12,886	11,727	11,600
Rental	7,985	8,229	8,250
Total unoccupied units	2,316	2,528	2,550
Total units	23,189	22,484	22,400
Jefferson County			
Owner occupied	20,121	20,221	20,200
Rental	9,880	10,334	10,400
Total unoccupied units	3,310	3,795	3,850
Total units	33,311	34,350	34,500
ROI total			
Owner occupied	110,001	118,512	119,000
Rental	66,123	70,491	70,900
Total unoccupied units	18,560	18,397	18,400
Total units	194,684	207,400	209,000

[a] U.S. Bureau of the Census (1994).

[b] U.S. Bureau of the Census (2001b).

[c] Allison (2001).

In the ROI as a whole, housing grew slightly during the 1990s, with an annual growth rate of 0.6%. Total housing units are expected to reach 209,000 by 2001. The vacancy rate currently stands at 8.9%, which means that more than 7,250 rental units would be available to construction workers at the proposed facility.

5.19.1.5 Community Resources

Community Fiscal Conditions. Construction and operation of the proposed facility would result in increased revenues and expenditures for local government jurisdictions, including counties, cities, and school districts. Revenues would come primarily from state and local sales taxes associated with employee spending during construction and operation. The money would be used to support additional local community services currently provided by each jurisdiction. Appendix G presents information on revenues and expenditures by the various local government jurisdictions in the ROI.

Community Public Services. Construction and operation of the proposed facility would result in increased demand for community services in the counties, cities, and school districts likely to host relocating construction workers and operations employees. Additional demands would also be placed on local medical facilities and physician services. Table 5.19-7 presents data on employment and levels of service (number of employees per 1,000 population) for public safety and general local government services. Tables 5.19-8 and 5.19-9 provide staffing data for school districts and hospitals. Table 5.19-10 presents data on employment and levels of service for physicians.

5.19.1.6 Traffic

Vehicle access to PBA is afforded from SR 365, which runs northwest from Pine Bluff toward Redfield along the western perimeter of PBA. The main entrance to PBA is located approximately 8 mi (5 km) from downtown Pine Bluff and is connected to SR 365 by SR 256, which runs southwest toward White Hall. Other roads in the immediate vicinity of PBA used byemployees working on the installation include I 530 (formerly U.S. Highway 65), which connects Pine Bluff with Little Rock, and SR 104, which runs north and south to the west of White Hall.

Table 5.19-11 shows average annual daily traffic flows over these road segments, together with designations for the congestion levels (level-of-service designations) developed by the Transportation Research Board (1985). The designations range from A to F; A through C represent good traffic operating conditions with some minor delays experienced by motorists, and F represents jammed roadway conditions.

TABLE 5.19-7 Public Service Employment in Jefferson County, Various Cities near PBA, and Arkansas[a]

Employment Category	Jefferson County[b] Number Employed	Jefferson County[b] Level of Service	Altheimer[b] Number Employed	Altheimer[b] Level of Service	Pine Bluff[b] Number Employed	Pine Bluff[b] Level of Service
Police protection	27	1.2	4	3.6	145	2.6
Fire protection[c]	0	0	0	0	90	1.6
General services	298	13.7	2	1.8	162	2.9
Total	325	14.9	6	5.4	397	7.2

Employment Category	Redfield[b] Number Employed	Redfield[b] Level of Service	Wabbaseka[b] Number Employed	Wabbaseka[b] Level of Service	White Hall[b] Number Employed	White Hall[b] Level of Service
Police protection	4	3.5	1	3.1	9	2.0
Fire protection[c]	0	0	0	0	0	0
General services	1	0.9	3	9.2	4	0.9
Total	5	4.4	4	12.3	13	2.8

Employment Category	Arkansas[d] Level of Service
Police protection	2.2
Fire protection[c]	0.9
General services	32.9
Total	36.0

[a] Level of service represents the number of employees per 1,000 persons in each jurisdiction. Data on the number of persons employed in the cities came from http://pinebluff.dina.org/general/qfacts.html; data for Jefferson County came from Holland (2000) and Skinner (2000).

[b] Source of population data was U.S. Bureau of the Census (2001b).

[c] Does not include volunteers.

[d] U.S. Bureau of the Census (2000).

TABLE 5.19-8 School District Data for Various Cities near PBA and Arkansas in 1999

Location	Number of Teachers Employed	Student to Teacher Ratio[a]
Altheimer	42	14.7
Dollarway	121	13.4
Pine Bluff	462	14.3
Watson-Chapel	194	17.1
White Hall	194	15.1
Arkansas[b]	-	15.0

[a] Student to teacher ratio represents the number of students per teacher in each school district.

[b] 1998 data.

Source: Arkansas School Information (2000).

TABLE 5.19-9 Medical Facility Data for Jefferson County in 1999

Hospital	Number of Staffed Beds	Occupancy Rate (%)[a]
Jefferson Regional Medical Center	324[b]	65[b]

[a] Percent of staffed beds occupied.

[b] Data source, by permission: SMG Marketing Group, Inc.,© copyright 2001.

TABLE 5.19-10 Physician Employment in Jefferson County and Arkansas in 1997[a]

	Jefferson County		Arkansas
Employment Category	Number Employed	Level of Service	Level of Service
Physicians	179	2.2	2.1

[a] Level of service represents the number of employees per 1,000 persons in each jurisdiction.

Source: American Medical Association (1999) for number employed; U.S. Bureau of the Census (2001b) for population data.

TABLE 5.19-11 Average Annual Daily Traffic (AADT) in the Vicinity of PBA

Road Segment	Traffic Volume (AADT)	Level of Service[a]
SR 365 at SR 104	4,500	A
SR 365 in White Hall	11,000	B
SR 104 south of SR 365	8,900	A
I 530 between White Hall and Pine Bluff	20,000	A
I 530 at SR 104	19,000	A
SR 256 between I 530 and SR 365	2,800	A
SR 256 between SR 365 and PBA	2,400	B

[a] Allison (2001).

Source: Boyles (2000).

5.19.2 Site-Specific Factors

This analysis covers the potential environmental consequences on socioeconomic factors from constructing and operating an ACWA pilot test facility. It considers effects on population, employment, income, regional growth, housing, community resources, and transportation.

5.19.3 Impacts of the Proposed Action

Impacts from construction and operations are summarized in Table 5.19-12. The impacts of no action are provided as well for comparison.

5.19.3.1 Impacts of Construction

Neutralization/SCWO. The potential socioeconomic impacts from constructing a neutralization/SCWO facility at PBA would be relatively small. Construction activities would create direct employment of approximately 730 people in the peak construction year and an additional 570 indirect jobs in the ROI. Construction activities would increase the annual average employment growth rate by less than 0.1% over the duration of construction. Neutralization/SCWO-related employment, wages, and salaries at PBA would also produce about $40 million of income in the peak year of construction.

In the peak year of construction, about 210 people would in-migrate to the ROI, both as a result of SCWO employment and as a result of the overall growth in the ROI economy through the local procurement of materials and services and through employee spending. However, in-migration would have only a marginal effect on population growth and would require only about 1% of vacant rental housing during the peak year. No significant impact on public finances would occur as a result of in-migration, and less than 10 local public service employees would be required to maintain existing levels of service in the various local public service jurisdictions in Jefferson County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding PBA.

Neutralization/GPCR/TW-SCWO. The potential socioeconomic impacts from constructing a Neut/GPCR/TW-SCWO facility at PBA would be relatively small. Construction activities would create direct employment of approximately 740 people in the peak construction year and an additional 610 indirect jobs in the ROI. Construction activities would increase the annual average employment growth rate by less than 0.1% over the duration of construction. Neut/GPCR/TW-SCWO-related employment, wages, and salaries at PBA would also produce about $42 million of income in the peak year of construction.

TABLE 5.19-12 Effects of Construction, Operations, and No Action at PBA on Socioeconomics[a,b]

Impact Category	Neut/SCWO		Neut/GPCR/TW-SCWO		Elchem Ox		
	Construction	Operation	Construction	Operation	Construction	Operation	No Action
Employment (number of jobs in ROI)							
Direct	730	720	740	720	780	720	100
Indirect	570	760	610	760	660	850	80
Total	1,300	1,480	1,350	1,480	1,440	1,570	180
Income (millions of $ in ROI)							
Direct	24.9	34.9	25.2	34.9	26.9	34.9	5.8
Indirect	15.5	18.0	16.7	18.1	18.1	21.4	1.8
Total	40.4	52.9	41.9	53.0	45.0	56.3	7.6
Population (number of new residents in ROI)	210	580	220	580	250	640	0
Housing (number of units required in ROI)	80	210	80	210	90	230	0
Public finances (% impact on fiscal balance)							
Cities in Jefferson County[c]	<1	<1	<1	<1	<1	<1	0
Jefferson County	<1	<1	<1	<1	<1	<1	0
Schools in Jefferson County[d]	<1	<1	<1	<1	<1	<1	0
Public service employment (number of new employees in Jefferson County)[c]							
Police officers	0	1	0	1	0	1	0
Firefighters	0	1	0	1	0	1	0
General	1	1	1	1	1	2	0
Physicians	0	1	0	1	0	1	0
Teachers[d]	2	4	2	4	2	6	0
Number of new staffed hospital beds in Jefferson County	1	3	1	3	1	3	0
Traffic (impact on current levels of service in Jefferson County)	None	None	None	None	None	None	None

[a] Impacts are shown for the peak year of construction (2004) and the first year of operations (2009).

[b] The sum of individual row entries and column totals may not correspond because of independent rounding.

[c] Includes impacts that would occur in the cities of Altheimer, Pine Bluff, Redfield, Wabbaseka, and White Hall, and in Jefferson County.

[d] Includes impacts that would occur in Altheimer, Pine Bluff, and White Hall school districts.

In the peak year of construction, about 220 people would in-migrate to the ROI, both as a result of SCWO employment and as a result of the overall growth in the ROI economy through the local procurement of materials and services and through employee spending. However, in-migration would have only a marginal effect on population growth and would require only about 1% of vacant rental housing during the peak year. No significant impact on public finances would occur as a result of in-migration, and less than 10 local public service employees would be required to maintain existing levels of service in the various local public service jurisdictions in Jefferson County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding PBA.

Electrochemical Oxidation. The potential socioeconomic impacts from constructing and operating an Elchem Ox facility at PBA would be relatively small. Construction activities would create direct employment of approximately 780 people in the peak construction year and an additional 660 indirect jobs in the ROI. Construction activities would increase the annual average employment growth rate by less than 0.1% over the duration of construction. Elchem Ox-related employment, wages, and salaries at PBA would also produce $45 million of income in the peak year of construction.

In the peak year of construction, about 250 people would in-migrate to the ROI, both as a result of Elchem Ox employment and as a result of the overall growth in the ROI economy through the local procurement of materials and services and through employee spending. However, in-migration would have only a marginal effect on population growth and would require only about 1% of vacant rental housing during the peak year. No significant impact on public finances would occur as a result of in-migration, and less than 10 local public service employees would be required to maintain existing levels of service in the various local public service jurisdictions in Jefferson County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding PBA.

5.19.3.2 Impacts of Operation

Neutralization/SCWO. The potential socioeconomic impacts from constructing and operating a Neut/SCWO facility at PBA would be relatively small. Operational activities would create about 720 direct jobs annually and an additional 760 indirect jobs in the ROI. Direct Neut/SCWO-related employment, wages, and salaries at PBA would also produce about $53 million annually during operations.

About 580 people would move to the area at the beginning of Neut/SCWO facility operation. However, in-migration would have only a marginal effect on population growth and would require about 9% of vacant owner-occupied housing during facility operations. No significant impact on public finances would occur as a result of in-migration, and less than 10 new local public service employees would be required to maintain existing levels of service in the various local public service jurisdictions in Jefferson County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding PBA.

Neutralization/GPCR/TW-SCWO. The potential socioeconomic impacts from constructing and operating a Neut/GPCR/TW-SCWO facility at PBA would be relatively small. Operational activities would create about 720 direct jobs annually and an additional 760 indirect jobs in the ROI. A Neut/GPCR/TW-SCWO facility would produce $53 million annually during operations.

About 580 people would move to the area at the beginning of operations. However, in-migration would have only a marginal effect on population growth and would require about 9% of vacant owner-occupied housing during facility operations. No significant impact on public finances would occur as a result of in-migration, and less than 10 new local public service employees would be required to maintain existing levels of service in the various local public service jurisdictions in Jefferson County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding PBA.

Electrochemical Oxidation. The potential socioeconomic impacts from constructing and operating an Elchem Ox facility at PBA would be relatively small. Operational activities would create about 720 direct jobs annually and an additional 850 indirect jobs in the ROI. An Elchem Ox facility would produce about $56 million annually during operations.

About 640 people would move to the area at the beginning of operations. However, in-migration would have only a marginal effect on population growth and would require about 10% of vacant owner-occupied housing during facility operations. No significant impact on public finances would occur as a result of in-migration, and 11 new local public service employees would be required to maintain existing levels of service in the various local public service jurisdictions in Jefferson County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding PBA.

5.19.4 Impacts of No Action

The socioeconomic impacts of continuing installation activities at PBA would be relatively small. PBCA currently employs 100 workers. Wage and salary expenditures by PBCA employees on goods and services have created an additional 80 indirect jobs in the ROI (Table 5.21-1) and increased the annual average employment growth rate in the ROI by less than 0.01% over the period 1990–2000. PBCA-related wage and salary expenditures have also created about $8 million in annual income in the ROI.

5.20 ENVIRONMENTAL JUSTICE

On February 11, 1994, President Clinton issued Executive Order 12898 (Volume 59, page 7629, in the *Federal Register* [59 FR 7629]). This order, along with its accompanying cover memo, calls on federal agencies to incorporate environmental justice as part of their missions. It directs them to address, as appropriate, disproportionately high and adverse human health or environmental effects of their actions, programs, or policies on minority and low-income populations.

This EIS used data from the two most recent decennial censuses (1990 and 2000) to evaluate environmental justice in the context of the ACWA Program at PBA. The 2000 census provides detailed data on race and ethnicity necessary for a systematic definition of minority populations. Although more than a decade old, the 1990 census nevertheless provides the most recent data available on income, which enabled the identification of low-income populations. To remain consistent with these data sources, the EIS employs the following definitions for minority and low-income:

- *Minority* — Individuals who classify themselves as belonging to any of the following racial groups: Black (including Black or Negro, African American, Afro-American, Black Puerto Rican, Jamaican, Nigerian, West Indian, or Haitian); American Indian, Eskimo, or Aleut; Asian or Pacific Islander; or "Other Race" (U.S. Bureau of the Census 1991). For present purposes, individuals characterizing themselves as belonging to two or more races also are counted as minorities. This study also includes individuals identifying themselves as Hispanic in origin, technically an ethnic category, under minority. To avoid double-counting, tabulations included only White Hispanics; the above racial groups already account for Non-white Hispanics.

- *Low-Income* — Individuals falling below the poverty line. For the 1990 census, the poverty line was defined by a statistical threshold based on a weighted average that considered both family size and the ages of individuals in a family. For example, the 1990 poverty threshold annual income for a family of five with two children younger than 18 years was $15,169, while the poverty threshold for a family of five with three children aged less than 18 years was $14,796 (U.S. Bureau of the Census 1992a). If a family fell below the poverty line for its particular composition, the census considered all individuals in that family to be below the poverty line. Low income figures in the 1990 census reflect incomes in 1989, the most recent year for which entire annual incomes were known at the time of the census.

For this EIS, an analysis of minority and low-income populations was done by using census data for two demographic units: counties and census block groups. A block group is a geographic unit consisting of a cluster of blocks that is used by the Census Bureau to present data (U.S. Bureau of the Census 1991). Block groups contain enough blocks to encompass about 250–550 housing units, with the ideal one containing about 400 housing units. Because housing density varies over space, the geographic sizes of block groups vary; smaller units tend to occur in denser areas, such as urban areas. This dual focus on counties and block groups enables the evaluation of environmental justice issues to remain consistent with the geographical focus of analyses in two issue areas where environmental justice is of particular concern: socioeconomics and human health. To maintain consistency with the socioeconomic analysis, the sections on current conditions and impacts under the environmental justice assessment consider Jefferson County to be the core county for PBA. To maintain consistency with the human health analysis, the environmental justice analysis considers population characteristics in census block groups within a 30-mi (50-km) radius of PBA. The block groups considered include all of Grant and Jefferson Counties and part of Arkansas, Cleveland, Dallas, Lincoln, Lonoke, Prairie, Pulaski, and Saline Counties.

To define disproportionate representations of either minority or low-income populations, this EIS uses values for the United States as a whole as reference points, thereby providing an identical comparison for all four installations considered in this EIS. This choice of a reference point, which is central to environmental justice analyses, reflects a desire to remain consistent with the environmental justice executive order and also with the need to select a meaningful reference point for any given impact assessment (see Council on Environmental Quality [CEQ] 1997; EPA 1998a). The 2000 census indicates the United States contains 30.9% minority persons (U.S. Bureau of the Census 2001c), while the 1990 census indicated that 13.1% of persons for whom poverty status was known were considered low-income population in 1989 (U.S. Bureau of the Census 1992b).

5.20.1 Current Environment

Of the Jefferson County residents recorded in the 1990 census, 52.0% were minority (U.S. Bureau of the Census 2001c). This percentage was well in excess of the minority representation for the United States as a whole and hence disproportionately high. The largest percentage of minority persons in Jefferson County (49.6% of the total population) was Black. The 1990 census recorded that 23.9% of the Jefferson County population was below the poverty level (U.S. Bureau of the Census 1992b); again, this percentage was greater than the figure for the United States as a whole and thus disproportionately high.

Of the 364 census block groups defined in the 2000 census partially or totally within a 30-mi (50-km) radius of PBA, 206 contained minority populations in excess of the percentage of minority representation in the United States (Figure 5.20-1). The 206 block groups contained a

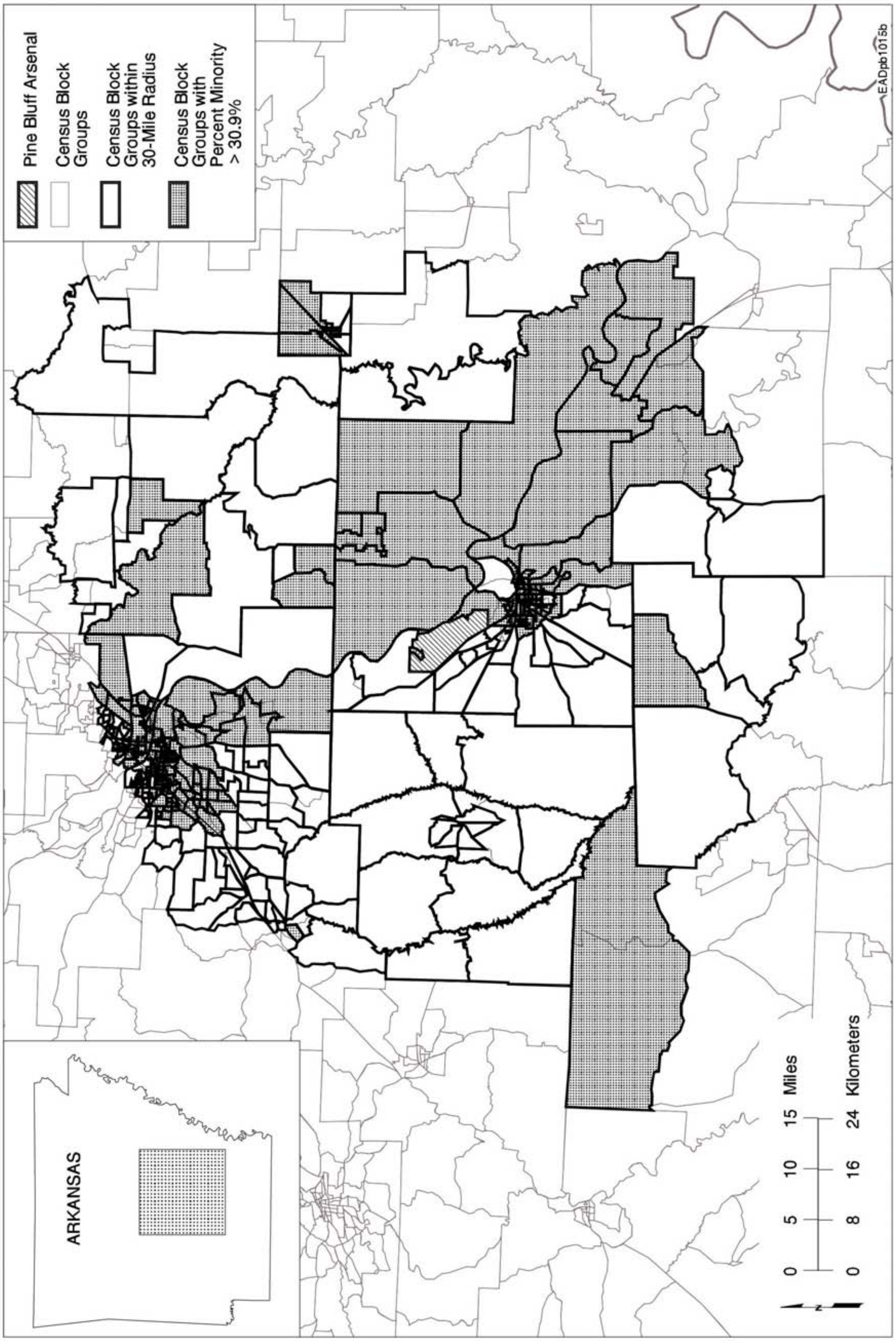

FIGURE 5.20-1 Census Block Groups within a 30-Mile (50-Kilometer) Radius of PBA with Minority Populations Greater than the National Average in 2000 (Source: U.S. Bureau of the Census 2001d)

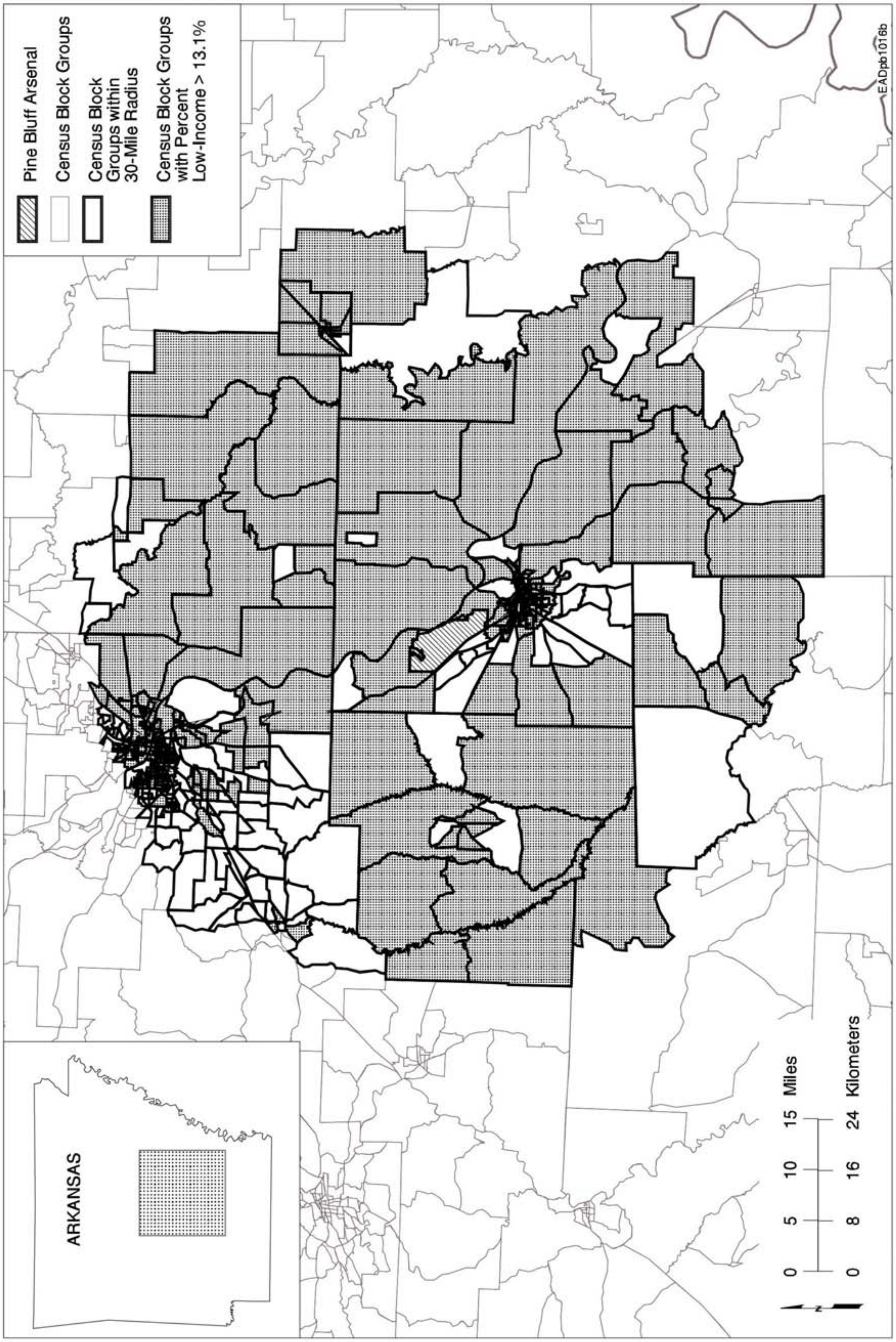

FIGURE 5.20-2 Census Block Groups within a 30-Mile (50-Kilometer) Radius of PBA with Low-Income Populations Greater than the National Average in 1989 (Source: U.S. Bureau of the Census 1992b)

total of 144,426 minority persons in 2000. Block groups with disproportionately high minority populations included the scattered farming communities of Altheimer, England, Grady, Sherrill, Wabbaseka, and Wrightsville as well as nearly all of the cities of Pine Bluff and Little Rock.

Two hundred seventy-three of the 450 census block groups defined in the 1990 census lying partially or totally within a 30-mi (50-km) radius of PBA contained low-income populations in excess of the 13.1% calculated for the United States as a whole (Figure 5.20-2). These block groups contained a total of 59,098 low-income persons in 1989. Block groups with disproportionately high representation of low-income populations included the same six farming communities as those noted in the preceding paragraph, other rural communities such as Allport, Coy, Humnoke, Humphrey, Keo, Parkers-Iron Springs, Prattville, Redfield, and Sheridan, and, once again, most of Pine Bluff and Little Rock.

5.20.2 Site-Specific Factors

Factors considered in this EIS with potential implications for environmental justice are any activities associated with the ACWA program at PBA. Included are impacts associated with construction, operations, and accidents. The evaluation of environmental justice consequences focuses on socioeconomic and human health impacts, two categories that directly affect all people, including minority and low-income populations.

To address Executive Order 12898, this analysis focuses on impacts that are both high and adverse and that disproportionately affect minority and low-income populations. Although it seems logical that certain characteristics of many environmental justice populations — such as having limited access to health care and reduced or inadequate nutrition — might make such populations disproportionately vulnerable to environmental impacts, there do not appear to be any scientific studies that support this contention for the types of impacts considered in this EIS. The absence of such information precludes any analysis that considers increased sensitivity of minority and low-income populations to impacts. To help compensate for this limitation, the analysis of human health impacts includes conservative assumptions and uncertainty factors to accommodate for potentially sensitive subpopulations (see Section 5.7.2.2). The present analysis considers that a disproportionate effect could occur only if the proportion of a population is in excess of the proportions in the United States as a whole, as discussed above under existing conditions. Therefore, significant environmental justice impacts are those that would have a high and adverse impact on the population as a whole and that would affect areas (Jefferson County or census block groups within 30-mi [50-km] of PBA) containing disproportionately high minority or low-income populations.

5.20.3 Impacts of the Proposed Action

5.20.3.1 Impacts of Construction

The primary socioeconomic impacts of construction under any alternative technology, discussed in Section 5.19.3.1, would be increases in short-term employment and income. They would also include small increases in the demand for local housing, schools, and public services. None of these impacts would be high and adverse; local governments and the existing housing stock should be able to accommodate increased demands, and the increased employment and income would be a positive consequence of construction. Human health and other impacts similarly are not expected to be high and adverse during construction. As a result, no environmental justice impacts are anticipated from construction.

5.20.3.2 Impacts of Operations

The primary socioeconomic impacts from operating an PBA facility, discussed in Section 5.19.2.2 for the three technologies, would be increases in employment and income. They would also include small increases in the demand for local housing, schools, and public services. None of these impacts would be high and adverse; local governments and the existing housing stock would probably be able to accommodate the increased demands, and the increased employment and income would be a positive consequence of operations. As a result, environmental justice impacts are not anticipated during operations.

Occupational hazards to workers and releases of agents or other hazardous materials represent the main impacts that could occur during routine operations of the alternative technologies. However, the risk of a noncancer health effect and the risk of cancer from hazardous chemicals released during normal operations would be very low for both workers and the public. These impacts would not be high and adverse; as a consequence, no environmental justice impacts are anticipated from normal operations.

5.20.4 Impacts of No Action

As discussed in Section 5.19.4, socioeconomic impacts of continued operations at PBA would be small: primarily a continuation of small, positive economic impacts and a slight increase in demand for housing, schooling, and public services. None of these impacts would be considered high and adverse. Similarly, high and adverse human health impacts on either workers at PBA or the general public are not anticipated (see Section 5.9.4). As a result, no environmental justice impacts are anticipated under the no action alternative.

5.21 ACCIDENTS INVOLVING ASSEMBLED CHEMICAL WEAPONS

5.21.1 Potential Accidental Releases

This analysis of accidents provides an estimate of the upper range of the potential impacts that might occur as a result of a hypothetical accident related to the proposed action (ACWA pilot testing) or no action (continued storage of chemical weapons). The accidents selected for analysis were the accidents that were shown to have the highest risk in previous Army analyses (Science Applications International Corporation [SAIC] 1997). The highest-risk accidents are defined as those with the highest combined consequences (in terms of human fatalities) and probability of occurrence. For existing continued storage conditions and for operations, the highest-risk accidents would involve the release of chemical agent; release of other materials would result in lower consequences and risks. In general, the accidents considered in this EIS have a fairly low frequency of occurrence. The accident considered for continued storage (lightning strike on a rocket storage igloo) has an estimated frequency on the order of 2×10^{-3} per year (i.e., one occurrence in 476 years). The accident considered for the pilot facility (handling accident in rocket storage igloo) has a somewhat lower estimated frequency of approximately 1×10^{-4} (i.e., one occurrence in 10,000 years).

5.21.1.1 Scenarios

The hypothetical highest-risk accident for ACWA pilot testing of GB and VX is a handling accident in a rocket igloo, with a subsequent fire and release of agent from all the munitions in the igloo. The hypothetical highest-risk accident for continued storage is a lightning strike into a GB- or VX-rocket-containing igloo, with a subsequent fire and release of agent from all the munitions in the igloo. Therefore, the accident consequences from no action (continued storage) and would be the same as those from the proposed action (pilot facility).

Impacts from accidents occurring during the transport of agent from the storage igloos to the pilot testing facility were not assessed for this EIS, because the risks from these accidents would be less than those from the accidents already considered. Accident scenarios and probabilities from on-site transportation are discussed in a PEIS support document (GA Technologies 1987). As noted above, potential accidents from handling the munitions inside the igloos were considered and, in fact, were identified as being the highest-risk accidents during facility operations (SAIC 1997).

For the storage igloo accident scenario, it was assumed that a lightning strike could release the entire contents of a rocket-containing storage igloo. Similarly, a handling accident in a rocket-storage igloo scenario could result in an explosion and propagation by fire, also causing the entire igloo contents to be released. The probability of such an event occurring is fairly low (on the order of 2×10^{-3}), but it increases slightly with increasing length of continued storage. For these scenarios, the maximum amount of agent at risk was obtained from estimates of the maximum amount of VX or GB agent stored in any single PBA rocket-containing igloo (Harris 2000).

5.21.1.2 Methods of Analysis

Potential accidental releases of chemical agent to the atmosphere and the associated consequences of such releases were assessed by using the D2PC[11] Gaussian dispersion model (Whitacre et al. 1987). Two meteorological conditions were assumed in the modeling to assess accident impacts. E-1 conditions consist of a slightly stable atmosphere (stability class E) with light winds (1 m/s). D-3 conditions consist of a neutral atmosphere (stability class D) with moderate winds (3 m/s). E-1 conditions would produce conservative impacts for the assessed accident scenarios. They represent accidents that would occur during the night or during a relatively short period after sunrise. The D-3 conditions would result in more rapid dilution of an accidentally released agent than would E-1 conditions. D-3 conditions represent accidents that would occur during daytime. When D-3 meteorological conditions are assumed, the size of the estimated plume is smaller. In conducting D2PC modeling, it was assumed that no plume depletion by agent deposition would occur. This is a conservative assumption for estimating the area potentially affected by an accidental release, because assuming that more agent remains in the plume allows farther plume travel before concentrations are diluted below the toxicological endpoint levels. The D2PC model default mixing height assumptions were used for modeling D-3 meteorological conditions, and per EPA guidance (EPA 1995), an unlimited mixing height was assumed for modeling E-1 meteorological conditions. A mixing height of 5,000 m is used as a default in D2PC to represent unlimited mixing. The D2PC model limits its application to accident release scenarios that could produce impacts at distances of less than or equal to about 30 mi (50 km).

5.21.1.3 Exposures and Deposition

For each of the accident scenarios assessed, the impacts of agent release were modeled by using D2PC-generated plumes with dosages estimated to result in adverse impacts for a certain percentage of the human population exposed (i.e., LCt_{50} = dosage corresponding to 50% lethality; LCt_{01} = dosage corresponding to 1% lethality; no deaths = dosage below which no deaths are expected in the human population exposed; no effects = dosage below which no adverse impacts are expected in the human population exposed). The distances to which these various plumes were predicted to extend were used as the starting point for the analyses of impacts to the various resources of concern under the proposed action and no action alternatives, as detailed in Sections 5.21.2 and 5.21.3 below. These distances are summarized in Table 5.21-1. For reference, the minimum distance from the hypothetical accident locations (i.e., the Chemical

---

[11] The Army has completed the development and validation of a new model (D2Puff). However, the new model is not accredited for use at all installations.

TABLE 5.21-1 Chemical Agent Plume Distances Resulting from Accidents at an ACWA Pilot Test Facility (Proposed Action) or in the Chemical Limited Area (No Action) at PBA[a]

Effect	Impact Distance, Mi (km)[b]	Exposure Dose (mg-min/m^3)[c]	Impact Area km^2	Impact Area Acres
GB Accidents				
Proposed action, D-3 (i.e., handling accident in rocket storage igloo)				
1% lethality	6.3 (10)	10	6.6	1,600
No deaths	8.5 (14)	6	11	2,700
No effects	>30 (>50)	0.5	180	44,000
Proposed action, E-1 (i.e., handling accident in rocket storage igloo)				
1% lethality	27 (43)	10	44	11,000
No deaths	>30 (>50)	6	70	17,000
No effects	>30 (>50)	0.5	130	32,000
No action, D-3 (lightning strike on rocket igloo)				
1% lethality	6.3 (10)	10	6.6	1,600
No deaths	8.5 (14)	6	11	2,700
No effects	>30 (>50)	0.5	180	44,000
No action, E-1 (lightning strike on rocket igloo)				
1% lethality	27 (43)	10	44	11,000
No deaths	>30 (>50)	6	70	17,000
No effects	>30 (>50)	0.5	130	32,000
VX Accidents				
Proposed action, D-3 (i.e., handling accident in rocket storage igloo)				
1% lethality	8.9 (14)	4.3	13	3,200
No deaths	12 (20)	2.5	23	5,700
No effects	>30 (>50)	0.4	180	44,000
Proposed action, E-1 (i.e., handling accident in rocket storage igloo)				
1% lethality	>30 (>50)	4.3	73	18,000
No deaths	>30 (>50)	2.5	90	22,000
No effects	>30 (>50)	0.4	130	32,000
No action, D-3 (lightning strike on rocket igloo)				
1% lethality	8.9 (14)	4.3	13	3,200
No deaths	12 (20)	2.5	23	5,700
No effects	>30 (>50)	0.4	180	44,000

TABLE 5.21-1 (Cont.)

Effect	Impact Distance, Mi (km)[b]	Exposure Dose (mg-min/m^3)[c]	Impact Area km^2	Impact Area acres
No action, E-1 (lightning strike on rocket igloo)				
1% lethality	>30 (>50)	4.3	73	18,000
No deaths	>30 (>50)	2.5	90	22,000
No effects	>30 (>50)	0.4	130	32,000

[a] Distances and plume areas in table are from D2PC output. Meteorological conditions are either D stability and 3-m/s wind speed or E stability and 1-m/s wind speed.

[b] Impact distances downwind of accident that would have 1% lethality, no deaths, or no effects on humans (see Table 5.21-2).

[c] Dosage for duration of accident at specific impact distance. The dosages correspond to default values used in the D2PC code (Whitacre et al. 1997).

Limited Area, or CLA) to the PBA installation boundary and other industrialized areas (e.g., the NCTR) is about 0.4 mi (0.7 km). For all the hypothetical accidents assessed, the no effects plume contour extends into off-post areas (i.e., extending to 30 mi [50 km]). The extent of the no deaths contour varies from 9 to 30 mi (15 to 50 km), depending on the assumed type of chemical agent release and meteorological conditions.

5.21.2 Impacts of Accidents during the Proposed Action

5.21.2.1 Land Use

An accidental agent release during operation of an ACWA pilot test facility could generate serious negative land use impacts outside the installation, including the death and quarantine of livestock, interruption of agricultural productivity, and disruption of local industrial activities (see Sections 5.21.2.9 and 5.23). Although such an accident would be capable of generating serious negative consequences, the likelihood of such an accident is extremely remote; consequently, the overall risk is very low.

5.21.2.2 Waste Management and Facilities

Hazardous Waste. The highest-risk accident scenario for ACWA pilot testing activities is a handling accident in a rocket-containing igloo. Waste generated under this scenario would be primarily contaminated soil and debris from dispersion of agent. An undeterminable amount of contaminated wastes could be produced by cleanup of a spill or accident involving dispersion of agent. Spill and emergency response plans and resources would be in place to contain, clean up, decontaminate, and dispose of wastes according to existing standards and regulations.

Chemical agents are not listed in the Arkansas hazardous waste regulations. In the case of an accident that involves the release of a chemical agent, any contaminated residue, soil, water, or other debris resulting from the cleanup of that agent must be characterized to determine if it is a hazardous waste (Arkansas Department of Environmental Quality [ADEQ] Regulation 23, Section 261). Debris and soil contaminated with agent could be considered hazardous waste if they demonstrated a hazardous characteristic. In this case, the hazardous waste could have a serious impact on hazardous waste management capabilities in the area.

Nonhazardous Waste. Depending on the particular accident conditions, if the cleanup material did not demonstrate a hazardous waste characteristic, the Army might be able to dispose of some or most of it as nonhazardous waste in a local landfill.

5.21.2.3 Air Quality

Depending on the amount, an accidental release of GB or VX at PBA during operation of an ACWA pilot test facility could have short-term but very significant adverse impacts on air quality, in terms of human injuries and fatalities (see Section 5.21.2.4). However, deposition of agent from air onto the ground surface and/or degradation in the environment would occur within a relatively short period of time. GB is considered nonpersistent because it is volatile, soluble in water, and subject to acid-base hydrolysis. Although data on the fate of GB in the atmosphere are lacking, GB is likely to be subject to photolysis, radical oxidation, or hydrolysis upon contact with water vapor (Munro et al. 1999). Therefore, it is unlikely to persist in air. VX is nonvolatile and persistent; however, after an accidental release, VX aerosols would be subject to rapid deposition onto ground surfaces. Therefore, long-term (e.g., more than a few days after release) adverse air quality impacts would not be expected from an accidental release of GB or VX.

5.21.2.4 Human Health and Safety

For each of the accident scenarios assessed, the impacts of agent release were modeled by using plumes with dosages estimated to result in death for a certain percentage of the population exposed (i.e., LCt_{50} = dosage corresponding to 50% lethality; LCt_{01} = dosage corresponding to 1% lethality; no deaths = dosage corresponding to 0% lethality. The assumption was made that for any accident, the wind direction would be toward the direction where the largest number of people live. By using site-specific population data, the potential numbers of fatalities for each accident were estimated. Further details on the methods used to estimate number of fatalities are given in Appendix H. This evaluation did not specifically estimate the numbers of nonfatal injuries that would occur for each accident scenario, because there would be great variation in the number and severity of nonfatal injuries, depending on the exposure concentration and duration and on variations in the populations exposed.

The population at risk at PBA (i.e., persons residing within a 30-mi [50-km] radius of the post) is about 440,000 people. The handling accident in a VX-rocket storage igloo scenario could result in an explosion and propagation by fire, causing the entire igloo contents to explode and/or burn (SAIC 1997). For this igloo scenario, the maximum amount of agent at risk was obtained from estimates of the maximum amount of VX stored in any single PBA igloo (Harris 2000). If this handling accident scenario occurred under E-1 meteorological conditions, 1% lethality distances and no deaths distances of more than 30 mi (50 km) would result (Table 5.21-2). The corresponding estimated number of fatalities among the general public would be about 6,000. The estimated number of fatalities for the on-post population would be about 440. If such an accident occurred under D-3 meteorological conditions, the 1% lethality distance would decrease to 9 mi (14 km). The corresponding estimated number of fatalities among the general public would be about 1,100. The estimated number of fatalities for the on-post population would be 350.

The above estimates are conservative with respect to several modeling assumptions, such as the number of munitions and amount of agent released, unvarying meteorology, no fire-induced plume buoyancy, and the size of the population exposed (e.g., wind assumed to be in direction of most populous area for an extended period of time). However, the toxicity levels used to estimate fatalities were originally developed for healthy adult males. If it is assumed that children and/or the elderly are substantially more susceptible to the effects of agent exposure than healthy adult males and all other conservative assumptions remain the same, then the estimated number of fatalities could increase. When a previously developed method for incorporating sensitive subpopulation risk assumptions is used (U.S. Army 1997) and when it is assumed that about 35% of the general population in the PBA ROI (see Section 4.19) falls into the sensitive subgroup, the fatality estimates for the accident scenarios addressed here for alternative technologies would increase by a factor of about 1.5. (Details of this assessment are provided in Appendix H.) For example, if children and the elderly are up to 10 times more

TABLE 5.21-2 Fatality Estimates for Potential Accidents Involving Agent Release at PBA[a]

Accident Scenario[b]	Distance (mi) To LCt_{50} Dose	Distance (mi) To LCt_{01} Dose	Distance (mi) To No Deaths Dose	On-Post Population at Risk (no. of persons)[c] Source to LCt_{50}	On-Post Population at Risk (no. of persons)[c] LCt_{50} to LCt_{01}	On-Post Population at Risk (no. of persons)[c] LCt_{01} to No Deaths	Maximum Estimated Fatalities for On-Post Population[d]
Continued storage highest-risk accident (applicable to no action and proposed action, all ACWA technologies)							
Lightning strike on VX rocket storage area with fire: D-3	3.9	8.9	12	448	52	126	350
Lightning strike on VX rocket storage area with fire: E-1	16	>30	>30	487	296	20	439
Facility highest-risk accident (applicable to all ACWA technologies)							
Handling accident in VX rocket storage igloo: D-3	3.9	8.9	12	448	52	126	350
Handling accident in VX rocket storage igloo: E-1	16	>30	>30	487	296	20	439

Accident Scenario[b]	Off-Post Public Population at Risk (no. of persons)[c] Source to LCt_{50}	Off-Post Public Population at Risk (no. of persons)[c] LCT_{50} to LCt_{01}	Off-Post Public Population at Risk (no. of persons)[c] LCT_{01} to No Deaths	Maximum Estimated Fatalities for Off-Post Population[d]
Continued storage highest-risk accident (applicable to no action and proposed action, all ACWA technologies)				
Lightning strike on VX rocket storage area with fire: D-3	240	3,367	7,770	1,061
Lightning strike on VX rocket storage area with fire: E-1	314	22,603	6,881	5,921
Facility highest-risk accident (applicable to all ACWA technologies)				
Lightening strike into VX rocket storage area with fire: D-3	240	3,367	7,770	1,061
Lightening strike into VX rocket storage area with fire: E-1	314	22,603	6,881	5,921

[a] Scenarios are highest-risk accidents for ACWA pilot facilities and for continued storage.

[b] D-3 corresponds to meteorological conditions of D stability with 3-m/s wind speed, and E-1 corresponds to conditions of E stability with 1-m/s wind speed. All accidents are assumed to occur with the wind blowing toward the location of maximum public or on-post population density.

Footnotes continue on next page.

TABLE 5.21-2 (Cont.)

---

[c] Population at risk indicates the number of individuals working (for on-post populations) or residing (for off-post populations) within the area encompassed by the plume. LCt_{50} values used were 18 and 42 for VX and GB, respectively, assuming a 25-L/min breathing rate (SAIC 1997; Goodheer 1994; Burton 2001). LCt_{01} and no deaths values were defaults from D2PC code (Whitacre et al. 1987), as given in Table 7.21-1. LCt_{50} values proposed by National Research Council (1997b) of <15 and <35 for VX and GB, respectively (for 15-L/min breathing rate) were not used in this assessment; these values have not been formally approved for use by the Army.

[d] Total fatalities were calculated by assuming (1) a fatality rate of 75% in the area between the point of agent release and the 50% lethality dosage contour, (2) a fatality rate of 25% in the area between the 50% lethality dosage contour and 1% lethality dosage contour, and (3) a fatality rate of 0.5% in the area between the 1% lethality dosage contour and no deaths dosage contour.

sensitive to the lethal effects than are healthy male adults, and if a handling accident in a VX rocket storage igloo occurred under E-1 meteorological conditions, up to about 12,000 fatalities ($8,100 \times 1.5$) would be expected in the general population. It must be emphasized that this is a very conservative estimate of the maximum number of fatalities that would be expected from a highly improbable accident; sufficient data are not available to determine whether children or the elderly are actually more sensitive to the toxic effects of an acute chemical agent exposure than the rest of the population.

For the human health impacts assessment, an internally initiated accident was also modeled (i.e., an accident caused by equipment failure or human error at the pilot facility). The internally initiated accident that was modeled involved a rupture in the 500-gal (1,900-L) agent holding tank or the connecting piping in the MDB that could result in the release of the tank's entire contents. Such an accident could result in the release of a small quantity of GB from the filter farm stack. Air concentrations would be too low to cause fatalities.

Essentially, the assessment did not find any difference between the technology systems with respect to accident impacts during pilot facility operations. This finding is attributable to the fact that acute health risks are mainly determined by the quantity of agent released in an accident (the source term). Once neutralization has taken place inside the pilot facility, the acute health risks associated with an accidental release of process by-products (e.g., hydrolysate solution) would be negligible in comparison with the risks associated with the release of an agent. Because the alternative technologies would operate at similar throughput rates, with similar total amounts of agent present at the front end of the process (during munitions disassembly), the maximum amounts of agent released in the pilot facility would be similar for all technologies and less than the amount released in a rocket igloo handling accident.

The main potential differences in accidents involving releases of agent for the different technology systems being tested would be related to the method used to access agent and explosives in the munitions. Cryofracture would be used for separation of energetics in some processes, while a reverse assembly process with some modifications would be used for other processes. Assessments of the consequences of accidents involving these separation processes are not presented here because the impacts would be substantially smaller than those of the other externally and internally initiated events considered. Also, the currently available design data do not indicate any major differences in the disassembly processes with respect to potential amounts of agent released.

The Neut/SCWO process would use five major process chemicals: sodium hydroxide, phosphoric acid, kerosene, liquid oxygen, and liquid nitrogen (PMACWA 1999). The Neut/GPCR/TW-SCWO process would use several hazardous chemicals, including sodium hydroxide, liquid oxygen, hydrogen, and kerosene. Finally, the Elchem Ox process would use sodium hydroxide, nitric acid, sodium hypochlorite, hydrochloric acid, calcium oxide, silver nitrate, and liquid oxygen (PMACWA 2001). Several of these chemicals are flammable or reactive (e.g., sodium hydroxide, sulfuric acid, kerosene) and exhibit irritant properties when inhaled or touched. However, all are common industrial chemicals with well-established handling procedures and safety standards. According to PMACWA (1999), "the risk from gaseous emissions of these chemicals is minimal, but more work is needed to demonstrate the effectiveness of the containment design in the event of an accidental ignition of energetics during processing." The effectiveness of the containment design is being further addressed in engineering design studies.

5.21.2.5 Soils

Under the accident scenarios considered for ACWA pilot testing activities at PBA, contamination of surface soils could extend over an area beyond the installation boundaries. Given the nature of the accidents, it is assumed that chemical agent would be widely deposited downwind on surface soils as fine particles or droplets. Degradation rates for fine particles of agent typically are rapid (see Appendix A). Therefore, any impacts on soils resulting from the deposition of fine particles of agent would be of limited duration — on the order of several days to two weeks — depending on ambient temperatures.

Pools or larger pieces of chemical agent might be deposited near the location of the agent release. Although larger pieces of chemical agent would degrade more slowly than fine particles, any agent released during such an accident would be removed during cleanup operations and would not have a long-term impact on surface soils. Contaminated soils excavated during cleanup would be disposed of in accordance with applicable requirements.

5.21.2.6 Water Resources

Impacting Factors. The agent deposited on the soil after a rocket storage igloo handling accident would be deposited as fine particles, aerosols, or vapor. No large masses (drops, pools, etc.) of agent would be deposited downwind of the accident site. Near the accident site, large drops or pools of agent might occur on the ground surface. This agent near the accident would be removed during cleanup operations and would not pose a long-term threat or be a source of water contamination. However, any agent deposited on the soil downwind of the accident as fine particles could be a potential source of surface or groundwater contamination.

GB deposited on the soil surface would degrade rapidly. GB has a volatilization half-life of 7.7 hours and a hydrolysis half-life of 46 to 460 hours, depending on the soil's pH (Appendix A). Within two to three days, surface concentrations of GB would be negligible. Only 0.1% of the original deposition would remain after about 10 half-lives; thus, within about three days, surface concentrations of GB would be below 0.01%, and within 15 half-lives (about five days), only 0.003% would remain.

VX deposited on the soil surface would be moderately persistent and could remain in significant concentrations for 15 to 20 days (Appendix A). The degradation half-life of VX in soil is estimated to be about 4.5 days, while the hydrolysis half-life ranges from 17 to 42 days, depending on temperature and pH. Within approximately 1.5 months, less than 0.1% of the VX would remain, and within about two months, less than 0.001% of the deposited VX would remain.

Once agent reached either surface water or groundwater, it would dissolve and begin to hydrolyze and undergo dilution as it mixed with the water. None of the agents would be persistent in water resources; however, some of the agent breakdown products would be persistent in the environment.

GB has one breakdown product that is persistent in the environment: isopropyl methyl phosphonic acid (IMPA), (Appendix A). It is considered an eye and skin irritant with low to moderate toxicity. VX has two relatively stable degradation products: EA2192 and methyl phosphonic acid (MPA) (Appendix A). EA2192 retains some anticholinesterase properties and has the potential to affect human health through the oral pathway. However, at concentrations estimated in the environment, EA2192 would not be expected to pose a significant threat.

Groundwater. Transportation of agent by subsurface flow would be minimal. Surface sources would not last for significant periods, and degradation would occur as the agents moved through the vadose zone to the groundwater. Once in the groundwater, degradation would continue, and significant dilution would occur.

In addition to the fact that the agent source would be present on the surface to contaminate groundwater for only a relatively short length of time, once the agents were dissolved and mobile, they would hydrolyze. GB hydrolyzes rapidly and would break down before being transported any significant distance in the subsurface. VX hydrolization takes a slightly longer time but still occurs rapidly when compared with groundwater travel times.

It is very unlikely that after an accident, conditions that would allow significant impacts on groundwater resources would exist. Trace amounts of agent breakdown products might be detected, but these contaminants would be present at low concentrations and would not pose significant threats to the environment.

Surface Water. Small ponds and other nonmoving surface water features would be affected after an accident for a short time. Agent concentrations would rapidly decrease as a result of agent degradation and dilution as the agent mixed with the water column.

Surface runoff might mobilize the agent present on the soil surface. If mobilization occurred, the turbulent water would dissolve the agent rapidly. Once dissolved, GB would hydrolize rapidly and not persist in the water. VX would be present for a slightly longer period but would also break down rapidly.

It is unlikely that agent transported by runoff would reach surface water bodies in appreciable concentrations because of agent dilution and degradation. Even if it did, impacts would be short-lived. Surface runoff might contain some agent when it reached various surface water bodies, but within a short time, depending on the agent and environmental conditions, these concentrations would be negligible. Dilution from both the overland flow and mixing in the water body would also reduce the concentration of agent reaching the water bodies. In addition, in order for any appreciable amount of agent to reach surface water bodies from overland flow, a rainfall event large enough to produce surface runoff, but small enough to not significantly dilute the dissolved agent, would have to occur shortly after an accident.

Because of the relatively low toxicity of the breakdown products and the low agent concentrations (because of dilution and low initial concentrations of agent or breakdown products), the impacts from degradation products on surface water resources would be none to negligible.

5.21.2.7 Biological Resources

Accident analyses were conducted for a scenario that involved a handling accident in a VX or GB rocket storage igloo. Ecological impacts from a major accident associated with operation of an ACWA pilot test facility were assessed on the basis of atmospheric concentration estimates made by using the D2PC model (Whitacre et al. 1987). Model output was used to conduct impact analyses for vegetation, wildlife, aquatic habitats and fish, protected species, and wetlands.

Terrestrial Habitats and Vegetation. VX and GB mainly interfere with neurotransmission in animals and would not likely affect vegetation; however, VX is known to be phytotoxic to some plants at 10 ppm (soil and solution). The toxicity of GB to terrestrial plants is unknown but is probably similar in magnitude to the toxicity of VX, since both agents are organophosphates (Opresko et al. 1998). Hydrolysis of GB would probably occur quickly after deposition on plant surfaces and soils downwind from the accident location (see Appendix A). Model runs for a handling accident in a GB rocket storage igloo under E-1 (nighttime) meteorological conditions showed an average GB deposition area of 4,400 ha (11,000 acres) in the 1% human lethality area that extends to 27 mi (43 km) downwind from the accident location (see Table 5.21-1). The maximum deposition area after an accident would occur during nighttime conditions. The average VX deposition area would be 7,300 ha (18,000 acres) in the 1% human lethality area located out to 30 mi (50 km) downwind of the accident during nighttime (E-1) conditions.

Wildlife. The deposition plume areas projected by the D2PC model would be elliptical in shape and would occur mostly downwind of the accident. The location and geometry of the plume areas would vary, depending on the atmospheric stability and wind direction at the time of an accident. At PBA, the prevailing winds that would result in the greatest consequences from an accident would be from the southwest. A release of nerve agents would thus have a higher probability of affecting ecosystems located northeast of the CHB. However, the release could presumably affect ecosystems in any direction, depending on the direction and speed of the wind at the time of the accident. Because of the limitations of the D2PC model, the size of habitat potentially exposed to agents cannot be reasonably approximated.

A screening-level ecological risk assessment was conducted to determine impacts of the bounding accident on four common wildlife species observed in grassland and forest habitats at PBA: white-tailed deer (*Odocoileus virginianus*), red fox (*Vulpes fulva*), meadow vole (*Microtus pennsylvanicus*), and white-footed mouse (*Peromyscus leucopus*). No benchmark values were found for exposure of birds, reptiles, or amphibians to VX and GB. Risks to the four ecological receptors from the accident scenarios were characterized by using the hazard quotient (HQ) approach for exposure to VX and GB. The HQ is the ratio between the concentration of a contaminant (VX, GB) in a medium (air, water) and a contaminant-specific benchmark concentration representing a “no observed adverse effects level” (NOAEL) and a “lowest observed adverse effects level” (LOAEL) exposure concentration on the basis of results from laboratory studies. HQs were calculated on the basis of inhalation benchmark values developed for use in ecological risk assessments of wildlife from exposure to combustion products at ANAD (USACHPPM 1999a). The HQ values could vary from zero to infinity. HQ values greater than one show a potential risk to the ecological receptor from the exposure. It is important to note that HQ values greater than one indicate only the potential for adverse risks (or effects) to individual animals and not actual impacts on them. Actual impacts would depend on many factors, such as the length of exposure to the plume, concentration of the chemical agent in air, and species sensitivities to various atmospheric concentration levels. HQ values were based on air concentrations estimated by the D2PC model under the air stability expected during typical nighttime conditions (wind speed of 1 m/s) and during typical daytime conditions (wind speed of 3 m/s). Benchmark values were adjusted for differences in inhalation rates on the basis of the body mass of the four species examined. Distances that were affected by a handling accident at an igloo followed by a fire were determined for HQ values of less than one on the basis of D2PC model output for both NOAEL and LOAEL exposures. Details of the HQ calculations are provided in Tsao (2001a–b).

Exposure of the four mammalian species to GB would result in lethality at distances extending out to 30 mi (50 km) downwind from the accident location (see Table 5.21-3). Species with small home ranges, such as small mammals, reptiles, and amphibians, would remain in the exposure plume during the accident and would thus experience higher mortality rates than more mobile species. Exposures to VX would result in some mortality to wildlife out to 30 mi (50 km) downwind of the accident for all four species evaluated in the ecological risk assessment (see Table 5.21-3).

Exposure of wildlife to VX and GB following an accident might have effects similar to those known to occur to humans. VX and GB are strong inhibitors of enzymes and effect neurotransmission by interfering with the enzyme cholinesterase, in particular. Nausea, vomiting, skeletal muscle twitching, seizures, and death typify the normal progression of effects from brief human exposures to high concentrations (see Appendix A). VX is not expected to be harmful to plants because of their low sensitivity, but it might be harmful to herbivores that consume contaminated vegetation downwind of the accident location over an extended period of time (Appendix O in U.S. Army 1988).

VX is not very volatile, is moderately persistent in the environment, and may occur in the environment for about 15 to 20 days following deposition on soil. The half-life of VX is about 4.5 days, and an estimated 90% of VX applied to soils would be lost in less than 15 days (Appendix A). No data were available to model wildlife uptake of VX or GB through ingestion. The nerve agent GB is considered nonpersistent in the environment and quickly breaks down in water. Impacts of GB through bioaccumulation in the food chain would not be likely to occur, given its tendency to volatilize quickly. The degradation products of GB have low toxicities (see Appendix A) and also would not be likely to pose a threat to wildlife through biomagnification in the food chain.

Aquatic Habitats and Fish. Aquatic habitats and fish in all water bodies at PBA might be affected by a release of GB or VX following a handling accident at a rocket storage igloo. VX is more environmentally persistent than GB. VX is moderately to highly soluble in water, with a solubility of 30 g/L at 77°F (25°C) (Munro et al. 1999). Its half-life ranges from 17 to 42 days at a temperature of 25°F (77°C) and pH of 7 (Appendix A). Depending on the concentrations of VX reaching surface waters, fish, amphibians, and reptiles would be likely to die if their responses were similar to those of mammals under laboratory conditions (Munro et al. 1999). Analyses of the effects from potential accidental releases of VX on fish and other aquatic

TABLE 5.21-3 Distance from Accident Location That Would Result in No or Lowest Adverse Effects on Wildlife at PBA[a]

	Distance (mi) with Hazard Quotient of <1[b]							
	GB				VX			
	Daytime Conditions		Nighttime Conditions		Daytime Conditions		Nighttime Conditions	
Species	LOAEL[c]	NOAEL[d]	LOAEL[c]	NOAEL[d]	LOAEL[c]	NOAEL[d]	LOAEL[c]	NOAEL[d]
White-tailed deer	17	26	>30	>30	>30	>30	>30	>30
Red fox	26	>30	>30	>30	>30	>30	>30	>30
Meadow vole	<30	>30	>30	>30	>30	>30	>30	>30
White-footed mouse	<30	>30	>30	>30	>30	>30	>30	>30

[a] Scenario is a GB release or a VX release that results from a handling accident or lightning strike at a rocket storage igloo.

[b] Hazard quotient = (dose at a given distance from the source) divided by (benchmark value of agent for receptor species). The air concentration used to determine dose was obtained by using the D2PC model and assuming a wind speed of 3 m/s during daytime and 1 m/s during nighttime.

[c] LOAEL = lowest observed adverse effect level; the maximum distance from the site at which an adverse effect would be expected to occur.

[d] NOAEL = no observed adverse effect level; the distance from the site beyond which no adverse effects would be expected to occur.

organisms (U.S. Army 1998) indicate that the impacts at PBA could be severe. Aquatic organisms in Yellow Lake, Tulley Lake, small ponds, and intermittent and ephemeral streams at PBA would be killed from exposure to VX following a handling accident in a VX rocket storage igloo. Mortality to aquatic biota from VX exposure after the accident could occur in any of the surface water bodies at PBA, depending on the wind direction at the time of the accident. Aquatic species in surface waters located downwind of the accident to the northeast of PBA would have the greatest probability of exposure to accidental release concentrations projected by the D2PC model (based on the direction of the prevailing winds). The D2PC model uses very conservative input parameters and assumptions; it is described in detail in Appendix H of this EIS.

Yellow Lake and Tulley Lake provide habitat for a variety of fish species (34 species recorded in Yellow Lake) that are important as recreational species and forage species for game fish, birds, and mammals. Mortality to these species from an accidental release of VX would result in the greatest impact to aquatic ecosystems at PBA.

Protected Species. No federal listed threatened and endangered species are known to occur at PBA (Tobin 2000). The federal threatened bald eagle *(Haliaeetus leucocephalus)* and federal endangered red-cockaded woodpecker *(Picoides borealis)* occur within 30 mi (50 km) of PBA and could be killed or adversely affected by a release of VX or GB following a handling accident in a rocket storage igloo. The potential for lethal and adverse impacts on these species would depend on the direction of the wind and extent of the plume following the accident. Prevailing winds are mainly from the south and southwest of PBA during all months except September, when they come mostly from the northeast.

The likelihood of impacts on to the bald eagle and the red-cockaded woodpecker populations within 30 mi (50 km) of PBA is low. Known breeding populations in 1997 (U.S. Army 1997) were located northwest of PBA in Grant, Pulaski, and Saline Counties. These areas are typically not downwind of PBA because the prevailing winds are from the southwest. The bald eagle is considered a transient species during spring and fall migration (PBA 1998). Severe accidents involving VX that occurred during the migration periods could adversely affect bald eagles if they were exposed to the agent in areas downwind from the release in five counties that are within 30 mi (50 km) of PBA.

The geocarpon (*Geocarpon minimum*), a federal threatened plant species, occurs within a 30-mi (50-km) radius of PBA. Eleven other plant species considered as state endangered or threatened by the Arkansas Natural Heritage Commission (see Table 5.15-1) are also known to occur in counties within 30 mi (50 km) of PBA. No studies were found to suggest that VX and GB would adversely affect the geocarpon or other listed plant species.

The Arkansas fatmucket (*Lampsilis porvelii*), a federal threatened clam species, is known to occur in Saline County, located northwest of PBA and within the 30-mi (50-km) radius. The extent to which this species would be affected by VX releases from an accident would depend on the water volume and flow rate of the stream, both of which would affect VX water concentration and exposure levels. Clams in shallow perennial or intermittent streams downwind from the accident during daytime could be exposed to relatively high concentrations of VX within the 1% human lethality, no human deaths, and no human health effects contours, located 3.9 mi (14 km), 12 mi (20 km), and more than 30 mi (50 km), respectively, from the accident. VX is known to persist in water for 17–42 days at a temperature of 77°F (25°C) and a pH of 7 (Appendix A). Given the sedentary nature of clams, individuals would be exposed to the entire aliquot of water containing agent deposited from the vapor plume following the accident. Clams surviving exposure would likely bioaccumulate VX in soft tissues.

Wetlands. Wetlands near the location of a handling accident at a rocket storage igloo would be exposed to VX or GB. The limited amount of data available on known impacts on plants suggests that some absorption of VX would occur (U.S. Army 1988). VX and its breakdown products would be harmful and potentially lethal to animals ingesting contaminated plant material. Plant species exposed to GB downwind of the accident site would not be likely to become contaminated to a large extent because of the agent's tendency to break down relatively quickly by hydrolysis.

5.21.2.8 Cultural Resources

The occurrence of an accident, either during the proposed action or no action, could result in impacts on cultural resources within the area exposed to agent. The building materials used in historic structures or the exposed surfaces of archaeological sites could become contaminated during an accident. At a minimum, public access to these historic properties would be temporarily denied until contamination was degraded by exposure to light and moisture or by active decontamination.

For the hypothetical accidents assessed here (i.e., handling accident at a GB or VX rocket storage igloo), only temporary impacts (i.e., access restrictions) on cultural resources located outside the maximum radial no effects distance of 30 mi (50 km) would be expected (see Table 5.21-1). Access restrictions could last for a few days or longer, depending on the degree of contamination and the length of time required to certify that access to these properties could again be permitted. It is expected that low levels of agent contamination would degrade in a few hours under certain conditions, while larger quantities might take several weeks to degrade (see Appendix A).

Significant historic properties located within 30 mi (50 km) of the accident (Appendix F) could be affected by temporary but extended restriction periods until the contaminant was degraded by light and moisture. If the contaminant was deposited as a liquid on these properties, the Army might require that the properties undergo various decontamination procedures before being released for access by the public. These decontamination procedures could potentially damage the property. However, deposition of liquid agent in quantities that would require decontamination procedures that could damage or destroy cultural resources would most likely be confined to the pilot test facility or storage area. Extended public access restrictions, lasting until the contaminant dissipated, would be the most likely measure for preserving significant properties.

5.21.2.9 Socioeconomics

The accidental release of chemical agent at PBA during ACWA pilot testing would have the potential to affect the socioeconomic environment in two ways. The demand for crops and livestock produced within the 30-mi (50-km) radius around the facility might change, and employees might need to be evacuated from work places.

Agriculture. The most significant impact of an accident on agriculture would be if all the crops and livestock produced in a single season were interdicted (either by federal or state authorities) and removed from the marketplace. Although the impacts from losses in agricultural output on the economy of the counties within the 30-mi (50-km) radius surrounding PBA would be significant (Table 5.21-4),it is unlikely that the severity of these losses would be any different for the no action and the proposed action alternatives.

TABLE 5.21-4 Socioeconomic Impacts of Accidents at PBA Associated with the Proposed Action and No Action[a]

Parameter	Neut/ SCWO	Neut/ GPCR/ TW-SCWO	Elchem Ox	No Action
Impacts from a one-year loss of agricultural output				
100% loss of agricultural output				
Employment (no. of jobs)	23,900	23,900	23,900	23,900
Income (millions of $)	1,030	1,030	1,030	1,030
75% loss of agricultural output				
Employment (no. of jobs)	17,900	17,900	17,900	17,900
Income (millions of $)	770	770	770	770
50% loss of agricultural output				
Employment (no. of jobs)	11,900	11,900	11,900	11,900
Income (millions of $)	510	510	510	510
Impacts from a single-day evacuation of businesses				
100% of economic activity affected				
Sales (millions of $)	150	150	150	150
Employment (no. of jobs)	360,000	360,000	360,000	360,000
Income (millions of $)	80	80	80	80
75% of economic activity affected				
Sales (millions of $)	110	110	110	110
Employment (no. of jobs)	270,000	270,000	270,000	270,000
Income (millions of $)	60	60	60	60
50% of economic activity affected				
Sales (millions of $)	74	74	74	74
Employment (no. of jobs)	180,000	180,000	180,000	180,000
Income (millions of $)	40	40	40	40

[a] Impacts for no action and the proposed action are presented for the first year of operation of an ACWA facility (2009).

Businesses and Housing. Although the evacuation of businesses as a result of an accident at PBA would likely be only on a temporary basis, disruption to the economy in the area likely to be evacuated (the CSEPP Protective Action Zone [PAZ]) surrounding PBA, consisting of Arkansas, Cleveland, Dallas, Grant, Jefferson, Lincoln, Lonoke, Pulaski, and Saline Counties) could be significant. In the worst-case scenario, all business sales and employee income in the PAZ would be lost as a result of the evacuation. An evacuation that might be required after an accident could last for many days. Since the exact duration of the evacuation cannot be determined, the consequent overall effect on local economic activity could not be determined. The impacts from a temporary, single-day evacuation of businesses in the PAZ are shown in Table 5.21-4. The data in the table may be used to estimate the impact of an evacuation over a multiple-day period.

Since it is likely that the presence of chemical agent and the risk of accidents at PBA are already captured in housing values nearby, an accident would probably not create significant additional impacts on the housing market, unless residents were prevented from quickly returning to their homes.

5.21.2.10 Environmental Justice

Within 30 mi (50 km) of PBA, the analysis of human health impacts anticipates that highly unlikely accident scenarios causing the widespread release of an agent would indeed result in high and adverse impacts (see Section 5.21.2.4). In such a situation, minority and low-income populations could suffer fatalities and serious injuries disproportional to their representation in the United States as a whole, if the wind direction at the time of the accident put the agent plume in the direction of census tracts with high numbers of minority or low-income populations (see Section 5.20.1 for identification of these census tracts). Such severe human health impacts would have similarly high and adverse socioeconomic consequences for the counties in the ROI, including the removal of some of the work force and the interruption of agricultural activity (see Section 5.21.2.9). However, such accidents have a low frequency of occurrence, on the order of 2×10^{-3} per year (i.e., one occurrence in 476 years), so the risk of the resultant disproportionate impacts would be low. Such impacts are not anticipated.

5.21.3 Impacts of Accidents during No Action (Continued Storage)

5.21.3.1 Land Use

Land use impacts from accidents under the no action alternative would be the same as those discussed under the proposed action (Section 5.21.2.1).

5.21.3.2 Waste Management and Facilities

Waste management impacts from accidents under the no action alternative would be the same as those discussed under the proposed action (Section 5.21.2.2).

5.21.3.3 Air Quality

After an accidental release of agent from a storage igloo at PBA, deposition of agent from air onto the ground surface and/or degradation in the environment would occur within a relatively short period of time (see Section 5.21.2.3). Therefore, long-term (e.g., more than a few days after release) adverse air quality impacts would not be expected from an accidental release of GB or VX.

5.21.3.4 Human Health and Safety

The U.S. Army and Federal Emergency Management Agency (FEMA) routinely conduct CSEPP exercises, in coordination with the communities surrounding PBA and with their participation. These exercises are required under a 1988 memorandum of understanding (MOU) between FEMA and the Army. Because chemical agent is currently stored at PBA, some risk from accidents is already present. For example, agent could be released if a pallet were accidentally dropped during daily operations (i.e., maintenance and inspection). The most probable event would be that the pallet would be dropped from 4 ft (1 m), the average height that a pallet could be dropped during normal operations. This event would involve three rounds of munitions spilling their contents on the igloo floor. Emergency response preparation for potential accidents of this type during normal PBA operations (e.g., maximum credible events [MCEs] for daily operations) is routinely evaluated under CSEPP (U.S. Army 1997).

For the EIS, the hypothetical accident for continued storage is assumed to be an event that could release the entire content of a storage igloo containing GB or VX rockets (e.g., a lightning strike). The probability of such an event occurring is low (on the order of 2×10^{-3}) but increases slightly with increasing length of continued storage. A lightning strike could result in an explosion and propagation by fire, causing the entire contents to explode and/or burn (SAIC 1997). Thus, the impacts of the lightning strike scenario are identical to those of the handling accident scenario (Section 5.21.2.4), because the estimated amount of nerve agent released is the same. The consequences from a lightning strike on a VX rocket storage igloo have been estimated in terms of the number of fatalities and are given in Table 5.21-2. A discussion of the impacts is provided in Section 5.21.2.4.

5.21.3.5 Soils

Potential impacts on soils associated with the accident scenarios considered under the no action alternative would be the same as those discussed under the proposed action (Section 5.21.2.5).

5.21.3.6 Water Resources

The factors that would affect water resources under the accident scenario would be the same for the no action and proposed action alternatives (Section 5.21.2.6). Impacts on surface water resources would be short-lived, although agent breakdown products might persist for some time. Impacts on groundwater resources would be unlikely and, if they did occur, would be negligible. Breakdown products might be detected, but their occurrence would be unlikely.

5.21.3.7 Biological Resources

The impact from an accident involving a lightning strike into a GB or VX rocket storage igloo in the CLA was evaluated for the no action alternative. The methodology used for assessing impacts to biological receptors under the no action accident scenario was the same as that used under the proposed action scenario (see Section 5.21.2.7). Table 5.21-1 presents the agent exposures and deposition areas that could result from this accident scenario for the 1% lethality, no deaths, and no effects distances to humans.

Terrestrial Habitats and Vegetation. Impacts on vegetation from GB deposited after the accident would be likely to be negligible. VX and its breakdown products could accumulate in plant tissues, but they would not be likely to cause adverse impacts because of the relatively low sensitivity of plants to nerve agents.

Wildlife. The impacts on wildlife under the no action accident scenario would be the same as those discussed under the proposed action scenario (see Section 5.21.2.7). Wildlife species with small home ranges, such as small mammals, reptiles, and amphibians, would remain in the exposure plume during the accident and would thus experience higher mortality rates than more mobile species. Mammals that did survive within this distance would suffer from blistering skin, respiratory system irritation, eye irritation, and other chronic effects known to occur to humans and laboratory animals (Appendix B in U.S. Army 1988).

Aquatic Habitats and Fish. The amount of GB or VX that would be deposited into aquatic habitats as the result of a lightning strike at a storage igloo would be the same as the deposition amounts that would result from a handling accident at a storage igloo (see Table 5.21-1). Aquatic habitats and fish would experience impacts the same as those discussed under the proposed action (Section 5.21.2.7).

Protected Species. The impacts on protected species from exposure to GB or VX released following an accident under the no action scenario (continued storage) would be the same as the impacts from an accident under the proposed action scenario (Section 5.21.2.7).

Wetlands. The impacts on wetland vegetation from a lightning strike at a storage igloo under no action (continued storage) would be the same as those from a handling accident at a storage igloo under the proposed action (Section 5.21.2.7).

5.21.3.8 Cultural Resources

Potential impacts on cultural resources associated with accident scenarios under the no action alternative would be the same as those discussed under the proposed action (Section 5.21.2.8). Appendix F discusses historic properties that could be affected by the modeled accidents under the no action alternative.

5.21.3.9 Socioeconomics

Potential impacts on socioeconomics associated with the accident scenarios under the no action alternative would be the same as those discussed under the proposed action (Section 5.21.2.9).

5.21.3.10 Environmental Justice

Potential impacts on environmental justice associated with the accident scenarios under the no action alternative would be the same as those discussed under the proposed action (Section 5.21.2.10).

5.22 CUMULATIVE IMPACTS

Cumulative impacts would result from adding the incremental impacts of the proposed action to other past, present, and reasonably foreseeable future actions. "Reasonably foreseeable future actions" are considered to be (1) actions that are covered in an environmental impact document that was either published or in preparation, (2) formal actions such as initiating an application for zoning approval or a permit, or (3) actions for which some funding has already been secured. Cumulative impacts could result from actions occurring at the same time or from actions occurring over a period of time.

Depending on the technology chosen, an ACWA pilot test facility would take up to 34 months to construct and would operate for up to about 36 months. This short operational time reduces the potential for cumulative impacts.

This cumulative impact analysis does not cover areas in which the proposed action and other reasonably foreseeable future actions would have no impacts or only localized impacts. Thus, the following areas were not analyzed for cumulative impacts:

- Geological resources,
- Cultural resources, and
- Communications infrastructure.

In addition, cumulative impacts were not assessed for accidents. Accidents are low-probability events whose exact nature and time of occurrence cannot reasonably be foreseen. Although their impacts may be large, these impacts cannot be added in a reasonably predictable manner to the impacts of other reasonably foreseeable future actions.

The analyses in this EIS were based on the assumption that a single, full-scale ACWA pilot test facility would be built. If two or more ACWA pilot test facilities would be built, they would share common facilities, and each one would be smaller than the full-scale pilot facility. Collectively, they would be similar in size to a full-scale pilot test facility, and their impacts together would reasonably be bounded by the impacts of the full-scale pilot and incinerator. The impacts of two ACWA pilot test facilities and/or an increase in weapons throughput would be reasonably bounded by the impacts of the full-scale pilot and incinerator. Thus, this cumulative impact analysis should represent the impacts from either one or two ACWA pilot test facilities.

Government and private organizations were contacted to identify reasonably foreseeable on-post and off-post actions for inclusion in this cumulative impact analysis. Organizations contacted included the following:

- Pine Bluff Arsenal;
- Southeast Arkansas Economic Development District;

- Entergy Arkansas;
- Reliant Energy;
- Arkansas Highway and Transportation Department;
- Arkansas Department of Environmental Quality, Air Quality Division, Permit Branch;
- Arkansas Department of Environmental Quality, Hazardous Waste Division, Active Site Branch;
- Southeast Arkansas Regional Planning;
- Economic Development Alliance of Jefferson County; and
- Arkansas Electric Cooperative.

5.22.1 Other Reasonably Foreseeable Future Actions

The impacts of past and present actions are included in the discussions of the affected environment. They are summarized here, when needed, in the corresponding discussions of cumulative impacts.

5.22.1.1 On-Post Actions

Some on-post actions have already been included in the proposed action as defined and analyzed in this document. These actions include building an access road to the ACWA pilot test facility. Actions included in the cumulative impact analysis include:

- Constructing and operating new facilities, including the conventional weapons SCWO and the new scrubber for the fluidized-bed incinerator, and
- Transferring land from PBA to another owner.

The impacts of these actions were assessed on the basis of information collected in discussions with post personnel (Smith 2001).

Other potential chemical demilitarization actions would be the operation of the PBCDF for demilitarization of stockpile munitions and the construction and operation of the nonstockpile SCWO. The PBCDF is under construction at PBA. A NEPA analysis has been completed for the PBCDF (U.S. Army 1997). Cumulative impacts for the ACWA proposed action are assessed on the basis of the assumption that there would be an operating PBCDF.

5.22.1.2 Off-Post Actions

The reasonably foreseeable off-post actions have been identified broadly as highway construction, housing development, and some light industrial expansion. Pine Bluff Energy has applied for a permit for a 250-MW electric turbine. This project was the only major industrial facility identified. Even though a permit has been applied for, future development of the project is unclear, and its impacts were not considered in this EIS (Smith 2001).

5.22.2 Land Use

PBA is in an area of interspersed agricultural land, woodland, industrial property, and built-up communities. Nearby federal lands are used by the Food and Drug Administration. Past and present land use on PBA itself has been primarily for industrial and related purposes associated with munitions production, storage, maintenance, testing, and disposal. Land use on the installation has also included administrative, residential, and recreational uses. The post covers about 15,000 acres (6,000 ha), of which about 8,700 acres (3,500 ha) is classified as forest. About 5,300 acres (2,200 ha) have been developed (Section 5.2).

About 1,500 acres (610 ha) of land at PBA has been transferred to another organization. Some temporary restrictions have been placed on the use of this land, since parts of it lie within the 1% lethality arcs and quantity-distance arcs of PBA facilities (Smith 2001).

An ACWA pilot test facility would have negligible effects on both on- and off-post land use (Section 5.2). The PBCDF is being constructed in a location consistent with current land use. The U.S. Army (1997) found no significant land use impacts from the PBCDF.

Depending on the site chosen, construction of an ACWA pilot test facility would disturb up to 37 acres (15 ha) of land — 25 acres (10 ha) for the site construction and 12 acres (5 ha) for utilities and access roads —in addition to the 45 acres (18 ha) of previously disturbed land affected by construction of the PBCDF. The two facilities together would disturb about 0.5% of the area of PBA. Use of Area A or Area B for an ACWA pilot test facility would be consistent with current and anticipated land use and would generate no significant impacts on on-post or off-post land use (Section 5.2). Construction of other on-post projects, including the nonstockpile SCWO and the conventional weapons SCWO, would disturb additional land and would follow current land use patterns. Cumulative land use impacts from an ACWA pilot test facility, the PBCDF, and other reasonably foreseeable on-post actions would not be significant.

Housing and commercial development is occurring near Whitehall (Smith 2001). These and other anticipated activities in the vicinity of PBA would not contribute cumulatively to significant adverse land use impacts when aggregated with impacts from on-post activities.

5.22.3 Infrastructure

Construction of the PBCDF should be completed before construction of the ACWA pilot test facility begins. This analysis assumes that construction and operation of the ACWA pilot test facility would overlap operation of the PBCDF.

Table 5.22-1 presents the expected utility demands for a baseline incinerator at PBA.

5.22.3.1 Electric Power Supply

Currently, PBA consumes about 27 GWh of electric power annually. Depending on the technology chosen, an ACWA pilot test facility could require up to 120 GWh of electric power annually (Table 5.3-2). The PBCDF would require another 33 GWh (Table 5.22-1). New power lines and service connections would be needed to supply the electric power needs of an ACWA pilot test facility. Other reasonably foreseeable on-post actions would require additional electric power and supply infrastructure. New off-post actions, including residential and commercial development, would add to the need for power from the utility. Discussions with local planners indicated no current or foreseen problems with electric supplies in the vicinity of PBA (Smith 2001).

TABLE 5.22-1 Estimated Annual Utility Demands for a Baseline Incinerator at PBA

Utility	Annual Demand
Electric power (GWh)	33
Natural gas (scf)	1,400,000,000
Process water (gal)	47,000,000
Potable water (gal)	5,500,000
Sewage produced (gal)	7,500,000

Source: Folga (2001).

5.22.3.2 Natural Gas Supply

The natural gas needs of an ACWA pilot test facility would be met by a gas line from the Binary Production Facilities as long as additional gas pipelines were added (Section 5.3.2). Additional new on-post facilities would require additional pipelines.

Reliant Energy has sufficient capacity to meet current and projected natural gas needs at PBA (Section 5.3.2). Current natural gas use at PBA is approximately 451 million scf (13 million m^3) annually. Depending on the technology chosen, an ACWA pilot test facility would require up to 140 million scf (4 million m^3) of natural gas annually (Table 5.3-2), and the PBCDF would require about an additional 1.4 billion scf (40 million m^3) annually (Table 5.22-1). Together, these two facilities would increase current natural gas consumption at PBA by about 340% during their temporary operating period while still supplying existing on-post use. Other reasonably foreseeable on-post actions would require additional natural gas. Overall, this use would represent a significant increase in the consumption of natural gas at PBA. New off-post actions, including residential and commercial development, would add to the gas required from the supplier. However, no problems are foreseen with natural gas supplies in the region around PBA (Smith 2001). Reliant Energy has reserves of around 710 billion scf (20 billion m^3) of natural gas, and discussions with local planners indicated no current or foreseen problems supplying natural gas in the vicinity of PBA (U.S. Army 1997; Smith 2001).

5.22.3.3 Water (Supply and Sewage Treatment)

No impacts on the water supply and infrastructure off post would occur, because these systems are self-contained at PBA.

Water for use at PBA is supplied by 12 on-post wells. Current water usage is approximately 320 million gal/yr (1.2 million m^3/yr). New water distribution pipelines and sewage pipelines, in addition to those supplying the PBCDF, would be needed for an ACWA pilot test facility. Part of this need could be supplied by existing lines built for the Binary Production Facilities. A new water storage tank for fire fighting and emergency needs would be needed for an ACWA pilot test facility. Additional new pipelines would also be needed for other reasonably foreseeable on-post facilities.

Water supply at PBA is sufficient to meet the needs of an ACWA pilot test facility and the PBCDF if they operated simultaneously (Section 5.3.3). Depending on the ACWA technology chosen, operation of an ACWA pilot test facility would require up to 24 million gal/yr (92,000 m^3/yr) of water, more than the amount that would be required during construction (Table 5.3-2). Operating the PBCDF, the new scrubber on the fluidized-bed incinerator, and the conventional weapons SCWO would require an additional 65 million gal/yr (246,000 m^3/yr) (Smith 2001; Table 5.22-1). Together with use by an ACWA pilot test facility, these actions would represent an increase of up to 28% over current water use at PBA and an increase of about 0.49% over current withdrawals in the vicinity of PBA. The nonstockpile

SCWO would process, at most, six weapons per day and would use only minor quantities of water. In view of the large PBA supply capacity, cumulative impacts on the water supply should not be significant.

Sewage treatment capacity would be sufficient to meet the needs of both an ACWA pilot test facility and the PBCDF. Currently, PBA discharges about 73 million gal/yr (280,000 m^3/yr) of sewage (Smith 2001). An ACWA pilot test facility and the PBCDF together would discharge about 15 million gal/yr (57,000 m^3/yr), less than 21% of the amount currently discharged (see Section 5.3) (Table 5.22-1). The total discharge would be less than the 430 million gal/yr (1.6 million m^3/yr) that PBA could treat. The conventional weapons SCWO and the new scrubber on the fluidized-bed incinerator have been included in existing plans. No adverse cumulative impacts to sewage treatment capacity should result from these and other reasonably foreseeable future actions at PBA.

5.22.4 Waste Management

Cumulative impact on waste management systems from construction and operation of an ACWA pilot test facility with concurrent operation of the PBCDF and other reasonably foreseeable actions would be minimal. Discussions with local planners indicated that current off-post hazardous and nonhazardous waste disposal capacities appear adequate (Smith 2001).

Hazardous wastes are transferred to the hazardous waste storage facility and shipped off post to permitted treatment and disposal facilities. PBA currently has a permitted hazardous waste landfill for disposal of remedial action wastes. In 1999, PBA generated 66 tons (59,000 kg) of hazardous wastes (Table 5.4-1). Nonhazardous wastes were disposed of off post or recycled. In 1999, PBA generated 7.8 million lb (3.6 million kg) of nonhazardous wastes. Sanitary wastes are treated in the on-post sewage treatment plant.

The quantities of construction wastes generated by an ACWA pilot test facility (Table 5.4-2) and other on-post actions would be small and would have minimal impacts on waste management systems. Depending on the ACWA technology chosen, operating an ACWA pilot test facility and the PBCDF could produce up to 6,500 tons (5,900,000 kg) of hazardous wastes annually, an increase of about 9,400% in the amount produced by PBA in 1999. Operating an ACWA pilot test facility and the PBCDF would produce amounts of hazardous and nonhazardous wastes that, while representing a substantial increase in amounts currently generated by PBA, would have a minimal impact in the vicinity of PBA (see Tables 5.4-3 and 5.4-4) (U.S. Army 1997). The U.S. Army (1997) found no significant impacts on waste management systems from operation of the PBCDF. The total stockpile of munitions to be demilitarized is fixed. If both an ACWA pilot test facility and the PBCDF were operated, fewer munitions would be demilitarized in each, and fewer wastes would be produced by each, than if a single facility was operated alone to process the entire stockpile. Either facility alone would produce a minimal amount of wastes. Together, they would produce wastes that, even when added to other reasonably foreseeable wastes, would have a minimal impact on waste management systems. The PBCDF would also produce brine salts, for which the ultimate disposal requirements are currently unclear (Section 5.4).

Sewage treatment capacity would be sufficient to meet the needs of both an ACWA pilot test facility and the PBCDF. Currently, PBA discharges about 73 million gal/yr (280,000 m^3/yr) of sewage (Smith 2001). An ACWA pilot test facility and the PBCDF together would discharge about 15 million gal/yr (57,000 m^3/yr), less than 21% of the amount currently discharged (see Section 5.3) (Table 5.22-1). The total discharge would be less than the 430 million gal/yr (1.6 million m^3/yr) that PBA could treat. The conventional weapons SCWO and the new scrubber on the fluidized-bed incinerator have been included in existing plans. No adverse cumulative impacts to sewage treatment capacity should result from these and other reasonably foreseeable future actions at PBA.

5.22.5 Air Quality

Emissions of toxic and hazardous air pollutants are of interest primarily with regard to their potential impacts on human health or biological resources. Sections 5.22.6 and 5.22.12 discuss potential cumulative impacts for these impact areas. This analysis assumes that the PBCDF would be operating during construction and operation of an ACWA pilot test facility.

5.22.5.1 Impacts of Construction

PM_{10} and $PM_{2.5}$ from fugitive emissions are the pollutants of principal concern during construction. Emissions of pollutants from worker and delivery vehicles, construction equipment, fuel storage, and refueling operations would be small, and off-post concentrations would not exceed NAAQS levels.

Table 5.22-2 summarizes the maximum ambient particulate concentrations, including the background concentration, from construction of an ACWA pilot test facility and operation of the PBCDF. Except for annual $PM_{2.5}$ concentrations, these concentrations are, at most, 84% of the NAAQS levels. The annual $PM_{2.5}$ level — when the particulate concentrations from the background level (93% of the NAAQS level), the operation of the PBCDF (2.7% of the NAAQS level), and the construction of an ACWA pilot test facility (3.5% of the NAAQS level) are accounted for — would exceed 99% of the NAAQS level. (Background levels in Arkansas tend to be near or above the annual $PM_{2.5}$ NAAQS level.) Other reasonably foreseeable on-post and off-post actions that emit particulates would contribute small or temporary concentrations to this level and would raise the cumulative annual $PM_{2.5}$ concentrations during the temporary period of ACWA pilot test facility construction activities.

TABLE 5.22-2 Air Quality Impacts from Construction of an ACWA Pilot Test Facility and Operation of the PBCDF at PBA[a]

		Concentration (μg/m^3)				
Pollutant	Averaging Time	Maximum Increment[b]	Background	Total	NAAQS	Percentage of NAAQS[c]
PM_{10}	24 hours	48	78	126	150	84 (32)
	Annual	1.5	26	28	50	56 (3.0)
$PM_{2.5}$	24 hours	25.4	29	55	65	84 (39)
	Annual	0.93	14.0	14.9	15	99.5 (6.2)

[a] See Section 5.5 for details on background and modeling.

[b] The maximum increment is the sum of the increment for the ACWA pilot test facility plus the increment for the PBCDF. The ACWA pilot test facility increment is based on Table 5.5-7. PBCDF PM_{10} impacts are based on U.S. Army (1997). PBCDF $PM_{2.5}$ impacts are assumed to be 100% of PM_{10} impacts during operation.

[c] Values are based on total concentration, including the background concentration and maximum increment, from simultaneous construction of an ACWA pilot test facility and operation of the PBCDF. Values in parentheses are based on the increment due to the two facilities alone without the background concentration.

5.22.5.2 Impacts of Operations

Table 5.22-3 summarizes the maximum ambient concentrations, including the background concentration, from concurrent operation of an ACWA pilot test facility and the PBCDF. Except for annual $PM_{2.5}$ concentrations, these concentrations are, at most, 56% of the NAAQS levels. The annual $PM_{2.5}$ level — when the background level (93% of the NAAQS level), operation of the PBCDF (2.7% of the NAAQS level), and operation of an ACWA pilot test facility (0.13% of the NAAQS level) are considered — would be more than 96% of the NAAQS level. (Background levels in Arkansas tend to be near or above the annual $PM_{2.5}$ NAAQS level.) Other reasonably foreseeable on-post and off-post actions that emit particulates would contribute small or temporary concentrations to this level and would raise the cumulative annual $PM_{2.5}$ concentrations during operation of an ACWA pilot test facility.

TABLE 5.22-3 Air Quality Impacts from Operation of an ACWA Pilot Test Facility and the PBCDF at PBA

		Concentration ($\mu g/m^3$)				
Pollutant	Averaging Time	Maximum Increment[a]	Background	Total	NAAQS	Percentage of NAAQS[b]
SO_2	3 hours	24	78	102	1300	7.8 (1.8)
	24 hours	7.2	29	36	365	9.9 (2.0)
	Annual	0.52	5.3	5.8	80	7.3 (0.65)
NO_2	Annual	3.4	21	24	100	24.3 (3.4)
CO	1 hour	91[c]	19,400	19,500	40,000	49 (0.23)
	8 hours	47[c]	5,300	5,380	10,000	54 (0.47)
PM_{10}	24 hours	6.7	78	85	150	56 (4.5)
	Annual	0.42	26	27	50	54 (0.84)
$PM_{2.5}$	24 hours	6.7	29	36	65	56 (10)
	Annual	0.42	14.0	14.4	15	96 (2.8)

[a] The maximum increment is the sum of the increment for an ACWA pilot test facility plus the increment for the PBCDF. The ACWA pilot test facility increment is based on the largest modeled values for any technology (Tables 5.5-8 through 5.5-10). PBCDF impacts are based on U.S. Army (1997). PBCDF $PM_{2.5}$ impacts assumed to be 100% of PM_{10} impacts during operation.

[b] Values are based on total concentration including background concentration and maximum increment, from simultaneous operation of an ACWA pilot test facility and the PBCDF. Values in parentheses are based on operation of the two facilities alone and ignore the background level.

[c] CO increment for PBCDF is from U.S. Army (1997).

5.22.6 Human Health and Safety — Routine Operations

5.22.6.1 Impacts of Construction

PM_{10} and $PM_{2.5}$ from fugitive emissions would be the pollutants of principal concern during construction. Emissions of pollutants from worker and delivery vehicles, construction equipment, fuel storage, and refueling operations would be small, and off-post concentrations would not exceed NAAQS levels.

Particulate NAAQS levels would not be exceeded off-post during construction of an ACWA pilot test facility with concurrent operation of the PBCDF (Section 5.22.5). However, even without any new actions, the current background annual $PM_{2.5}$ level is more than 93% of the NAAQS level. (Background levels in Arkansas tend to be near or above the annual $PM_{2.5}$ NAAQS level.) Concurrent construction of an ACWA pilot test facility and operation of the PBCDF would raise the maximum level to more than 99% of the NAAQS level (Table 5.22-2). Other reasonably foreseeable future actions would contribute small concentrations to this level and would temporarily raise the cumulative annual $PM_{2.5}$ concentrations during construction of an ACWA pilot test facility. Because of the preexisting high background level, the potential exists for cumulative adverse health impacts off post.

5.22.6.2 Impacts of Operations

A report by the Army's Center for Health Promotion and Preventive Medicine (USACHPPM 1997) presents the results of a human health risk analysis for the PBCDF and CIC. The fluidized-bed incinerator is in the CIC. The analysis included emission increases to account for startup, shutdown, and upsets.

Noncarcinogenic risks for operation of an ACWA pilot test facility are less than 0.7% of the levels considered to represent hazards (Table 5.7-2). USACHPPM (1997) concluded that stack emissions from the proposed PBCDF and emissions from the CIC should not adversely affect human health. All hazard indices were less than 20% of the level of 1 used in this EIS to indicate that adverse health impacts are unlikely. The new scrubber on the fluidized-bed incinerator would reduce emissions from that facility. No significant cumulative emissions impacts or health impacts are expected from the small nonstockpile SCWO or the conventional weapons SCWO. Cumulative adverse health impacts from an ACWA pilot test facility, the PBCDF, and other reasonably foreseeable on-post actions would be unlikely.

The maximum carcinogenic risk from agent processing to on-post and off-post populations associated with any ACWA pilot test facility would be 4×10^{-8}, or 2% of the 1×10^{-6} benchmark level generally considered representative of negligible risk. USACHPPM (1997) found a maximum excess cancer risk of 7×10^{-6}. If additivity for the carcinogens is assumed (a common assumption in risk assessments), the PBCDF and an ACWA pilot test facility, operating simultaneously, would represent an increased carcinogenic risk of approximately 7×10^{-6}. This total risk is in the lower end of the target range for residual carcinogenic risk of between 1×10^{-6} and 1×10^{-4} (one in 1 million to one in 10,000) used by the EPA to determine whether cleanup of hazardous waste sites is warranted (EPA 1990). This risk would still generally be considered negligible.

Risks from the maximum possible release of agent from an ACWA pilot test facility were estimated by assuming that agent could be emitted continuously from the filter farm stack at the agent detection limit of the in-stack monitor (Section 5.6). The detection limit is about 20% of the concentration allowed in the stack. Operations would be shut down if the detection limit were reached. Thus, the estimate of risk is conservative (i.e., it overestimates risk). The maximum estimated risk from ACWA pilot test facility emissions would be 0.03% of the maximum allowable level recommended by the CDC (Table 5.6-4). U.S. Army (1997) estimates the maximum risk from the PBCDF conservatively and assumes that emissions are at the allowable level. This EIS assumes lower emissions are at the detection limit. By adjusting the Army's results for lower emissions to put them at the detection limit, the maximum risk from the baseline incinerator would be 2.0% of the maximum allowable level recommended by the CDC. If an ACWA pilot test facility and a baseline incinerator were operating concurrently, the worst case would have agent levels equal to 2.03% of the allowable level. However, it is unlikely that such levels would be reached under routine operating conditions, because the two plant stacks would be at different locations, which would lead to lower maximum air concentrations than if all emissions were from one stack. Also, the assumption of continuous agent release at the detection limit (Section 5.6) is very conservative and results in overestimates of possible agent releases.

Only annual $PM_{2.5}$ concentrations would exceed 56% of the corresponding NAAQS levels during concurrent operation of an ACWA pilot test facility and the PBCDF (Table 5.22-3). Even without any new actions, the current background annual $PM_{2.5}$ level is at 93% of the NAAQS level. (Background levels in Arkansas tend to be near or above the annual $PM_{2.5}$ NAAQS level.) Concurrent operation of an ACWA pilot test facility and the PBCDF would raise the maximum level to about 96% of the NAAQS level. Other reasonably foreseeable future actions would contribute small concentrations to this level and raise the cumulative annual $PM_{2.5}$ concentrations during operation of the ACWA pilot test facility. Because of the preexisting high background level, the $PM_{2.5}$ level could be close to the standard during operation.

5.22.7 Noise

Measurements of noise levels around PBA were not available. Existing levels should be typical of rural areas, 30 to 35 dBA, except near the western boundary, where highway and traffic could raise background noise levels to the 40 to 45 dBA range. The maximum noise level from construction and routine operation of an ACWA pilot test facility would be less than 50 dBA at the nearest PBA boundary, to the southwest of Area A (Section 5.8). This level is less than EPA's guideline of 55 dBA for protection against annoyance and interference with outdoor activities. The U.S. Army (1997) found minimal impact from operation of the PBCDF at the nearest residence located east of the post. The PBCDF is located more than 1.5 mi (2.4 km) from the closest potential area for an ACWA facility. No perceptible cumulative noise impacts from these two facilities would be expected at off-post locations. Noise from a nonstockpile SCWO in Area C could add to noise from an ACWA pilot test facility. The increase would be far less than the barely perceptible level of 3 dBA, and the cumulative noise level would be less than EPA's 55-dBA guideline. Other reasonably foreseeable on-post actions would be sufficiently distant from the ACWA pilot test facility to preclude significant noise interactions. Thus, no significant off-post impacts on noise would be expected from an ACWA pilot test facility, the PBCDF, and other reasonably foreseeable on-post and off-post actions.

5.22.8 Visual Resources

PBA is located in an area of interspersed agricultural land, woodland, industrial properties, and built-up communities. Heavy vegetation and gently rolling hills restrict viewing distances on post. Much of PBA itself is of military and industrial character (Section 5.9).

Current actions and reasonably foreseeable on-post actions are in keeping with the existing visual environment of PBA. The areas proposed for an ACWA pilot test facility would not be visible from the perimeter fence. Traffic and dust during construction of an ACWA pilot test facility and other on-post facilities would affect the visual character of PBA but would be intermittent and temporary. During operations, a small steam plume from the ACWA pilot test facility would be visible. This plume would add to the visual impact of the large steam plume from the PBCDF. Any plumes associated with other reasonably foreseeable on-post facilities would also be small. The cumulative visual impact would remain in keeping with the visual character of PBA and would not be significant.

5.22.9 Soils

With the exception of the area of potential soil contamination resulting from deposition of air emissions released during operations, the analysis area for cumulative impacts on soils was limited to the immediate vicinity of the areas for the proposed ACWA facility. Activities disturbing soils have very localized impacts and hence little chance for cumulative impacts.

Construction of the PBCDF affected about 45 acres (18 ha) of previously disturbed soils. Construction of an ACWA pilot test facility in either Area A or Area B would disturb 25 acres (10 ha) of largely undisturbed soils and up to an additional 12 acres (4.8 ha) for development of the associated infrastructure.

Future construction actions not associated with an ACWA pilot test facility could contribute to soil erosion and accidental spills and releases. These impacts would be the same types of impacts as those associated with construction of an ACWA pilot test facility. The impacts would be temporary and minor if best management practices noted in Section 5.10.3 were followed. Overall, cumulative impacts from construction on soils should be negligible.

No significant cumulative impacts on surface soils would be expected from routine operation of an ACWA pilot test facility and other identified on-post and off-post actions, including routine operation of the PBCDF. Because of its low emissions, the ACWA pilot test facility should have no significant deposition impacts (Section 5.10.3). The emissions from the PBCDF would also be low (U.S. Army 1997). Other reasonably foreseeable on-post and off-post actions would be sufficiently far away or have sufficiently small emissions to preclude significant cumulative deposition at PBA. Thus, cumulative impacts on soils through deposition would be negligible.

5.22.10 Groundwater

All water used at PBA is withdrawn from the Sparta Aquifer. Past and current pumping of the aquifer has caused a water table decline of up to 160 ft (46 m) in the Pine Bluff area. Past operations at PBA have led to groundwater contamination in the Quaternary Aquifer and possibly the Cockfield-Jackson Aquifer. The contaminant sources have been removed, and a monitoring program is in place (Section 5.11.1).

To avoid contaminating groundwater, best management practices for avoiding leaks and spills during refueling and maintenance should be followed during construction of the ACWA pilot test facility and other on-post actions.

As indicated in Section 5.22.3.3, current water use at PBA is 320 million gal/yr (1.2 million m^3/yr). The city of Pine Bluff and local industry withdraw an additional 18 billion gal/yr (69 million m^3/yr) (Section 5.11.1). Depending on the ACWA technology chosen, operation of an ACWA pilot test facility would require up to 24 million gal/yr (92,000 m^3/yr) of water, more than the amount that would be required during construction (Table 5.3-2). Operating the PBCDF, the new scrubber on the fluidized-bed incinerator, and the conventional weapons SCWO would require an additional 65 million gal/yr (246,000 m^3/yr) (Smith 2001; Table 5.22-1). Together with an ACWA pilot test facility, these actions would represent an increase of up to 28% over current water use at PBA and an increase of about 0.49% over current withdrawals in the vicinity of PBA. The on-post wells could supply the increased need. Additional drawdown in the Sparta Aquifer during operation of an ACWA pilot test facility and the PBCDF would not be significant and would end when the facilities ceased operations. After that, groundwater levels would rebound. The nonstockpile SCWO would process, at most, six weapons per day and would use minor quantities of water. Other on-post and off-post actions would increase the total withdrawals and increase the decline in the water table. In view of the large groundwater supply capacity at PBA, cumulative impacts on groundwater supplies and flows should not be significant.

During routine operations of an ACWA pilot test facility and the PBCDF, all liquid process wastes would be recycled, and no process wastewater would be discharged (see Section 5.11) (U.S. Army 1997). Hence, no cumulative impacts involving discharges from these facilities would be expected on groundwater.

Although no data were available to account for the water supply needs for off-post actions, local planners indicated in discussions that water supplies in the vicinity of PBA are expected to be adequate to meet all needs (Smith 2001).

5.22.11 Surface Water

Some of the surface waters at PBA were contaminated by past production activities at the post. Pollution control equipment was installed in the 1980s, and long-term monitoring has indicated that surface water quality is improving. Surface water contamination from current activities has not been noted (Section 5.12). Groundwater, not surface water, is used for potable water supply by PBA and in Jefferson County.

To avoid contaminating surface waters, best management practices for avoiding leaks and spills during refueling and maintenance should be followed during construction of the ACWA pilot test facility and other on-post facilities. During routine operations of an ACWA pilot test facility and the PBCDF, all liquid process wastes would be recycled, and none would be discharged (see Section 5.12 and U.S. Army 1997). Hence, no cumulative impacts involving discharges from these facilities would be expected on surface waters. Process water from other reasonably foreseeable on-post actions would be treated before being discharged under the post's NPDES permit.

Sanitary sewage would be treated in the on-post treatment plant. An ACWA pilot test facility and the PBCDF together would discharge about 15 million gal/yr (57,000 m^3/yr), less than 21% of the amount currently discharged (see Section 5.3) (Table 5.22-1). Other reasonably foreseeable on-post facilities would discharge additional minor amounts of sewage. The cumulative additional discharge should not affect surface water flows on PBA or in the vicinity.

5.22.12 Biological Resources

5.22.12.1 Terrestrial Habitats and Vegetation

PBA covers about 15,000 acres (6,000 ha), of which more than 8,700 acres (3,500 ha) is classified as forest (Section 5.13.1). Both Area A and Area B are largely undisturbed and located in upland areas; the site of the PBCDF was previously disturbed. Area A is located in a dense hardwood/pine forest community. Area B is located in a grassland savanna community. Section 5.13 describes the potential impacts on vegetation and wildlife that might result from disturbing up to 37 acres (15 ha) of land, a small fraction of the 9,000 acres (3,500 ha) of forest at PBA, while constructing an ACWA pilot test facility and its associated infrastructure. Disturbance of this land would add to the 45 acres (18 ha) already disturbed during construction of the PBCDF (U.S. Army 1997). Construction of other on-post facilities would increase vegetation loss as sites were cleared. The conventional weapons SCWO would be located in the manufacturing area in the southern portion of the post, and constructing that facility would be unlikely to contribute to significant loss of vegetation. Building the nonstockpile SCWO in Area C would add to the overall vegetation loss. Use of standard erosion and runoff controls would mitigate impacts on vegetation due to sedimentation and erosion.

A screening-level ecological risk assessment for soils found that air emissions from routine operation of an ACWA pilot test facility would have negligible impacts on terrestrial habitats and vegetation (Section 5.13). The U.S. Army (1997) found that deposition from operation of the PBCDF would not affect significantly terrestrial biota in the vicinity of PBA. In addition, the total stockpile to be demilitarized is fixed; if both the ACWA pilot test facility and the PBCDF were operated, fewer munitions would be demilitarized in an ACWA pilot test facility, reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions and their distance from the ACWA pilot test facility, cumulative impacts on terrestrial habitats and vegetation from an ACWA pilot test facility, the PBCDF, and other potential facilities should be negligible during routine operations.

Impacts on terrestrial habitats and vegetation associated with reasonably foreseeable off-post activities would be related to the size of the developments and the land occupied. These impacts could not be determined accurately but are expected to be minor.

5.22.12.2 Wildlife

Both Area A and Area B are largely undisturbed and located in upland areas; the site of the PBCDF was previously disturbed. Area A is located in a dense hardwood/pine forest community. Area B is located in a grassland savanna community. Section 5.14 describes the impacts on wildlife that might result from disturbing up to 37 acres (15 ha) of land, a small fraction of the 9,000 acres (3,500 ha) of forest at PBA, while constructing an ACWA pilot test facility and its associated infrastructure. Loss of this amount of potential habitat at Area A or

Area B should not eliminate any wildlife species from PBA (Section 5.14). Disturbance of this land would add to the 45 acres (18 ha) already disturbed during construction of the PBCDF (U.S. Army 1997). Construction of other on-post facilities would increase habitat loss as areas were cleared. The conventional weapons SCWO would be located in the manufacturing area in the southern portion of the post, and constructing it would be unlikely to cause significant loss of habitat. Building the nonstockpile SCWO in Area C would add to the overall habitat loss.

Each new, on-post construction activity would also affect wildlife by increasing human activity and construction traffic. Cumulatively, these increases would cause additional deaths among less mobile species and displace additional wildlife during the construction period. Increased noise would displace additional small mammals and potentially lead to increased habitat abandonment by songbirds.

A screening-level ecological risk assessment for soils found that air emissions from routine operation of an ACWA pilot test facility would have negligible impacts on wildlife (Section 5.14). The U.S. Army (1997) found that deposition from operation of the PBCDF would not affect terrestrial biota in the vicinity of PBA significantly and that inhalation would not be a significant exposure pathway. In addition, the total stockpile to be demilitarized is fixed; if both the ACWA pilot test facility and the PBCDF were operated, fewer munitions would be demilitarized in an ACWA pilot test facility, reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions and their distance from the ACWA pilot test facility, cumulative impacts on wildlife from an ACWA pilot test facility, the PBCDF, and other potential facilities should be negligible during routine operations.

Operation of an ACWA pilot test facility, the PBCDF, and other possible on-post facilities would increase the number of workers worker and deliveries. Roadkills would increase as a result of the consequent increase in traffic.

Given the distance of other reasonably foreseeable on-post actions from the potential areas for an ACWA pilot test facility and the small size of these projects, additive noise impacts would be negligible. Overall noise impacts would be the same as those associated with each action considered by itself.

Impacts on wildlife associated with reasonably foreseeable off-post actions would depend on the size of the developments and the land occupied. These impacts could not be determined accurately but are expected to be minor.

5.22.12.3 Aquatic Habitats and Fish

Aquatic habitats and fish would not be likely to be affected during construction of an ACWA pilot test facility and other reasonably foreseeable on-post facilities if runoff and siltation control measures were employed. Any impacts would add to those already caused by construction of the PBCDF. Avoiding construction activities along the tributaries of Triplett Creek in Area B would lessen the potential for downstream impacts on aquatic biota (Section 5.15).

During routine operations, air emissions and deposition from an ACWA pilot test facility would be small and would not affect aquatic habitats and fish adversely (Section 5.15). The U.S. Army (1997) found that routine operation of the PBCDF would have little or no potential for negative impacts on aquatic biota in the vicinity of PBA. In addition, the total stockpile to be demilitarized is fixed; if both the ACWA facility and the PBCDF were operated, fewer munitions would be demilitarized in an ACWA pilot test facility, thus reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions and their distance from potential sites for an ACWA pilot test facility, cumulative impacts on aquatic habitats and fish from an ACWA pilot test facility, the PBCDF, and other potential facilities would be negligible during routine operations.

5.22.12.4 Protected Species

No federally listed species are known to occur at PBA (Section 5.16). The U.S. Army (1997) found little or no potential for negative impacts on protected species from routine operation of the PBCDF. Off-post impacts on protected species from the low emissions and deposition from an ACWA pilot test facility, the PBCDF, and other reasonably foreseeable on-post actions would be negligible.

5.22.12.5 Wetlands

Both Area A and Area B contain wetlands that could be eliminated or otherwise adversely affected by construction of an ACWA pilot test facility (Section 5.17). Construction in Area A could eliminate a 0.4-acre (0.2-ha) palustrine emergent wetland that is temporarily flooded and represents about 0.3% of the emergent wetland type on PBA. Construction in Area B could eliminate two wetlands that make up 1.2 acres (0.5 ha) of palustrine forested wetlands that are temporarily flooded and represent about 0.15% of forested wetlands on PBA. There are no bodies of water or streams adjacent to the site of the PBCDF. Construction of utility corridors and uncontrolled runoff from the areas could adversely affect downstream wetlands, and about 0.04 acre (0.02 ha) of a 0.9-acre (0.4-ha) scrub/shrub temporarily flooded wetland could be eliminated by filling during construction of the access road to Area B. Wetlands are also located in Area C, in which the conventional weapons SCWO will be built, but the potential for impacts from that action was not assessed in this EIS. Avoidance of wetlands or the use of standard practices for controlling runoff, sedimentation, and erosion for all on-post construction projects would lessen the potential for wetland impacts.

Routine operation of an ACWA pilot test facility and the PBCDF would have negligible impacts on wetlands (Section 5.17 and U.S. Army 1997). In addition, the total stockpile to be demilitarized is fixed; if both an ACWA facility and the PBCDF were operated, fewer munitions would be demilitarized in an ACWA pilot test facility, thus reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions, cumulative impacts on wetlands from an ACWA pilot test facility, the PBCDF, and other potential on-post facilities would be negligible during routine operations.

Reasonably foreseeable future off-post actions would be too far away to affect wetlands on PBA.

5.22.13 Socioeconomics

Construction and operation of any of the ACWA technologies could produce cumulative socioeconomic impacts if construction and operational activities occurred concurrently with other existing or future activities at PBA in the four-county ROI surrounding the post.

Other reasonably foreseeable on-post actions might create additional demands on on-post utility and transportation infrastructures if they occurred concurrently with construction and operation of an ACWA pilot test facility. However, other reasonably foreseeable on-post actions would be expected to require employment of far fewer people than would any ACWA pilot test facility. In the area surrounding the post, any industrial, commercial, and residential development that might occur could also lead to cumulative impacts on local socioeconomic resources if planning for impacts was not adequate.

The cumulative socioeconomic impacts from operation of any of the ACWA technologies, together with the operation of the PBCDF and existing or planned economic development activities, would be relatively small. Construction of an ACWA pilot test facility would be expected to generate approximately 1,400 direct and indirect jobs in the ROI during the peak year, with employment during the operation of both facilities likely to be about 3,000. Operations jobs for both facilities would be filled partially by workers moving into the ROI. However, in-migration of workers would have only a minor effect on the local housing market. Project-related demand for rental housing during the peak year of construction of an ACWA facility would require approximately 1% of the vacant rental housing stock, with about 14% of vacant owner-occupied housing required during operation of both an incinerator and an ACWA facility. If current vacancy rates and housing development continue, adverse cumulative impacts on housing would not be expected to occur.

A number of local road expansion projects, including a southern bypass of Pine Bluff that is to be built from 2004 until 2007, are planned for the next five years. Employment growth is expected to occur in the ROI in the near future as a result of the construction of a number of new industrial facilities, including a cogeneration plant in Wrightsville. More specific information on the size and precise timing of all of these projects is not available. However, judging from the size of the impact from similar activities on other rural communities, even if these projects were to occur during construction and operation of an ACWA pilot test facility and the PBCDF, the potential cumulative impact of these activities, together with other reasonably foreseeable on-post actions on the local economy, local labor markets, and public and community services, would be minor.

Local labor markets would probably not be adversely affected by the construction of an ACWA pilot test facility or the concurrent operation of an ACWA pilot test facility and the PBCDF and projected off-post activities. The PBA is located in the Little Rock Metropolitan Statistical Area (MSA), in which a variety of occupations are represented and in which the unemployment level is high enough to provide workers to meet the local labor demand created by both projects.

Concurrent operation of the PBCDF, an ACWA pilot test facility, and projected off-post activities might have moderate impacts on the local transportation network. Construction of an ACWA pilot test facility would result in an additional 1,200 daily trips on SR 365/SR 104, the local road segment most heavily used by existing post employees. These trips would represent a 26% increase in annual average daily traffic. Concurrent operation of both facilities would result in an additional 1,500 daily trips, or an increase of 33% in annual average daily traffic on SR 365/SR 104.

Additional local public service employees, medical services, and teachers would be needed if the ACWA pilot test facility and PBCDF operation, together with projected off-post activities, occurred concurrently. However, given sufficient planning, local public service providers should be able cope with the additional demands on public service through increases in city, county, and school district revenue collections.

5.22.14 Environmental Justice

Environmental justice impacts would be related to socioeconomic and human health impacts. No environmental justice impacts are anticipated from construction and routine operation of an ACWA pilot test facility (Section 5.20). During the construction and routine operations of any ACWA technology at PBA, high and adverse impacts are not anticipated on either socioeconomic-related activities or human health (Sections 5.7 and 5.19). The construction and operation of an ACWA pilot test facility would add to the environmental justice impacts of a PBCDF. However, the cumulative impacts associated with construction and routine operations are not anticipated to contribute to high and adverse impacts on populations (see Sections 5.22.6 and 5.22.13). As a result, significant cumulative environmental justice impacts from construction and routine operation of an ACWA pilot test facility, the PBCDF, and other reasonably foreseeable actions are not anticipated.

5.23 AGRICULTURE

This section was prepared in response to public comment on the draft of this EIS (see Volume 2, Section 2, Part DD of this final EIS). This assessment describes agriculture near PBA and evaluates whether toxic air pollutants from pilot facility operations would impact crops and livestock. It also assesses potential agricultural losses from an accident involving release of chemical agent.

5.23.1 Current Environment

5.23.1.1 Land Use

The region of influence (ROI) used to assess impacts on agriculture consists of 10 counties located entirely or partly within an area 30 mi (50 km) around the installation. This agricultural ROI contains 4.6 million acres (1.9 million ha) of land, of which 1.6 million acres (650,000 ha) (35%) were in farms in 1997 (USDA 1999). The ROI contained 3,800 farms in 1997, with more than half operated by full-time farmers (Table 5.23-1). In the ROI counties, average farm size ranged from 148 to 823 acres (60 to 333 ha).

TABLE 5.23-1 Farms and Crop Acreage in the Agricultural Region of Influence around PBA in 1997[a]

	Land (acres) and Farms (no.)	
Farms and Land	ROI	State
Land in farms (acres)	1,614,886	14,364,955
Number of farms	3,796	45,142
Full-time farms	1,942	22,300
Average farm size (acres)	148 – 823	318
Total cropland (acres)	1,296,035	10,062,289
Harvested cropland (acres)	1,125,799	7,665,490

[a] The agricultural ROI is composed of the following counties: Arkansas, Cleveland, Dallas, Grant, Hot Spring, Jefferson, Lincoln, Lonoke, Pulaski, and Saline.

Source: USDA (1999).

5.23.1.2 Employment

Agriculture was historically only a moderately significant local source of employment in the 10-county ROI, and its importance declined during the 1990s. Farm workers and agricultural services employment totaled 7,158, contributing a little less than 3% to total employment in the region in 1999. In Jefferson County, agricultural employment accounted for about 4% of total employment (U.S. Bureau of the Census 2001a). Recent estimates of the number of migrant and seasonal farm workers indicate that about 1,700 are employed annually in the ROI. The total statewide is 16,100 (Larson 2000). Within the South Census Region in 1998, about half of such farm workers were White, 37% were Hispanic, and the remainder were Black and other racial/ethnic groups (Runyan 2000).

5.23.1.3 Production and Sales

Beans, rice, wheat, cotton, and hay are the primary crops harvested (Table 5.23-2). Cattle and poultry are the major types of livestock production. Farms in the region generated $570 million in agricultural sales in 1997, representing 17% of total agricultural sales in the state as a whole. The majority of sales (69%) consisted of crops, with a smaller contribution made by livestock (Table 5.23-3) (USDA 1999).

5.23.2 Site-Specific Factors

The only aspect of pilot facility operations that could have an impact on agriculture is the release of substances that could cause toxic effects on crops or livestock. Routine or fluctuating operations of a pilot facility or an accident could release organic or inorganic compounds, including agent or processing by-products, to the environment (see Sections 5.5 and 5.6). Atmospheric releases could result in the widespread dispersal and deposition of contaminants. Exposures might result in lethal effects, reduced growth or other limiting effects, or no observable effect.

5.23.3 Impacts of the Proposed Action

Impacts from construction and operations are discussed below. This analysis considers effects on agricultural production, employment, and sales. The impacts of no action are provided for comparison.

TABLE 5.23-2 Agricultural Production in the Agricultural Region of Influence around PBA in 1997[a]

Crops and Livestock	Crops (acres) and Livestock (no.) ROI	State
Selected crops harvested		
Beans	573,107	3,571,342
Rice	284,620	1,384,969
Wheat	170,554	763,388
Cotton	118,452	962,272
Hay	80,802	1,232,771
Sorghum	9,705	130,948
Livestock inventory		
Cattle and calves	93,879	1,770,248
Hogs and pigs	1,432[b]	858,741
Sheep and lambs	160[b]	8,284
Layers and pullets	124,841[b]	20,213,603
Broilers sold	48,285,986[b]	1,003,161,769

[a] The agricultural ROI is composed of the following counties: Arkansas, Cleveland, Dallas, Grant, Hot Spring, Jefferson, Lincoln, Lonoke, Pulaski, and Saline.

[b] ROI inventory is an underestimate due to data unavailability for some counties.

Source: USDA (1999).

5.23.3.1 Impacts of Construction

Construction impacts would be confined to the installation; therefore, no significant impacts on agriculture would be likely from facility construction activities.

5.23.3.2 Impacts of Routine Operations

During routine operations, crops and livestock in the vicinity of the pilot test facility would be exposed to atmospheric emissions from the boiler stack and process stack. All such facility emissions, including emissions of criteria pollutants, organic compounds, and trace elements, would be within applicable air quality standards (see Sections 5.5 and 5.6).

TABLE 5.23-3 Sales by Farms in the Agricultural Region of Influence around PBA in 1992 and 1997[a]

	Sales (millions of $)	
Product	1992	1997
Livestock	104.5	178.3
Harvested crops	306.4	391.4
Agricultural ROI total	410.9	569.7
State total	4,159.5	5,479.7

[a] The agricultural ROI is composed of the following counties: Arkansas, Cleveland, Dallas, Grant, Hot Spring, Jefferson, Lincoln, Lonoke, Pulaski, and Saline.

Sources: USDA (1994, 1999).

A screening-level ecological/agricultural risk assessment was conducted to assess the risk to agricultural resources from deposition of air emissions during routine operations of each of the three pilot test technologies. For this evaluation, it was assumed that all emissions were deposited on the soils within a circle defined by the distance from the proposed pilot test site to the nearest PBA installation boundary. This assumption provides an upper limit on possible deposition at off-site locations. Actual deposition of pollutants would be less than this value and would tend to decline with distance from PBA. Within this area, the deposited emissions were assumed to be completely mixed into the top 1 cm (0.5 in.) of soil. The resulting pollutant concentration was compared with the lowest soil benchmark value available from the EPA and state sources. These benchmark concentrations for soil are based on conservative ecological endpoints and sensitive toxicological effects on plants, wildlife, and soil invertebrates. Soil chemical concentrations that fall below the benchmark are considered to have negligible risk. Those chemicals that exceed the benchmark values are considered to be contaminants of concern and would be evaluated in further detail. The only chemical emitted by a pilot test facility that, when deposited on soils, would exceed the soil benchmark values was chloroform from Neut/GPCR/TW-SCWO pilot testing, which exceeded its benchmark by a factor of seven. However, because of its volatility and low solubility in water, it is unlikely that chloroform would be deposited on soil to the extent assumed in the analysis. It would be more likely to volatilize and be dispersed. Potential inhalation exposures from chloroform gas would be at levels thousands of times lower than levels at which effects have been induced in laboratory animals. The analysis indicates that the risks of impacts on agriculture from maximum concentrations of emissions from operations would be negligible (Tsao 2001c). Off-site concentrations would be substantially lower due to the effect of emission dilution over a larger area.

Most of the toxic air pollutants emitted by a pilot test facility (Section 5.6) would be from the boiler stack, a source type commonly found in any combustion facility that requires fuel to heat up the system. Boiler emissions would be followed in quantity by the emissions from the emergency diesel generator, which would operate only in case of power failure. The technology-specific emissions would contribute very little to the overall deposition of metals and organics onto soil. There is no evidence that deposited residuals from agent emitted due to fluctuating operations would bioaccumulate through the food chain (USACHPPM 1999b).

5.23.3.3 Impacts of Accidents

Section 5.21 describes potential accidents for both the proposed action and no action, including a catastrophic event that would release agent to surrounding land areas. Although extremely unlikely, release of agent might affect a major portion of the ROI. The largest impact of an accident on agriculture would result if all of the crops and livestock produced in a single season in the ROI were interdicted (either by federal or state authorities) and removed from the marketplace. The impacts from such losses in agricultural output on the economy of the counties within the 30-mi (50-km) radius surrounding BGAD would be significant. Table 5.23-4 presents three scenarios of regional losses of employment and income associated with 50, 75, or 100% loss of agricultural production (see Appendix G). These scenarios are presented for each of the pilot test technologies and for no action. The estimated losses do not include the losses that would occur in the case of death of breeding stocks of animals. Because scenarios involving widespread agent release were identified for both the proposed action and no action, the magnitude of such losses is unlikely to differ between the proposed action and no action.

5.23.4 Impacts of No Action

5.23.4.1 Impacts of Routine Operations

The agricultural impacts of continuing routine operations at PBA would be negligible and as included in baseline conditions for the PBA region.

5.23.4.2 Impacts of Accidents

Potential impacts on agriculture associated with the accident scenarios under the no action alternative would be the same as those discussed under the proposed action alternatives (Section 5.23.3.3).

TABLE 5.23-4 Agricultural Impacts of Accidents at PBA Associated with the Proposed Action and No Action[a]

Parameter	Neut/ SCWO	Neut/ GPCR/ TW-SCWO	Elchem Ox	No Action
Impacts to the regional economy from a one-year loss of agricultural output				
100% loss of agricultural output				
Employment (no. of jobs)	23,900	23,900	23,900	23,900
Income (millions of $)	1,030	1,030	1,030	1,030
75% loss of agricultural output				
Employment (no. of jobs)	17,900	17,900	17,900	17,900
Income (millions of $)	770	770	770	770
50% loss of agricultural output				
Employment (no. of jobs)	11,900	11,900	11,900	11,900
Income (millions of $)	510	510	510	510

[a] Impacts for no action and the proposed action are presented for the first year of operation of an ACWA facility (2009).

5.24 OTHER IMPACTS

5.24.1 Unavoidable Adverse Impacts

Most potential adverse impacts identified in this EIS would either be negligible or could be avoided through careful facility siting and adherence to best management practices during the construction and operation of industrial facilities. However, some minor to moderate unavoidable adverse impacts could result from implementation of an ACWA technology. These are described in this section.

ACWA facility construction activities, including land clearing and moving of personnel and equipment in the construction staging area(s), would require disturbance of as much as 25 acres (10 ha) and could result in unavoidable adverse impacts comparable to those that would occur at any construction site of similar size. Depending on the construction area chosen, an additional 5 to 12 acres (2 to 5 ha) could be disturbed during utility and access road construction.

- As much as 37 acres (15 ha) of vegetative and terrestrial habitats could be disturbed. Cleared lands would include dense hardwood/pine forest community for Area A and grassland savanna community composed of loblolly pine trees and grasses for Area B. Most disturbances would be short-term (less than 34 months) and would be mitigated through revegetation and careful construction siting and planning.

- Wildlife would be affected by landscape modification, loss of habitat, increased human activity in the construction area, increased traffic on local roads, and noise. Less mobile and burrowing species (such as amphibians, some reptiles, and small mammals) could be killed during vegetation clearing and other site preparation activities. The increased traffic volume would likely increase roadkills to species such as the eastern cottontail, gray and eastern fox squirrels, opossum, and raccoon along the new access road and existing roads. Overall, most disturbances would be short-term (less than 34 months), and construction at either Area A or Area B would not be expected to permanently displace any mammals or birds.

- Air quality would be affected during construction as a result of increased fugitive dust emissions (PM_{10} and $PM_{2.5}$). Background concentrations of $PM_{2.5}$ are already near the maximum levels of applicable air quality standards. Emissions from construction of an ACWA pilot test facility, although they would be very low overall, would result in levels near the applicable NAAQS, primarily because of high background concentration levels. Similarly, emissions of $PM_{2.5}$ during operations would be very low, but would be near the maximum NAAQS because the background levels are already high.

- A small number of worker injuries would be expected during construction of an ACWA facility: 22 for Neut/SCWO, 23 for Neut/GPCR/TW SCWO, and 24 for Elchem Ox. Worker injuries were estimated on the basis of the number of workers and duration of construction. When workers follow established safety precautions, the risk of worker fatalities is very low, and no worker fatalities would be expected.

The normal operations of an ACWA facility would have minor unavoidable adverse impacts. Facility workers would be subject to some risks from operations, and an estimated 49 worker injuries would be expected for each of the technologies; no worker fatalities would be expected. Worker injuries were estimated on the basis of the number of workers and duration of operations. There would also be minor increases in emissions of air pollutants, but these emissions would be well below allowable levels and would not significantly affect human health, ecological resources, or wetlands. Impacts related to fluctuating operations are also expected to be minimal, given the safety features that would be built into the design of ACWA facilities, which would prevent migration of contaminants to the environment in the event of a spill or other operational accident. While there would be significant unavoidable adverse impacts related to a catastrophic accident, the probability of this scenario is extremely remote.

5.24.2 Irreversible and Irretrievable Commitment of Resources

Irreversible commitments are those that cannot be reversed (i.e., the resource is permanently lost or consumed). Irreversible commitments that would result from the construction and operation of a proposed ACWA pilot test facility include consumption of electricity, natural gas, and fuel oil, as described in Section 5.3. Materials such as the concrete and steel used to construct the pilot test facility would also generally be irreversible commitments because they would probably not be recyclable because of potential agent contamination. Data on the quantities of construction materials required for an ACWA pilot facility are provided in Kimmell et al. (2001).

Irretrievable commitments are those that are lost for a period of time. Irretrievable commitments that would result from the construction and operation of a proposed ACWA pilot test facility would include water and habitat. Implementation of an ACWA technology would consume both process and potable water for the period of construction and operations (i.e., less than six years total). (Amounts of water consumed are discussed in Section 5.3.) When proposed operations ended, the water used by the ACWA technology would be available for other uses. Habitat lost because of the construction of an ACWA pilot test facility would also represent an irretrievable commitment. Habitat in the footprint of an ACWA pilot facility would be lost during the period of construction and operations (i.e., less than seven years total). After decontamination and decommissioning, the land could be revegetated, and habitat could be restored. Depending on the methods chosen for decommissioning, habitat losses could also be considered irreversible.

5.24.3 Short-Term Uses of the Environment and Enhancement of Long-Term Productivity

Constructing and operating one or more pilot test facilities would be an action of limited duration — less than six years. Construction would disturb soils, wildlife, and other biota, and it would produce temporary air emissions. Operations would produce air emissions, liquid effluents, and liquid and solid wastes. Air emissions and liquid effluent releases would be temporary, ceasing at the end of the project life. Disposal of wastes on post and off post would be a long-term commitment of land with restricted use. Construction and operation of one or more pilot test facilities would have short-term socioeconomic impacts for the duration of construction and pilot testing by creating jobs, increasing tax revenues, and increasing demand for housing and public services.

After pilot testing, the ACWA facility might be used to destroy the remaining on-post ACW stockpile. At the end of stockpile destruction, the facilities would be decontaminated and demolished, and the land would be returned to long-term productivity.

The pilot testing of an ACWA technology system would not substantially reduce or increase the risks to the public from accidents involving chemical agent. This situation would occur because the accidents with the greatest consequences, although highly unlikely, are associated with ACW storage, and ACW storage would continue during pilot testing. The consequences from highly unlikely accidents involving agents at a pilot test facility would be less than the consequences from similar highly unlikely accidents, including ACW storage.

5.25 MITIGATION

For environmental resource areas where adverse impacts have been identified, mitigation measures have been developed to minimize or avoid potential impacts from constructing and operating an ACWA pilot facility. The mitigation measures are outlined below. Because no adverse impacts on land use, infrastructure, noise, visual resources, aquatic species, protected species, socioeconomics, or environmental justice were identified, no mitigation would be required for these resource areas.

5.25.1 Waste Management

Adequate facilities exist to handle hazardous and nonhazardous wastes that would be generated by construction activities. Large potentially hazardous waste streams would be produced from operating either of the neutralization pilot test facilities; Elchem Ox would generate a smaller volume of hazardous wastes. In addition, PCBs have been identified as a constituent in the firing tubes of M55 rockets held in the inventory at PBA. PCB concentrations in wastes generated during the pilot-scale testing of ACWA technologies would need to be evaluated and would probably be subject to regulation under TSCA. The Army would work with regulators to develop procedures for handling potentially hazardous wastes resulting from ACW destruction. These procedures might include conducting tests to determine the toxicity of wastes, developing a process to stabilize salt wastes, sending wastes to a permitted hazardous waste disposal facility, or others.

5.25.2 Air Quality — Criteria Pollutants

Fugitive dust emissions would be generated during construction of an ACWA pilot facility. To minimize dust emissions, access roads would be paved with asphaltic concrete, and standard dust suppression measures (i.e., watering) would be employed at the construction areas.

5.25.3 Air Quality — Toxic Air Pollutants

No significant emissions of hazardous air pollutants are expected during construction of an ACWA pilot facility. During operations, the ACWA facility would be equipped with multiple carbon filter banks and with agent monitoring devices between banks to ensure that, in the unlikely event that some agent was not destroyed in the neutralization process and subsequent treatment, it would be detected, and the causes would be mitigated immediately.

5.25.4 Human Health

Some risk to workers would result from constructing and operating an ACWA pilot facility. Workers would adhere to safety standards and use protective equipment as necessary to reduce these risks. Also, the ACWA facility would be designed and operated to contain potential agent emissions to air, water, or soils. Design components (e.g., recycling process effluents, surrounding the facility with a berm, installing automated agent detection devices) would be incorporated to minimize operational and accidental emissions. Emergency response procedures are in place to protect human health and safety, both on post and off post, in the unlikely event of a significant release to the environment from a catastrophic accident (see Section 5.21).

5.25.5 Geology and Soils

Best management practices (e.g., use of siltation fences, berms, and liners; revegetation of disturbed land following construction) would be employed to minimize the potential for soil erosion potentially caused by construction of an ACWA pilot facility. A berm would surround the facilities to contain any potential releases from spills or fluctuating operations. In addition, the facilities would be designed with many safety features (e.g., detection devices, automatic shutoff) that would prevent migration of spills from an operational accident.

5.25.6 Groundwater, Surface Water, and Wetlands

Best management practices would be implemented for erosion and sedimentation control to avoid impacts on groundwater, surface water, or wetlands, and disturbed areas would be immediately replanted with native species. A buffer area would be maintained around wetlands during construction, and construction would avoid the small palustrine wetland located on the southwest margin of Area A and the two wetlands located on Area B, including locating facilities immediately adjacent to wetlands.

A berm would surround the facilities to contain any potential releases from spills or fluctuating operations. The facilities would be designed with many safety features (e.g., detection devices, automatic shutoff) to prevent migration of spills from an operational accident.

5.25.7 Vegetation and Wildlife

Construction could affect as much as 37 acres (15 ha) of vegetative and terrestrial habitat. Construction areas would be immediately replanted with native vegetation, and no long-term impacts are expected.

5.25.8 Cultural Resources

The probability of adverse effects on cultural resources because of the construction of one or more or the proposed facilities appears to be small. Area A has not been surveyed for archaeological resources, but on the basis of past disturbance in the area, the potential for finding intact cultural deposits that would meet significance criteria for listing on the NRHP in this location appears small. Area B has been surveyed, and no culturally important sites were recorded. While it is not likely, it is possible that archaeological artifacts could be encountered during construction activities. If cultural material were unexpectedly encountered during ground-disturbing activities at previously disturbed or surveyed areas of PBA, construction would stop immediately, and the Arkansas SHPO and a qualified archaeologist would be consulted to evaluate the significance of the cultural artifacts.

5.26 REFERENCES FOR CHAPTER 5

Acoustical Society of America, 1983, *American National Standard Specification for Sound Level Meters*, *ANSI S1.4-1983*, New York, N.Y., Feb.

Acoustical Society of America, 1985, *American National Standard Specification for Sound Level Meters, ANSI S1.4A-1985, Amendment to ANSI SI.4-1983*, New York, N.Y., June.

Allison, T.A., 2001, *Forecasted Data for ACWA Socioeconomic Analyses*, intralaboratory memorandum from Allison to M. Goldberg (Argonne National Laboratory, Argonne, Ill.), Oct. 22.

American Medical Association, 1999, *Physician Characteristics and Distribution in the U.S.*, Chicago, Ill.

Andersen, P., 2000, e-mail on noise associated with Tooele incinerator from Andersen (EG&G Inc., Tooele, Utah) to Y.-S. Chang (Argonne National Laboratory, Argonne, Ill.), Oct. 4.

Arkansas Geological Commission and USGS, 1998, Arkansas State Minerals Information, *Map of Principal Mineral-Producing Localities*, U.S. Geological Survey, Mineral Resources Program, http://minerals.usgs.gov/minerals/pubs/state/ar.html., accessed Oct. 2, 2000.

Arkansas Pollution Control and Ecology Commission, 1999, *Regulation 19 — Regulations of the Arkansas Plan of Implementation for Air Pollution Control, Effective Date: February 15, 1999*, http://www.adeq.state.ar.us/regs/files/reg19.pdf, accessed in Oct. 2000.

Arkansas School Information, 2000, *AS-IS Arkansas School Information Site*, http://www.as-is.org/, accessed in Sept. 2000.

Atkinson, L., 2000, personal communication from Atkinson (Pine Bluff Chemical Activity, Environment and Safety Division, Pine Bluff Arsenal, Pine Bluff, Ark.) to T. Allison (Argonne National Laboratory, Argonne, Ill.), June 29.

Avian Power Line Interaction Committee, 1996, *Suggested Practices for Raptor Protection on Power Lines: The State of the Art in 1996*, Edison Electric Institute/Raptor Research Foundation, Washington, D.C.

Becker, C., 2000, personal communication from Becker (Natural Resource Specialist, Pine Bluff Arsenal, Pine Bluff, Ark.) to E. Pentecost (Argonne National Laboratory, Argonne, Ill.), Aug. 29.

Bennett, W.J., and J. Stewart-Abernathy, 1982, *Cultural Resources Survey of Two Proposed Facility Locations, Pine Bluff Arsenal, Jefferson County, Arkansas*, Archeological Assessments Report No. 16, prepared by Archeological Assessments, Inc., Nashville, Ark., for U.S. Army Corps of Engineers, Fort Worth District, Texas.

Bennett, W.J., et al., 1993, *The Humanly-Altered Landscape: The Archaeological Record at the Pine Bluff Arsenal, Jefferson County, Arkansas*, Archeological Assessments Report No. 142, prepared by Archeological Assessments, Inc., Nashville, Ark., for U.S. Army Corps of Engineers, Little Rock District, Ark.

Boyles, M., 2000, personal communication from Boyles (Arkansas Department of Transportation, Little Rock, Ark.) to T. Allison (Argonne National Laboratory, Argonne, Ill.), Dec.

Branner, G.C., and J.M. Hansell, 1932, *Earthquake Risks in Arkansas; A Statistical Study Covering the Period from 1811 to 1931*, Information Circular 4, Arkansas Geological Survey, Little Rock, Ark.

Brattstrom, G.H., and M.C. Bondello, 1983, “Effects of Off-Road Vehicles on Desert Vertebrates,” pp. 167–206 in R.H. Webb and H.G. Wilshore (editors), *Environmental Effects of Off-Road Vehicles: Impacts and Management of Arid Regions*, Springer Verlag, New York, N.Y.

Burton, T.M., 2001, *Breathing Rates for Toxicity Data*, memorandum from Burton (U.S. Army Nuclear and Chemical Agency, Springfield, Va.) to Commander (Soldier and Biological Chemical Command, Aberdeen Proving Ground, Md.), May 24.

Campbell, J.C., et al., 1997, *Pine Bluff Arsenal Survey of Threatened and Endangered Plants Vegetation/Natural Areas*, final report, prepared by The Nature Conservancy, Arkansas Field Office, Little Rock, Ark., for C. Becker, Pine Bluff Arsenal, Pine Bluff, Ark.

CDC: see Centers for Disease Control and Prevention.

CEQ: see Council on Environmental Quality.

Centers for Disease Control and Prevention, 1988, "Final Recommendations for Protecting the Health and Safety against Potential Adverse Effects of Long-Term Exposure to Low Doses of Agents: GA, GB, VX, Mustard Agent (H, HD, T) and Lewisite (L)," U.S. Department of Health and Human Services, *Federal Register* 53(50):8504–8507, March 15.

Consent Administrative Order LIS 84-068, 1985, Arkansas Department of Pollution Control and Ecology, Aug. 6.

Corbitt, R.A., 1990, *Standard Handbook of Environmental Engineering*, McGraw-Hill, Inc.

Council on Environmental Quality, 1997, *Environmental Justice Guidance under the National Environmental Policy Act*, CEQ, Executive Office of the President, Washington, D.C., Dec.

Dawson, S.V., and G.V Alexeef, 2001, "Multi-Stage Model Estimates of Lung Cancer Risk from Exposure to Diesel Exhaust, Based on a U.S. Railroad Worker Cohort," *Risk Analysis* 21(1): 1–18.

DOI: see U.S. Department of the Interior.

Efroymson, R.A., et al., 1997, *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision*, Oak Ridge National Laboratory, Oak Ridge, Tenn.

EPA: see U.S. Environmental Protection Agency.

Executive Order 13045, 1997, "Protection of Children from Environmental Health Risks and Safety Risks," *Federal Register* 62(78):19885–19888, Apr. 23.

Folga, S.M., 2001, *Incinerator Utility Usage*, intraoffice e-mail from Folga to A.E. Smith and L.A. Nieves (Argonne National Laboratory, Argonne, Ill.) May 25.

Foster Wheeler et al., 2000, *Draft Final PMACWA Demonstration II Test Program Technical Report*, prepared by Foster Wheeler Corporation, Eco Logic Inc., and Kvaerner, Nov.

GA Technologies, 1987, *Risk Analysis of the Continued Storage of Chemical Munitions, Chemical Stockpile Disposal Program*, SAPEO-CDE-IS-87009, prepared by GA Technologies, Inc., San Diego, Calif., for Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Aug.

General Atomics, 1999, *Assembled Chemical Weapons Assessment (ACWA) Draft Test Technical Report*, DAAM01-98-D-003 129300/0, San Diego, Calif., June 30.

Goodheer, I., 1994, *Dose Response Data for the Tooele Chemical Agent Disposal Facility Quantitative Risk Assessment (TOCDF QRA)*, memorandum from Goodheer (U.S. Army Nuclear and Chemical Agency, Springfield, Va.) to Commander (U.S. Army Chemical Materiel Destruction Agency, Aberdeen Proving Ground, Md.), June 13.

Haley, B.R., et al., 1993, *Geologic Map of Arkansas*, prepared cooperatively by the Arkansas Geological Commission and the U.S. Geological Survey, Little Rock, Ark.

Harris, S., 2000, *Igloo Munitions*, e-mail from Harris (Environmental Coordinator, Pine Bluff Chemical Activity Environmental and Safety Division, Pine Bluff, Ark.) to H. Hartmann (Argonne National Laboratory, Argonne, Ill.), Aug. 15.

Hazardous Substances Data Bank, 2001, *Chloroform CAS No. 67-66-3*, National Library of Medicine, National Institutes of Health, U.S. Department of Health and Human Services, Bethesda, Md., http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB, revised Aug. 2001.

Hess, J.A., 1984, *Written Historical and Descriptive Data, Pine Bluff Arsenal*, HAER No. AR-2, prepared for the U.S. Department of the Interior, Historic American Engineering Record, National Park Service, Washington, D.C.

Holland, N., 2000, record of telephone conversation between Holland (Jefferson County, Ark.) and L. Nieves (Argonne National Laboratory, Argonne, Ill.), Oct.

IOC, 2000, *Pine Bluff Arsenal (PBA)*, U.S. Army, Industrial Operations Command, http://www.osc.army.mil/rm/oscfact/pba2.htm, accessed on Sept. 28.

Jackson, K.C., 1979, *Earthquakes and Earthquake History of Arkansas*, Information Circular 26, Arkansas Geological Commission, Little Rock, Ark.

J.R. Benjamin and Associates, Inc., 1996, *Probabilistic Seismic Hazard Assessment for the U.S. Army Chemical Disposal Facility, Pine Bluff, Arkansas*, JBA 148-130-PB-002, Rev. 0, Mountain View, Calif.

Kimmell, T., et al., 2001, *Technology Resource Document for the Assembled Chemical Weapons Assessment Environmental Impact Statement*, ANL/EAD/TM-101, Vols. 1–5 and errata, Argonne National Laboratory, Argonne, Ill.

Larson, A.C., 2000, *Migrant and Seasonal Farmworker Enumeration Profiles Study: Arkansas*, prepared for the Migrant Health Program, Health Resources and Services Administration, Department of Health and Human Services, Washington, D.C.

Liebich, R.E., and M.P. Cristoforo, 1988, "The Use of Audibility Analysis to Minimize Community Noise Impact of Today's Smaller Generation Facilities Located near Residential Areas," presented at American Power Conference 50th Annual Meeting, Chicago, Ill., Apr.

Luz, G.A., and J.B. Smith, 1976, "Reactions of Pronghorn Antelope to Helicopter Overflight," *Journal of the Acoustical Society of America* 59:1514–1515.

Manci, K.M., et al., 1988, *Effects of Aircraft Noise and Sonic Booms on Domestic Animals and Wildlife*, AFESC TR 88-14, NERC-88/29, U.S. Air Force, Engineering and Service Center, and U.S. Fish and Wildlife Service, Fort Collins, Colo.

Mitretek, 2001a, *Estimates of Environmental Releases Associated with the Destruction of Assembled Chemical Weapons during Pilot Plant Testing of the Parsons Honeywell Neutralization/Biotreatment Process*, Mitretek Systems, Inc., McLean, Va., May.

Mitretek, 2001b, *Estimates of Environmental Releases Associated with the Destruction of Assembled Chemical Weapons during Pilot Plant Testing of the General Atomics Neutralization/Supercritical Water Oxidation Process*, Mitretek Systems, Inc., McLean, Va., May.

Mitretek, 2001c, *Estimates of Environmental Releases Associated with the Destruction of Assembled Chemical Weapons during Pilot Plant Testing of the Foster Wheeler-Ecologic-Kvaerner Neutralization/Supercritical Water Oxidation with Gas Phase Chemical Reduction Process*, Mitretek Systems, Inc., McLean, Va., May.

Munro, N.B., et al., 1999, "The Sources, Fate, and Toxicity of Chemical Warfare Agent Degradation Products," *Environmental Health Perspectives*, 107(12):933–974, Dec.

National Oceanic and Atmospheric Administration, 1999, *Local Climatological Data: Annual Summary with Comparative Data for Little Rock, Arkansas*, National Climatic Data Center, Asheville, N.C.

National Research Council, 1997a, *Risk Assessment and Management at Deseret Chemical Depot and the Tooele Chemical Agent Disposal Facility*, prepared by National Research Council, Washington, D.C., published by National Academy Press, Washington, D.C.

National Research Council, 1997b, *Review of Acute Human-Toxicity Estimates for Selected Chemical-Warfare Agents*, prepared by Subcommittee on Toxicity Values for Selected Nerve and Vesicant Agents, Washington, D.C., published by National Academy Press, Washington, D.C.

National Safety Council, 1999, *Injury Facts, 1999 Edition*, Itasca, Ill.

Neel, C., 2000, *Existing Noise-Producing Activities at PBA*, record of telephone conversation between Neel (Pine Bluff Arsenal, Pine Bluff, Ark.) and Y.-S. Chang (Argonne National Laboratory, Argonne, Ill.), Aug. 29.

NOAA: see National Oceanic and Atmospheric Administration.

Opresko, D.M., et al., 1998, "Chemical Warfare Agents: Estimating Oral Reference Dose," in Ware, G.W. (editor), *Reviews of Environmental Contamination and Toxicology*, Vol. 156, Springer-Verlag, New York, N.Y.

Osborne, C., 2000, *Elements of Special Concern, Pine Bluff Arsenal*, letter from Osborne (Department of Arkansas Heritage, Little Rock, Ark.) to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), June 27.

Parker, P.L., 1995, *Guidelines for Evaluating and Documenting Traditional Cultural Properties*, National Register Bulletin 38, U.S. Department of the Interior, National Park Service, Washington, D.C.

PBA: see Pine Bluff Arsenal.

Peacock, L., and D. Zollner, 1998, *An Inventory of the Birds of Pine Bluff Arsenal, Jefferson County, Arkansas*, final report to Pine Bluff Arsenal, Pine Bluff, Ark.

Phelps, J.P., 1997, *A Survey of Terrestrial Mammals on the Pine Bluff Arsenal: Final Report*, presented to The Nature Conservancy, Arkansas Field Office, Little Rock, Ark.

Pine Bluff Arsenal, 1998, *Pine Bluff Arsenal Integrated Natural Resources Five Year Management Plan,* U.S. Army, Pine Bluff, Ark., Oct. 1.

Pine Bluff Arsenal, 1999, *86 Hazardous Waste Landfill Groundwater Assessment*, U.S. Army, Pine Bluff, Ark., March.

Pine Bluff Arsenal, 2000, *Hazardous Material/Waste Management Letter of Instruction*, U.S. Army, Pine Bluff, Ark., June.

PMACWA, 1999, *Assembled Chemical Weapons Assessment Program: Supplemental Report to Congress*, U.S. Department of Defense, Program Manager Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md., Sept. 30.

PMACWA, 2001, *Final Technical Evaluation Report: AEA Technology/CH2MHill SILVER II Electrochemical Oxidation, Foster Wheeler/Eco Logic International/Kvaerner Neutralization/GPCR/TW-SCWO, Teledyne-Commodore Solvated Electron Systems*, Appendix C in *Assembled Chemical Weapons Assessment Program: Supplemental Report to Congress,* June 2001, U.S. Department of Defense, Program Manager Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md., March.

Raytheon, 1996, *Johnston Atoll Chemical Agent Disposal System (JACADS) Human Health & Ecological Risk Assessment,* prepared by Raytheon Engineers & Constructors, Inc., Philadelphia, Penn., for U.S. Army Chemical Demilitarization and Remediation Activity, Aberdeen Proving Ground, Md., Dec. 30.

Rhodes, M., 2000, e-mail from Rhodes (University of Illinois, Urbana, Ill.) to Y.-S. Chang (Argonne National Laboratory, Argonne, Ill.), Sept. 1.

Robison, H.W., 1997, *An Inventory of the Amphibians and Reptiles of Pine Bluff Arsenal, Jefferson County, Arkansas,* final report to The Nature Conservancy, Little Rock, Ark., Dec. 20.

Robison, H.W., 2000, *An Inventory of the Fishes of the Pine Bluff Arsenal, Jefferson County, Arkansas*, final report, prepared by Southern Arkansas University, Department of Biological Sciences, Magnolia, Ark., for The Nature Conservancy, Little Rock, Ark., Jan. 15.

Runyan, J.L., 2000, *Profile of Hired Farmworkers, 1998 Annual Averages*, U.S. Department of Agriculture, Economic Research Service, Washington, D.C., http://www.ers.usda.gov/Publications/AER790/.

SAIC: see Science Applications International Corporation.

Saugey, D.A., 1997, *Bat Faunal Survey Pine Bluff Arsenal*, final report, prepared by Nightwing Consulting, Jessieville, Ark. for The Nature Conservancy, Arkansas Field Office, Little Rock, Ark., Dec. 28.

SBCCOM, 2000a, *Pine Bluff Arsenal Disaster Control Plan, Annex C: Chemical Accident or Incident Response and Assistance*, Soldier and Biological Chemical Command, Pine Bluff Chemical Activity, Pine Bluff, Ark., Feb. 14.

SBCCOM, 2000b, *Pine Bluff Chemical Activity*, Soldier and Biological Chemical Command, Pine Bluff Chemical Activity, Pine Bluff, Ark., http://pinebluff.sbccom.army.mil/.

Science Applications International Corporation, 1997, *Pine Bluff Chemical Agent Disposal Facility Phase 1 Quantitative Risk Assessment*, Report SAIC-96/1120, prepared by SAIC, Abingdon, Md., for U.S. Army, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., March.

Skinner, A., 2000, record of telephone conversation between Skinner (Southeast Arkansas Regional Planning Commission) and L. Nieves (Argonne National Laboratory, Argonne, Ill.), Oct.

SMG Marketing Group, Inc., 2001, data from Hospital Select web site, Chicago, Ill., http://www.hospitalselect.com.

Smith, A.E., 2001, record of telephone conversations on actions in Jefferson and Grant Counties in the vicinity of Pine Bluff Arsenal between Smith (Argonne National Laboratory, Argonne, Ill.) and various sources, March 26.

Staub, W.P., 1991, "Nuclear Power Station Seismic Hazard Curves in the Eastern United States and the Uniform Building Code," *Bulletin of the Association of Engineering Geologists* 28(3):227–232.

Storm Prediction Center, 2000, *Historical Tornado Data Archive*, http://www.spc.noaa.gov/archive/tornadoes/index.html.

Tobin, M., 2000, letter from Tobin (U.S. Fish and Wildlife Service, Conway, Ark.) to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), June 23.

Transportation Research Board, 1985, *Highway Capacity Manual*, National Research Council, Washington, D.C.

Tsao, C.L., 2001a, *Calculation of Inhalation HQ of GB (Sarin) for Terrestrial Wildlife Ecological Risk Assessment at Pine Bluff Arsenal (PBA)*, intraoffice memorandum from Tsao to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), Nov. 30.

Tsao, C.L., 2001b, *Calculation of Inhalation HQ of VX for Terrestrial Wildlife Ecological Risk Assessment at Pine Bluff Arsenal (PBA)*, intraoffice memorandum from Tsao to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), Jan. 15.

Tsao, C.L., 2001c, *Ecological Risk Assessment of Chemical Emissions from ACWA Pilot Facility during Normal Operation at Pine Bluff Arsenal (PBA)*, intraoffice memorandum from Tsao to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), Nov. 30.

USACHPPM: see U.S. Army Center for Health Promotion and Preventive Medicine.

U.S. Army, 1988, *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Jan.

U.S. Army, 1997, *Revised Final Environmental Impact Statement for Disposal of Chemical Agents and Munitions Stored at Pine Bluff Arsenal, Arkansas*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Apr.

U.S. Army, 1998, *Final Environmental Impact Statement for Pilot Testing of Neutralization/Supercritical Water Oxidation of VX Agent at Newport Chemical Depot, Indiana*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Dec.

U.S. Army Center for Health Promotion and Preventive Medicine, 1997, *Environmental Impact Risk Analysis in Support of NEPA for Pine Bluff Chemical Agent Disposal Facility, Pine Bluff, Arkansas*, Aberdeen Proving Ground, Md., Apr.

U.S. Army Center for Health Promotion and Preventive Medicine, 1999a, *Development and Derivation of Inhalation Benchmark Values for Wildlife: An Application to Identify Ecological Risk to Airborne Contaminants*, Study 87-1299-99, Health Effects Research Program, Toxicology Directorate, USACHPPM, Aberdeen Proving Ground, Md., Dec.

U.S. Army Center for Health Promotion and Preventive Medicine, 1999b, *Derivation of Health-Based Environmental Screening Levels for Chemical Warfare Agents*, Aberdeen Proving Ground, Md.

U.S. Bureau of Labor Statistics, 2001, *Local Area Unemployment Statistics*, Washington, D.C., ftp://ftp.bls.gov/ pub/time.series/la/, accessed in Feb. 2001.

U.S. Bureau of the Census, 1991, *1990 Census of Population and Housing*, *Summary of Population and Housing Characteristics*, *Arkansas*, U.S. Department of Commerce, Washington, D.C.

U.S. Bureau of the Census, 1992a, *1990 Census of Population and Housing, Summary of Social, Economic, and Housing Characteristics, Arkansas*, U.S. Department of Commerce, Washington, D.C.

U.S. Bureau of the Census, 1992b, *1990 Census of Population and Housing*, data including STF 1 and STF 3a, http://factfinder.census.gov, accessed in Sept. 2000.

U.S. Bureau of the Census, 1992c, *County Business Patterns*, *1990*, Washington, D.C., http://www.census.gov/frp/pub/epcd/cbp/view/cpbview.html.

U.S. Bureau of the Census, 1994, *City and County Data Book, 1994*, Washington, D.C.

U.S. Bureau of the Census, 2000, *1997 Census of Governments*, Compendium of Public Employment, Washington, D.C., http://www.census.gov/ftp/pub/govs/www/cog.html, accessed in Sept. 2000.

U.S. Bureau of the Census, 2001a, *County Business Patterns*, *1999*, Washington, D.C., http://www.census.gov/ftp/pub/epcd/cbp/view/cbpview.html, accessed in Sept. 2000.

U.S. Bureau of the Census, 2001b, *American FactFinder*, Washington, D.C., http://factfinder. census.gov.

U.S. Bureau of the Census, 2001c *State and County Quickfacts*, Washington, D.C., http://quickfacts.census.gov/qfd/states/05000.html, accessed in Sept. 2001.

U.S. Bureau of the Census, 2001d, *Census 2000 Redistricting Data (Public Law 94-171) Summary File*, Washington, D.C., http://www.census.gov/clo/www/redistricting.html, accessed in Aug. 2001.

USDA: see U.S. Department of Agriculture.

U.S. Department of Agriculture, 1980, *Soil Survey of Jefferson and Lincoln Counties, Arkansas*, Soil Conservation Service in cooperation with the Arkansas Agricultural Experiment Station, Dec.

U.S. Department of Agriculture, 1994, *Census of Agriculture 1992*, National Agricultural Statistics Service, Washington, D.C., http://www.nass.usda.gov/census/census92/agrimenu.htm, accessed in Dec. 2000.

U.S. Department of Agriculture, 1999, *Census of Agriculture 1997*, National Agricultural Statistics Service, Washington, D.C., http://www.nass.usda.gov/census/census97/volume1/vol1pubs.htm, accessed in Dec. 2000.

U.S. Department of Commerce, 2001, *Local Area Personal Income*, Bureau of Economic Analysis, Washington, D.C., http://www.bea.doc.gov/bea/regional/reis/.

U.S. Department of the Interior, 1986a, *Visual Resource Inventory*, BLM Manual Handbook H-8410-1, Bureau of Land Management, Washington, D.C., Jan.

U.S. Department of the Interior, 1986b, *Visual Resource Contrast Rating*, BLM Manual Handbook H-8431-1, Bureau of Land Management, Washington, D.C., Jan.

U.S. Environmental Protection Agency, 1974, *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, EPA-550/9-74-004, Washington, D.C.

U.S. Environmental Protection Agency, 1979, "Protective Noise Levels" (condensed version of *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, EPA/ONAC 550/9-74-004, March 1974), http://www.nonoise.org/library/levels/levels.htm.

U.S. Environmental Protection Agency, 1989, *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A)*, EPA/540/1-89/002, Interim Final, Office of Emergency and Remedial Response, Washington, D.C., Dec.

U.S. Environmental Protection Agency, 1990, "National Oil and Hazardous Substances Pollution Contingency Plan; Final Rule (40 CFR Part 300)," *Federal Register* 55(46):8666–8865, March 8.

U.S. Environmental Protection Agency, 1994, *Exposure Assessment Guidance for RCRA Hazardous Waste Combustion Facilities (Draft)*, EPA 530/R-94/021, Office of Solid Waste, Washington, D.C.

U.S. Environmental Protection Agency, 1995, *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models*, EPA-454/B-95-003a and updated model (Version 00101), Office of Air Quality Planning and Standards, Research Triangle Park, N.C., Sept.

U.S. Environmental Protection Agency, 1997, *Exposure Factors Handbook*, EPA/600/P-95/002Fa, Office of Health and Environmental Assessment, Washington, D.C., Aug.

U.S. Environmental Protection Agency, 1998a, *Final Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses*, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency, 1998b, *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Peer Review Draft,* EPA/530/D-98/001A, July.

U.S. Environmental Protection Agency, 2000a, *Surface Meteorological Data,* Office of Air Quality Planning and Standards, Research Triangle Park, N.C., Support Center for Regulatory Air Models (SCRAM), TTNWeb, http://www.epa.gov/ttn/scram, accessed in Sept. 2000.

U.S. Environmental Protection Agency, 2000b, *National Emission Trends Inventory (NET 1996), County and Plant Emission Summaries*, Office of Air Quality Planning and Standards, Research Triangle Park, N.C., Regional Transport Office (RTO), TTNWeb, http://www.epa.gov/ttn/rto/areas/net.htm, accessed in Oct. 2000.

U.S. Environmental Protection Agency, 2000c, *AIRSData, Monitor Values Report*, Office of Air Quality Planning and Standards, Research Triangle Park, N.C., http://www.epa.gov/air/data/monvals.html, accessed in Oct. 2000.

U.S. Environmental Protection Agency, 2000d, *Documentation for the 1996 Base Year National Toxics Inventory for Nonroad Vehicle and Equipment Mobile Sources,* prepared by Eastern Research Group, Inc., Morrisville, N.C., for EPA, Emissions Monitoring and Analysis Division, Research Triangle Park, N.C., June 2.

U.S. Environmental Protection Agency, 2000e, *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources*, Office of Air Quality Planning and Standards, Research Triangle Park, N.C., Clearinghouse for Inventories and Emission Factors (CHIEF), TTNWeb, http://www.epa.gov/ttn/chief/ap42/index.htm.

U.S. Environmental Protection Agency, 2000f, *Ecological Soil Screening Level (Draft), Appendix 4-1: Exposure Factors and Bioaccumulation Models for Derivation of Wildlife Eco-SSL*, Office of Emergency and Remedial Response, Washington, D.C., June 27.

U.S. Environmental Protection Agency, 2000g, *Technical Support Document: Control of Emissions of Hazardous Air Pollutants from Motor Vehicles and Motor Vehicle Fuels,* EPA-420-R-00-023, Office of Air and Radiation, Dec.

U.S. Environmental Protection Agency, 2001, *Region 4 Waste Management Division Soil Screening Values for Hazardous Waste Sites*, EPA Region 4 Ecological Risk Assessment Bulletins — Supplement to Ecological Risk Assessment Guidance for Superfund, updated Apr. 2001.

U.S. Fish and Wildlife Service, 1990, *National Wetlands Inventory, Rob Roy Quadrangle*, Washington, D.C.

U.S. Fish and Wildlife Service, 1995, *National Wetlands Inventory, Pine Bluff Quadrangle*, Washington, D.C.

U.S. Fish and Wildlife Service, 1998a, *Wetlands Inventory Report for Pine Bluff Arsenal, Jefferson County, Arkansas*, National Wetland Inventory Program, Washington, D.C.

U.S. Fish and Wildlife Service, 1998b, *National Wetlands Inventory, White Hall, Hardin, Redfield, and Wright Quadrangles*, Washington, D.C.

USFWS: see U.S. Fish and Wildlife Service.

U.S. Geological Survey, 1985, *Malvern, Arkansas, 1:100,000-Scale Metric Topographic Map, 30 × 60 Minute Quadrangle* 34092-A1-TM-100, Washington, D.C.

Vestal, M., 2001, *Toxic Release Inventory (TRI) Information and 2000 Emission Inventory, Pine Bluff Arsenal*, fax from Vestal (Pine Bluff Arsenal Environmental Management, Pine Bluff, Ark.) to H. Hartmann (Argonne National Laboratory, Argonne, Ill.), Jan. 24.

Wachowiak, E., 2000, e-mail on PBA Title V permit application from Wachowiak (Pine Bluff Arsenal, Pine Bluff, Ark.) to Y.-S. Chang (Argonne National Laboratory, Argonne, Ill.), Oct. 19.

Welke, B., et al., 1998, “Sorption of Volatile Organic Chemicals in Plant Surfaces,” *Environmental Science and Technology* 32:1099–1104.

Whitacre, G.C., et al., 1987, *Personal Computer Program for Chemical Hazard Prediction (D2PC)*, CRDEC-TR-87021, U.S. Army, Armament Munitions Chemical Command, Chemical Research, Development, and Engineering Center, Aberdeen Proving Ground, Md., Jan.

6 PUEBLO CHEMICAL DEPOT (PCD), COLORADO

6.1 INTRODUCTION

PCD is located in southeastern Colorado, approximately 14 mi (23 km) east of the center of the City of Pueblo in Pueblo County and about 2 mi (3 km) north of the Arkansas River (Figure 6.1-1). The installation encompasses approximately 23,000 acres (9,300 ha) and includes a variety of buildings, structures, and undeveloped areas.

6.1.1 Potential Sites and Facility Locations

Existing facilities at PCD include approximately 270 buildings used for administration, housing, maintenance, and storage (Figure 6.1-2). Most of these structures are located in the southern portion of the installation. In addition, PCD has earth-covered concrete igloos initially constructed for storage of conventional and chemical munitions. The storage igloos are located in Munitions Storage Areas A and B situated in the central and north central portions of the installation. Most of the igloos outside Munitions Storage Area A are empty; a small number (about 40) are leased to other organizations for storage. PCD also contains inactive demolition grounds and undeveloped perimeter zones.

An Assembled Chemical Weapons Assessment (ACWA) pilot test facility would require about 25 acres (10 ha) of land. In addition, during construction, land area would be required for a construction laydown area, temporary offices, parking, holding basins for surface water, and temporary utility installations. This additional land area could total 60 acres (24 ha). Together the facility and land area requirements could total 85 acres (34 ha) (Kimmell et al. 2001).

For the purposes of this *National Environmental Policy Act* (NEPA) assessment, it is assumed that any ACWA pilot test facility would be constructed within the chemical demilitarization (Chem Demil) area in the northeastern section of PCD near Munitions Storage Area A, where the chemical weapons are stored (Figure 6.1-2). The presence of certain physical features in the Chem Demil area — such as the installation's north boundary fence and the upper reaches of Haynes and Boone Creeks — limited the number of potential sites that could be used for ACWA Program facilities. The area appropriate for construction was limited even more to avoid areas adjacent to the installation boundary or within a surface water drainage area.

Three areas along the western, southern, and eastern edges of Munitions Storage Area A were considered appropriate for construction of ACWA pilot test facilities. These areas, labeled A, B, and C, are shown on Figure 6.1-2. Area A is approximately 180 acres (70 ha). Area B is approximately 120 acres (50 ha). Area C is approximately 180 acres (70 ha).

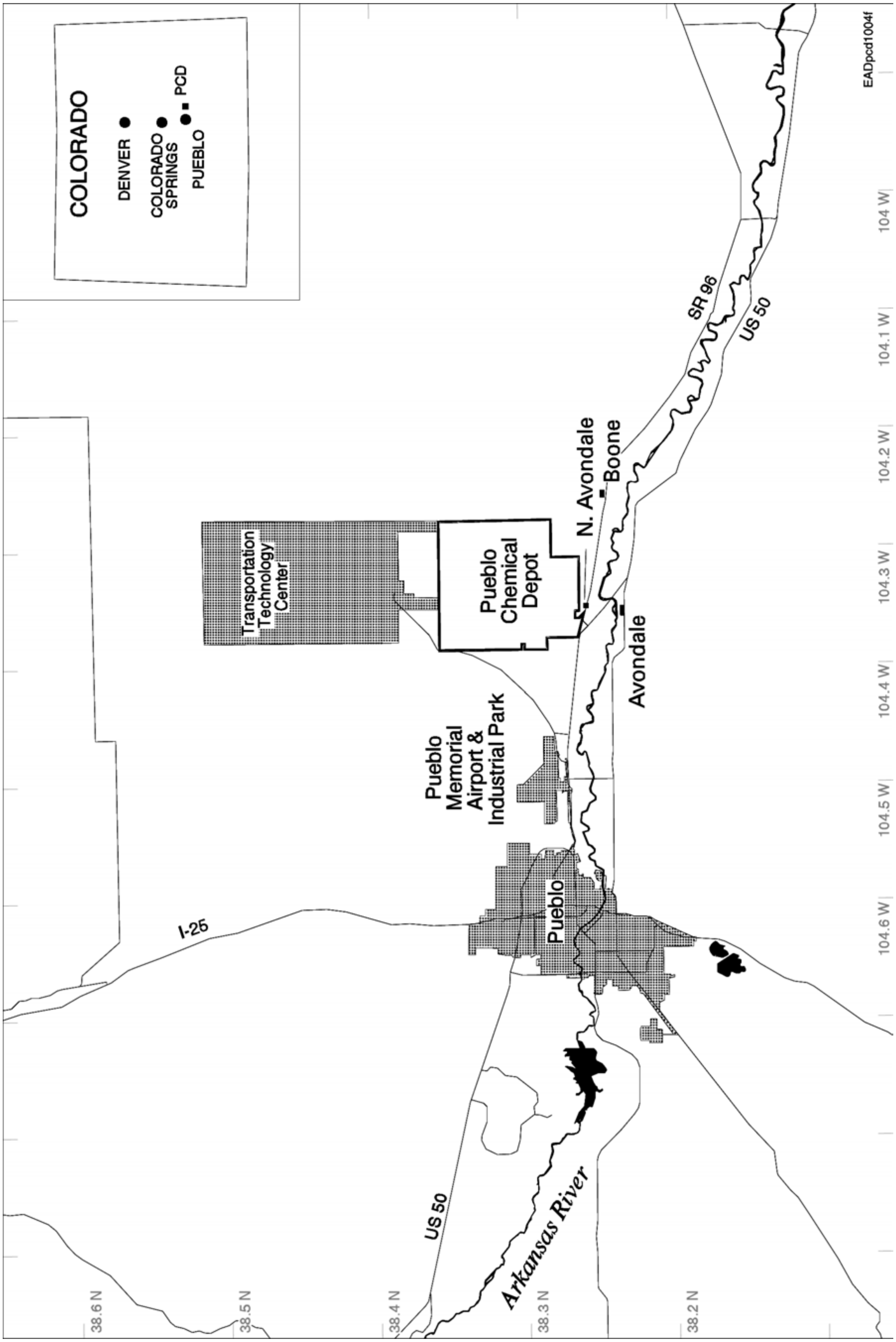

FIGURE 6.1-1 Location of PCD

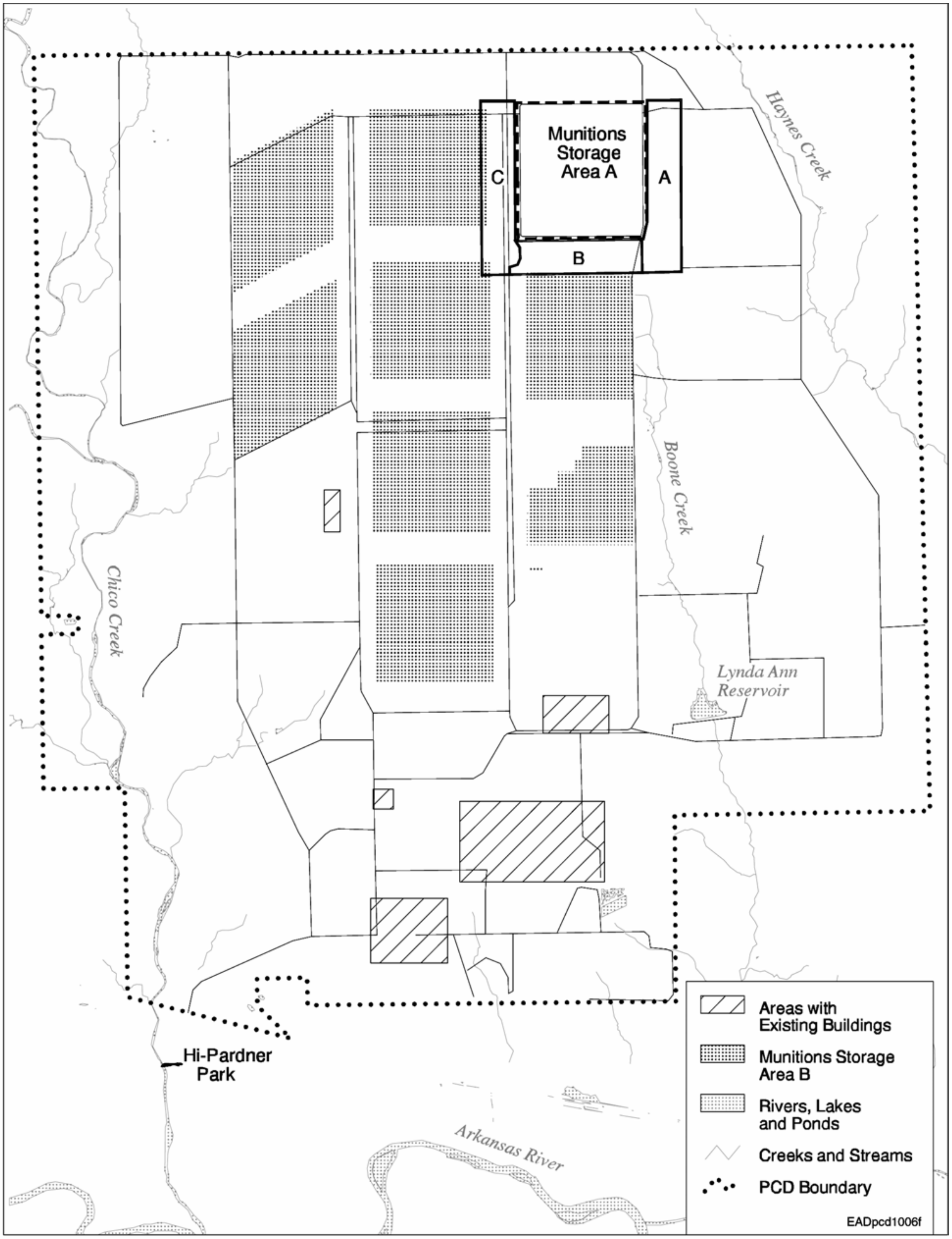

FIGURE 6.1-2 Facilities at PCD

In addition, the Army identified four potential routes for constructing supply lines for electric power, water, and natural gas. Any of these routes (labeled Corridors 1, 2, 3, and 4 on Figure 6.1-3) could serve any of the three areas.

6.1.2 Munitions Inventory

PCD currently houses 780,078 chemical munitions. The munitions stored at PCD are 105-mm and 155-mm projectiles and 4.2-in. mortar rounds, all filled with mustard agent (Table 6.1-1). Small quantities of nonstockpile chemical materiel are also stored at PCD. However, these are not ACWs and are not part of the ACWA Program.

6.2 LAND USE

6.2.1 Installation History and Uses

PCD is a part of the U.S. Army Soldier and Biological Chemical Command (SBCCOM). The current missions at PCD are to manage the on-post stockpile of chemical munitions, prepare for chemical munitions disposal under the Chemical Stockpile Disposal Program, manage environmental restoration activities, and provide limited maintenance to existing facilities. The U.S. Army first established PCD in 1942 as the Pueblo Ordnance Depot (POD). The depot's primary function at that time was the storage and shipment of ammunition, but it was also used as a medical supply depot.

In the early 1950s, during the Cold War, POD was a distribution center for military supplies for 78 installations in a nine-state region from the Dakotas to Arizona. During this time, POD expanded much of its storage capacity and facilities to accommodate a growing work force. Also during this time, POD began storing chemical munitions, such as distilled mustard, that were being produced at Rocky Mountain Arsenal in Denver, Colorado, and Redstone Arsenal in Huntsville, Alabama. Originally the chemical munitions were stored in the igloos in Munitions Storage Area B, but they were later moved to Munitions Storage Area A in the northeastern portion of POD. Nuclear weapons, such as atomic cannon ammunition, were stored in Munitions Storage Area B from 1954 until 1965.

Another expansion of POD occurred in the late 1950s with the addition of a new function for the depot: missile storage and maintenance. In 1961, POD was the "nation's prime depot for maintenance, rebuilding, and storage of the Army's three major missiles [the Redstone, Pershing, and Sergeant] and their systems" (Simmons and Simmons 1998). Hawk and LaCrosse missiles were also serviced at POD.

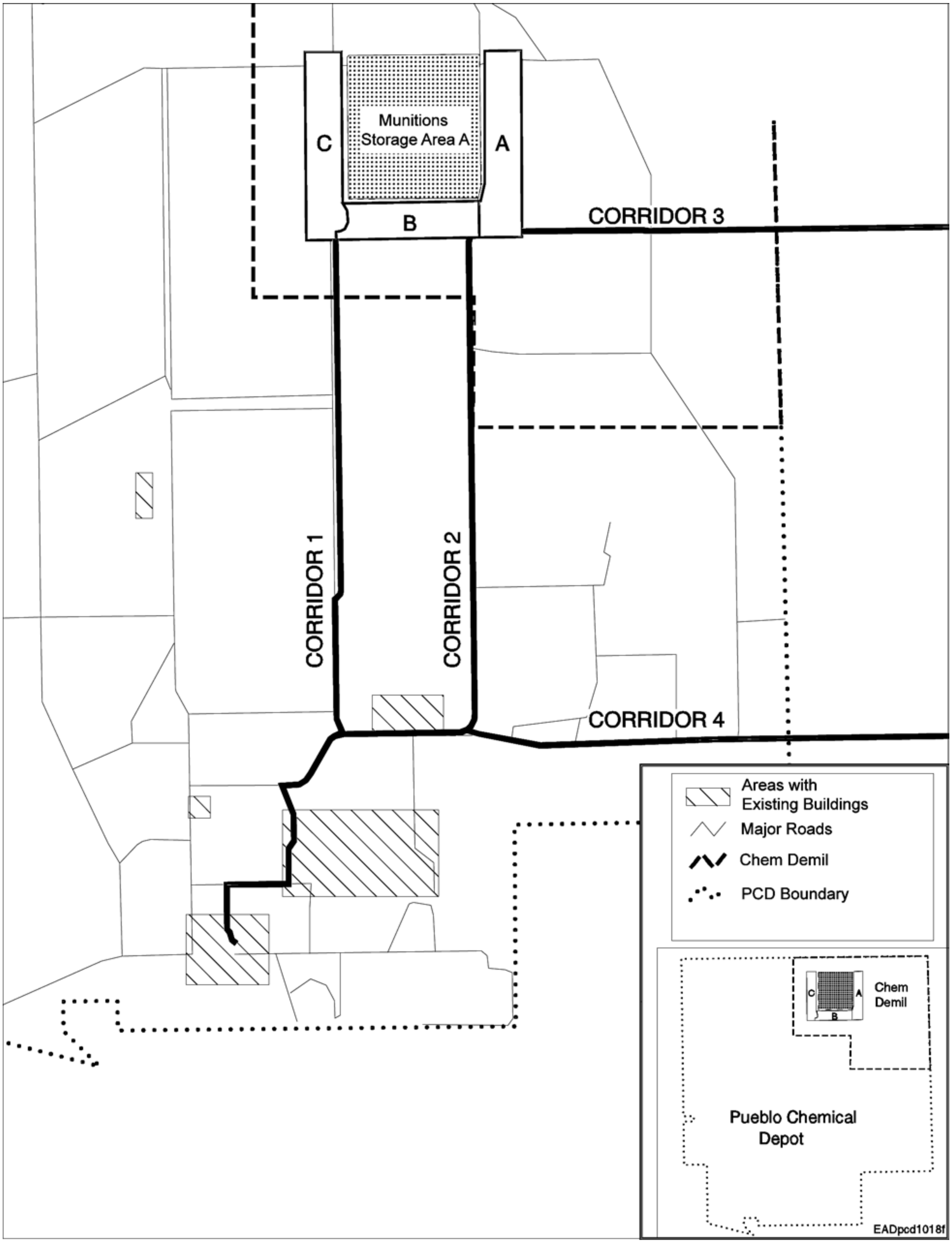

FIGURE 6.1-3 Proposed Utility and Road Access Corridors for an ACWA Pilot Test Facility at PCD

TABLE 6.1-1 Assembled Chemical Weapons Inventory at PCD

Type of Munition[a]	Agent	Total No. of Munitions	Total Weight of Agent (lb)[b]
M104 projectiles (155 mm)[c]	HD	33,062	386,820
M110 projectiles (155 mm)[c]	HD	266,492	3,117,960
M60 cartridges (105 mm)[d]	HD	383,418	1,138,760
M2 mortars (4.2 in.)[e]	HT	20,384	118,220
M2A1 mortars (4.2 in.)[e]	HD	76,722	460,340
Total		780,078	5,222,100

[a] Basic configurations are shown. Some of the munitions have been modified through maintenance activities.

[b] Numbers may vary due to roundoff errors. The agent numbers shown are those reported under the Chemical Weapons Convention (CWC) requirements (Chemical and Biological Defense Command [CBDCOM] 1997).

[c] Include an explosive burster with 0.41 lb of tetrytol with each munition.

[d] Include an explosive burster with 0.26 lb of tetrytol, a fuze, 2.8 lb of propellant, and a packing and shipping container with each munition.

[e] Include an explosive burster with 0.14 lb of tetrytol, a fuze, and a propelling charge with each munition.

POD was renamed Pueblo Army Depot (PAD) in 1962. Depot closures in South Dakota and Nebraska in the mid-1960s led to yet another expansion of PAD, making it one of the largest U.S. Army Materiel Command depots in the nation. Activities continued to diversify: the facility was used to maintain and rebuild vehicles and equipment; store, maintain, and distribute materials for fixed and floating bridges; and provide a repository for U.S. Army historical properties.

A phase-down of PAD was announced in 1974 in response to the end of the Vietnam War. Many activities were transferred to other facilities. PAD continued to act as a storage supply depot for ammunition and supplies and as a maintenance facility for the Pershing missile system. In 1976, PAD became a satellite facility to Tooele Army Depot, Utah, and was renamed Pueblo Depot Activity (PDA).

In 1988, the Base Realignment and Closure (BRAC) Commission recommended realignment of PAD (U.S. Army 1997a). All of PAD's missions, except storage and demilitarization of chemical weapons, were realigned (i.e., transferred to other installations).

The main mission of the depot today is the storage of a portion of the nation's chemical weapons stockpile. In 1996, PDA was renamed Pueblo Chemical Depot (PCD) to reflect its primary current mission. Notwithstanding the limitations in the authority of the 1988 BRAC legislation, final closure of the installation is anticipated after completion of chemical demilitarization.

6.2.2 Current and Planned On-Post Land Use

Past and present land use on PCD has been primarily for industrial and related purposes, with administrative purposes present as well (EDAW et al. 1994). Past and present land use has also included residential and recreational purposes to support personnel housed at the depot.

In 1995, the Pueblo Depot Activity Development Authority (PDADA) adopted a reuse development plan for PCD (EDAW et al. 1994). The plan was updated in June 2000 (PDADA 2000). In this plan, land reuse categories were assigned to all of the property located within the boundaries of PCD. Land reuse categories were designated for Chem Demil, industrial, residential, recreational, and wildlife management activities (Figure 6.2-1).

The reuse development plan considered 14 different uses for PCD and, in the process, maintained more than 5,200 acres (2,104 ha) in the northeastern portion of the installation for Chem Demil. The plan made the remaining part of the depot available for use by other entities, as summarized in Table 6.2-1. Tenants present at PCD include the Colorado National Guard 947th Engineering Company, a special forces unit, and PDADA. Other parties sublease space at PCD through PDADA. These sublessees include not-for profit, commercial, and state and local government entities.

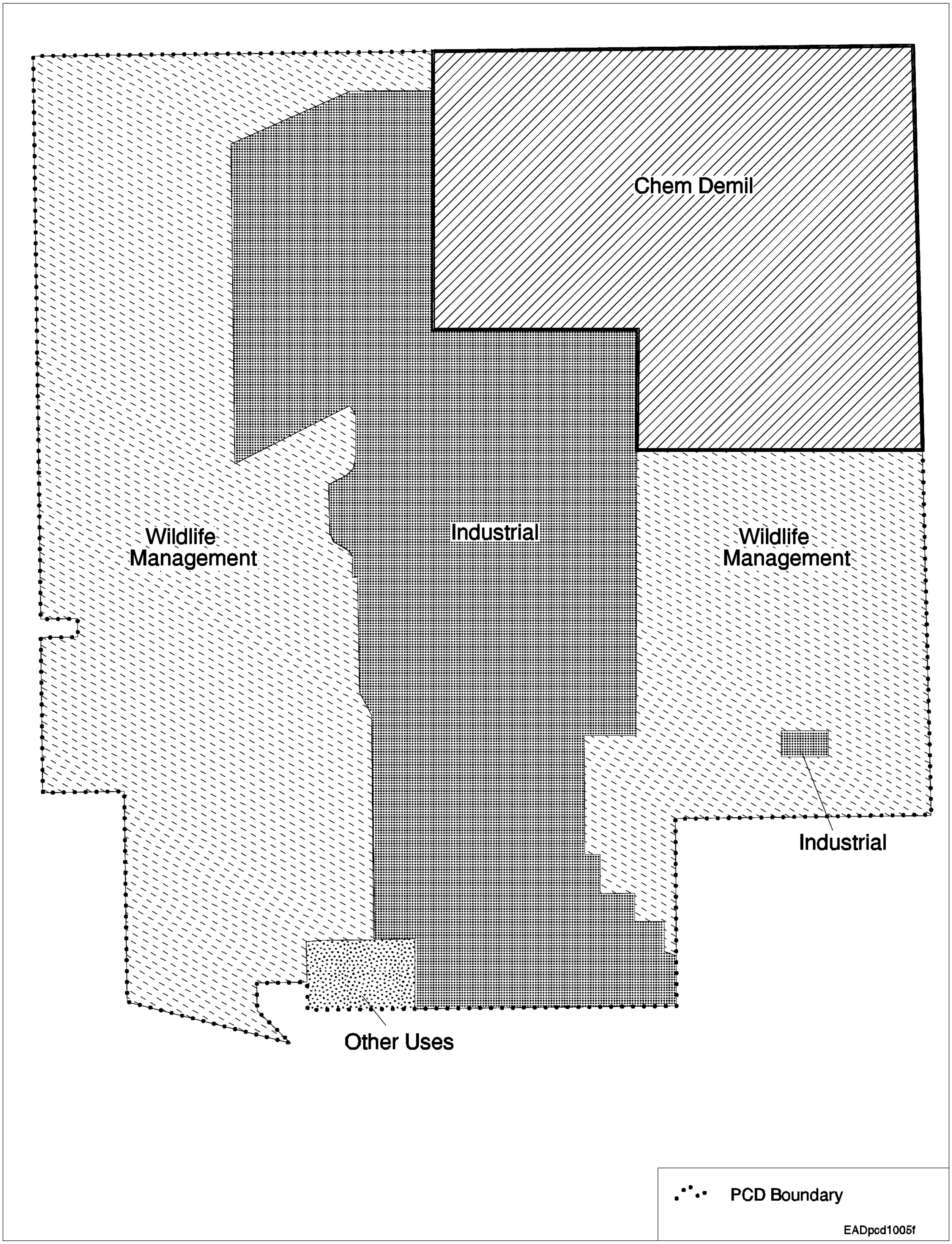

FIGURE 6.2-1 Land Use at PCD

TABLE 6.2-1 Potential Land Uses Considered under Base Realignment and Closure at PCD

Land Use Category	Approximate Total Area (acres)[a]	Approximate Area Required for Chemical Demilitarization (acres)[a]
General warehouse/industrial	700	10
Special materials warehouse	90	0
Material storage (igloos)	1,900	0
Material storage reserve (igloos)	4,500	1,500
Office/commercial/institutional	20	10
Light industrial	100	60
Open storage	300	0
Livestock grazing	6,500	3,300
Wildlife management	4,900	0
Open space	900	300
Residential	60	10
Land reserve	1,900	0
Recreation	10	5
Open storage reserve	900	0
Total	22,900	5,200

[a] 1 acre = 0.4 hectare.

Source: EDAW et al. (1994).

6.2.3 Current and Planned Off-Post Land Use

Most of the land surrounding PCD is undeveloped ranch land used for grazing. In 1997, Pueblo County contained 664 farms covering about 880,000 acres (360,000 ha) (U.S. Department of Agriculture [USDA] 1999). Cropland on these farms totaled about 90,000 acres (36,000 ha), with the remaining vast majority used for pasture.

Various private and public interests own the land surrounding PCD (EDAW et al. 1994) (Figure 6.2-2). The state of Colorado owns most of the land north of the installation, as well as parcels east and west of PCD. The Transportation Technology Center (TTC), which is owned by the Federal Railroad Administration and operated in the private sector by the Association of American Railroads, is situated on state lands adjacent to the north boundary of PCD. TTC's center for testing rail engines and cars lies about 2 mi (3 km) north of the PCD boundary. The federal government owns several small tracts east of the installation; these are managed by the Bureau of Land Management (BLM) in the U.S. Department of the Interior (DOI). Remaining land surrounding PCD is privately owned, including a private ranch adjacent to PCD boundary and north of Munitions Storage Area A.

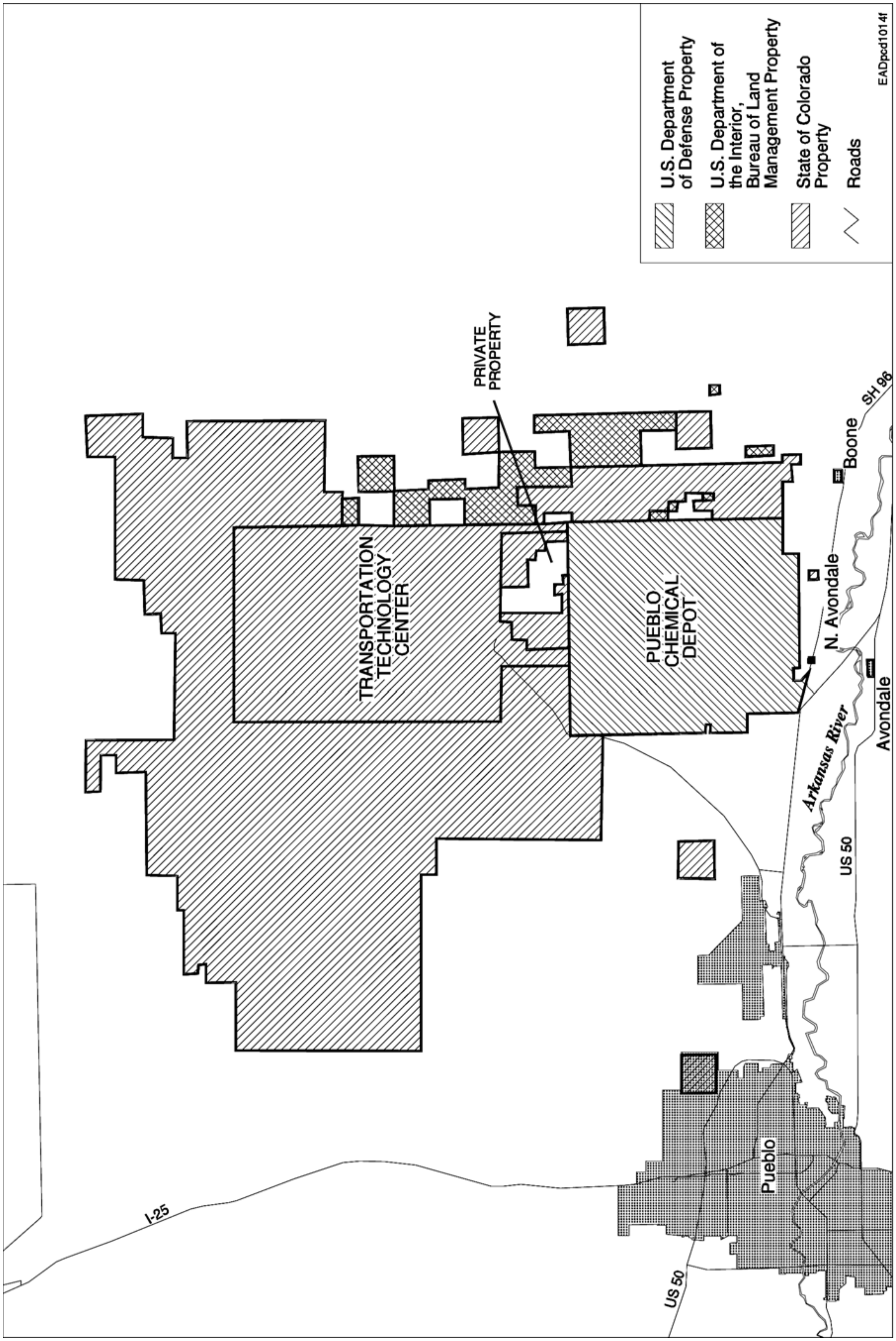

FIGURE 6.2-2 Land Ownership near PCD

Land use near PCD is mainly agricultural and zoned Agricultural One (A-1) by the Pueblo Board of County Commissioners (U.S. Army 1984). With the exception of the TTC, the state lands depicted in Figure 6.2-2 are leased for grazing (EDAW et al. 1994). The State Board of Land Commissioners maintains a multiple-use policy for land owned by the state, and the state land near PCD could be managed for wildlife and recreational purposes. However, these uses remain unexplored. The federal land managed by the BLM is leased for grazing. Because these tracts are small and noncontiguous, they are difficult to manage, and BLM is studying their future disposition. Most of the private land near the installation is also used for grazing. Land lying along the Arkansas River, roughly 2 mi (3 km) south of PCD, is used for irrigated agriculture.

Pueblo (population 102,121), located east of PCD, is the only city in Pueblo County (population 141,472) as well as the only city within a 30-mi (50-km) radius of the installation. Some areas to the south of PCD are zoned light commercial and residential, and several small communities are present there, including Boone, Avondale, and North Avondale.

During the 1990s, the population grew slowly in both Pueblo County and the city of Pueblo (U.S. Bureau of the Census 1999a,b). Land use until 2010 is likely to remain largely rural, focused on grazing and agriculture, with a concentration of trade and service activities and residential uses in the city of Pueblo.

6.2.4 Impacts on Land Use

6.2.4.1 Impacts of the Proposed Action

No impacts to land use would be expected from construction or operation of ACWA facilities. The proposed locations for the ACWA facilities are within the Chem Demil area, and any impacts from construction and normal operations would be localized in this area. Impacts from normal operations at the proposed ACWA pilot testing facilities would be consistent with proposed installation reuse and would not significantly adversely affect those proposed operations (U.S. Army 1997a). Although wildlife would be adversely affected by the construction and operation of an ACWA facility, the impacts would be consistent with the reuse areas at PCD.

Impacts resulting from the construction and normal operation of ACWA facilities would be very localized and would not adversely affect areas outside PCD. Potential small discharges that could occur during operations would have no impacts on land use off the installation. Impacts on more distant land use patterns in the city of Pueblo would be further reduced because of the increased distance.

6.2.4.2 Impacts of No Action

Under the no action alternative, storage of chemical stockpile components at PCD would continue. Land use in the immediate storage area, already identified for activities associated with chemical weapons in the current reuse plan, would also continue. This would be consistent with existing on-post and off-post plans.

6.3 INFRASTRUCTURE

Table 6.3-1 lists the annual utility requirements for an ACWA facility. Table 6.3-2 lists the approximate acreage needed for construction of an ACWA facility and associated utilities infrastructure. The following sections describe the requirements for an ACWA pilot test facility, current installation utility and infrastructure demands, and the impacts that the construction and operation of an ACWA pilot test facility would have on utilities and infrastructure.

TABLE 6.3-1 Approximate Annual Utility Demands for Operation of an ACWA Pilot Test Facility at PCD[a]

	Annual Demand	
Utility	Neut/Bio	Neut/SCWO
Electric power (GWh)	36	60
Natural gas (scf)	94,000,000	149,000,000
Fuel oil (gal)	48,000	48,000
Process water (gal)	13,000,000[b]	18,000,000[b]
Potable water (gal)	6,400,000	6,400,000
Sewage (gal)	7,500,000	7,500,000

[a] Based on 365 d of facility operation during which system operation would occur 12 h/d, 6 d/wk, and 46 wk/yr. Unit conversions: 1 scf (standard cubic foot) = 0.028 Nm^3. 1 gal = 3.8 L.

[b] The numbers used for process water for Neut/Bio and Neut/SCWO at PCD were from demonstration testing. Subsequent design studies now indicate Neut/Bio would use 5.7 million gal/yr and Neut/SCWO would use 1.3 million gal/yr.

Source: Kimmell et al. (2001).

TABLE 6.3-2 Estimated Land Area Disturbed for Construction of an ACWA Pilot Test Facility and Associated Infrastructure at PCD[a]

	Area Disturbed (acres)		
Construction Activity	Area A	Area B	Area C
Pilot facility, including sewage evaporation lagoon and electrical substation	25	25	25
Transmission lines (115-kV)			
Option 1 or 3			
Towers	1	1	1
Conductor stringing	<1	<1	<1
Option 2			
Towers	<1	<1	<1
Conductor stringing	<1	<1	<1
Construction access road[b]	9	9–10	10–11
Gas pipeline[c]	37–43	37–43	37–43
Water pipeline[c]	5–6	5	4
Maximum possible area disturbed	85	84	85

[a] Unit conversion: 1 acre = 0.4 ha.

[b] A new 35-ft-wide (11-m-wide) access road would be required from the east boundary of PCD to the construction area.

[c] The maximum width of corridor disturbed would be 60 ft (18 m).

6.3.1 Electric Power

6.3.1.1 Current Supply and Use

Currently, the Western Area Power Administration (Western) is the primary provider of electric power to PCD. Existing PCD activities consume the full Western allotment of 1,600 MWh/yr, and additional electric power is purchased each year through a supplemental contract with West Plains Energy Corporation. Southern Colorado Power Company delivers power to PCD through an existing 69-kV transmission line.

6.3.1.2 ACWA Pilot Test Facility Requirements

The electrical demands of an ACWA facility would require the purchase of additional power. Table 6.3-1 lists the amounts of electricity required by the proposed ACWA pilot test facilities. The quantity of electricity required for construction (18 GWh) would be the same for either facility. During operations, annual electricity use by Neut/Bio (36 GWh) would be 60% of the use by Neut/SCWO (60 GWh).

Neither the current power supply nor infrastructure is adequate to meet ACWA Program needs. Either additional power could be purchased to meet the needs of proposed ACWA facilities via the existing supplemental contract with West Plains Energy Corporation, or a contract with a new provider could be established. In either case, new transmission lines would need to be constructed because those currently leading to Munitions Storage Area A are old and unreliable and require frequent maintenance.

Three options exist for the transmission line (see Figure 6.3-1).

- Under Option 1, the new 115-kV line would be extended from the existing substation in the PCD office complex to the ACWA facilities along either Corridor 1 or Corridor 2, a distance of approximately 6 mi (10 km). These corridors, which would be a maximum of 60 ft (18 m), would use existing roads for access and would follow previously disturbed areas along the road rights-of-way.

- Under Option 2, electric power would be extended from an existing power line that runs parallel to the eastern boundary of PCD. Under this option, the new 115-kV transmission line would run along Corridor 3, a distance of about 3 mi (5 km), and a 35-ft-wide (11-m-wide) access road would be constructed.

- Under Option 3, electric power would be delivered from power lines along the eastern boundary (similar to Option 2, but from a point further south along an existing road way).

Because Corridors 1 and 2 are longer, implementation of Option 1 or 3 would cause more ground disturbance than would Option 2.

6.3.1.3 Impacts of the Proposed Action

Although an ACWA facility would demand substantially more electric power than is currently used at the site, the increased demand could be accommodated by existing suppliers

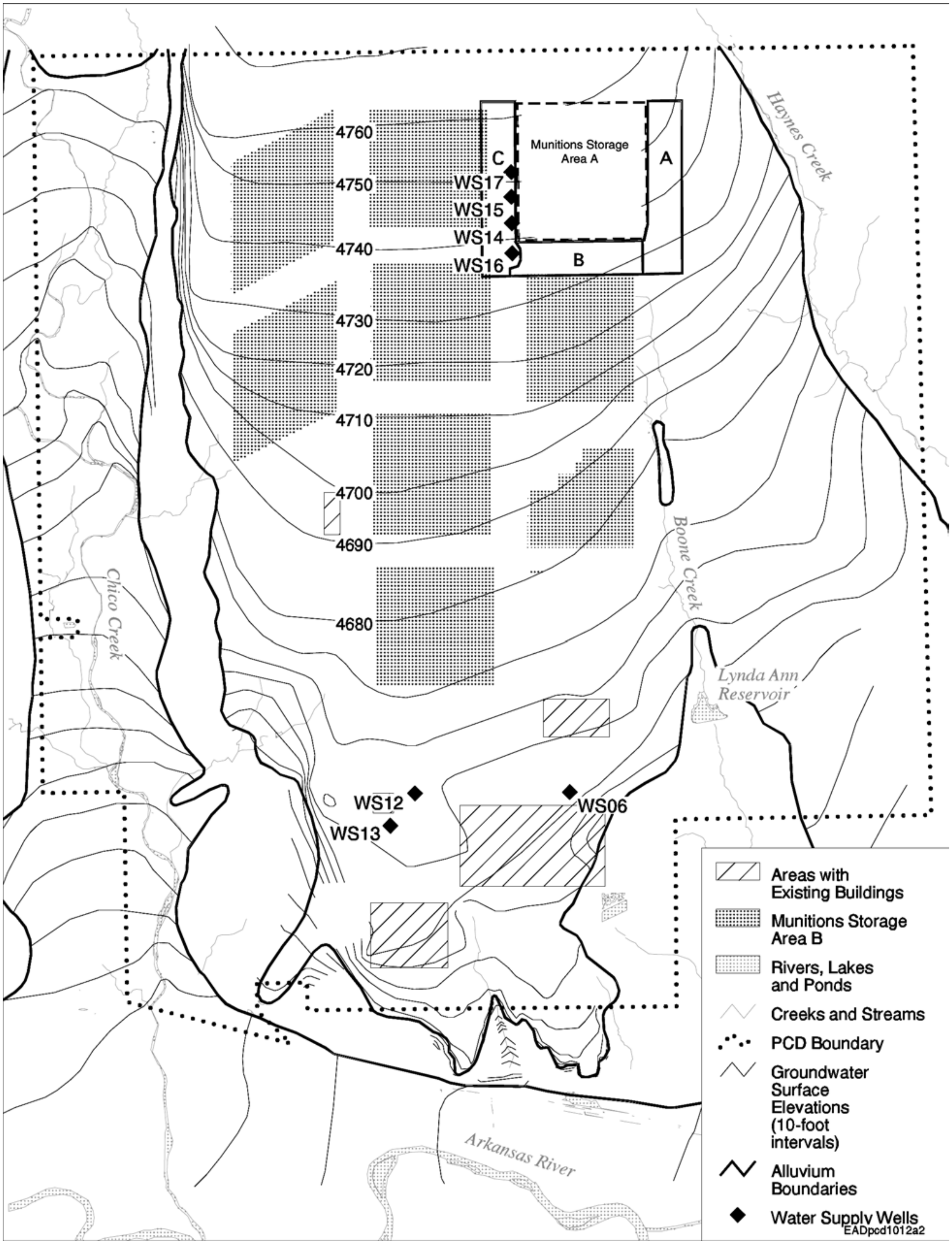

FIGURE 6.3-1 Locations of Water Supply Wells at PCD

and would not significantly affect the regional power supply. Moreover, the use of electric power by the ACWA facility would be temporary; it would cease after three years.

The provision of an additional, reliable electrical infrastructure to support ACWA facilities could have a positive effect on redevelopment initiatives, which could access the new infrastructure.

Ground disturbance impacts that would result from the construction of power facilities are discussed in this EIS under specific environmental resource areas. The only potential for significant impacts would be associated with destruction of sensitive plant habitat, as discussed in Section 6.13.3. Depending on the options chosen, these impacts could be largely avoided or mitigated.

6.3.1.4 Impacts of No Action

Under the no action alternative, the electrical upgrades required by the ACWA Program would not be undertaken. New power lines would not be installed, power usage would continue at current levels, and no ground disturbance would occur.

6.3.2 Natural Gas

6.3.2.1 Current Supply and Use

Excel Energy supplies natural gas to PCD. Currently, natural gas is used in buildings located in the administration area and in some of the warehouse buildings. The main gas line at PCD was installed in 1998 and sized to meet the requirements of Chem Demil activities. Gas pipelines do not extend to Munitions Storage Area A.

6.3.2.2 ACWA Pilot Test Facility Requirements

Table 6.3-1 lists the amount of natural gas that would be used by the proposed ACWA facilities. The quantity of natural gas used during construction would be the same for either facility. Annual natural gas use for operating a Neut/Bio system (94,000,000 scf) would be about 50% less than use for operating a Neut/SCWO system (149,000,000 scf).

The provision of natural gas to an ACWA facility would require the construction of new pipelines to the Munitions Storage Area A area. In this assessment, it was assumed that these pipelines would be installed along either Corridor 1 or 2, as shown on Figure 6.1-3. Since no gas line exists along the east PCD boundary, Corridors 3 and 4 would not be viable for running a gas supply line. For the purpose of this assessment, it was assumed that a 60-ft-wide (18-m-wide) corridor might be affected during installation of these pipelines, and that the pipelines would run along existing roadways. Construction in any of the areas A, B, or C would create a maximum of 43 acres (17 ha) of disturbance.

6.3.2.3 Impacts of the Proposed Action

The ACWA pilot test facilities would require between 94,000,000 and 149,000,000 scf of natural gas annually for approximately three years of operation. The Neut/SCWO technology would require about 50% more natural gas than the Neut/Bio technology. Excel Energy could supply this quantity to PCD without affecting regional gas supplies. Further, the use of natural gas would be temporary; it would cease after three years. Since pipelines would be laid in previously disturbed areas, no significant impacts would be expected from the installation of new pipelines.

6.3.2.4 Impacts of No Action

Under the no action alternative, a natural gas pipeline required by the ACWA Program would not be constructed. New pipelines would not be installed, no ground disturbance would occur, and natural gas consumption would remain at baseline levels.

6.3.3 Water

6.3.3.1 Current Supply and Use

Current water use is approximately 4.3 acre-ft/yr (1,400,000 gal or 5,300 m^3/yr) and is supplied from seven active water supply wells (Ebasco Environmental 1990). Figure 6.3-1 shows the location of these wells. Historically, water usage was much greater; in 1981, water usage was 290 acre-ft/yr.

Water supply wells at PCD provide water on the basis of a delivery contract with more senior water rights holders, because in most years, there is not enough water in the Arkansas River tributary aquifers to fulfill PCD’s junior water rights to extract 1,000 acre-ft/yr (1,200,000 m^3/yr) from the terrace alluvium aquifer. As a result, in order to use water on post, PCD must purchase water from more senior water rights holders. All water used at PCD has been diverted from other water rights holders and potential uses.

PCD has the capacity to treat 7,800,000 gal (29,500 m^3) of wastewater annually. Wastewater is treated on post in lagoon systems. One system is located near the administrative area, and one is near Munitions Storage Area A (Figure 6.3-2).

6.3.3.2 ACWA Pilot Test Facility Requirements

Existing water supply wells have adequate extraction capacity to meet the water use requirements for both construction and normal operations of either of the ACWA technologies. However, it is anticipated that the ACWA Program may need to establish a new contract with current water right holders in order to obtain rights to extract additional water. In addition, new water distribution pipelines would need to be installed to convey the water from the water supply wells to the Munitions Storage Area A area (see Figure 6.3-1). For this EIS, it is assumed that these pipes would be installed along Corridor 1, as shown in Figure 6.1-3.

6.3.3.3 Impacts of the Proposed Action

Estimated annual water use during construction of ACWA facilities would be 2,800,000 gal (10,600 m^3 or 8.6 acre-ft) (Kimmell et al. 2001). Existing wells have adequate capacity to meet water use requirements, although new water pipelines would need to be laid.

During operation, total annual water use (potable and process water) would be 19,400,000 gal (73,400 m^3 or 59 acre-ft) for Neut/Bio and 24,400,000 gal (92,400 m^3 or 75 acre-ft) for Neut/SCWO. Existing water supply wells have the capacity (more than 290 acre-ft/yr) to meet this additional need, and no new construction would be required. The existing sewage lagoons (see Figure 6.3-2) might need to be expanded to handle sanitary wastes.

PCD's need to purchase the right to extract additional water from more senior water rights holders could conceivably affect water use prices and other water uses in the Arkansas River drainage. However, because of the relatively small volumes of water involved, it is expected that additional water use by the ACWA pilot test facilities would have a negligible impact on these prices and other water uses.

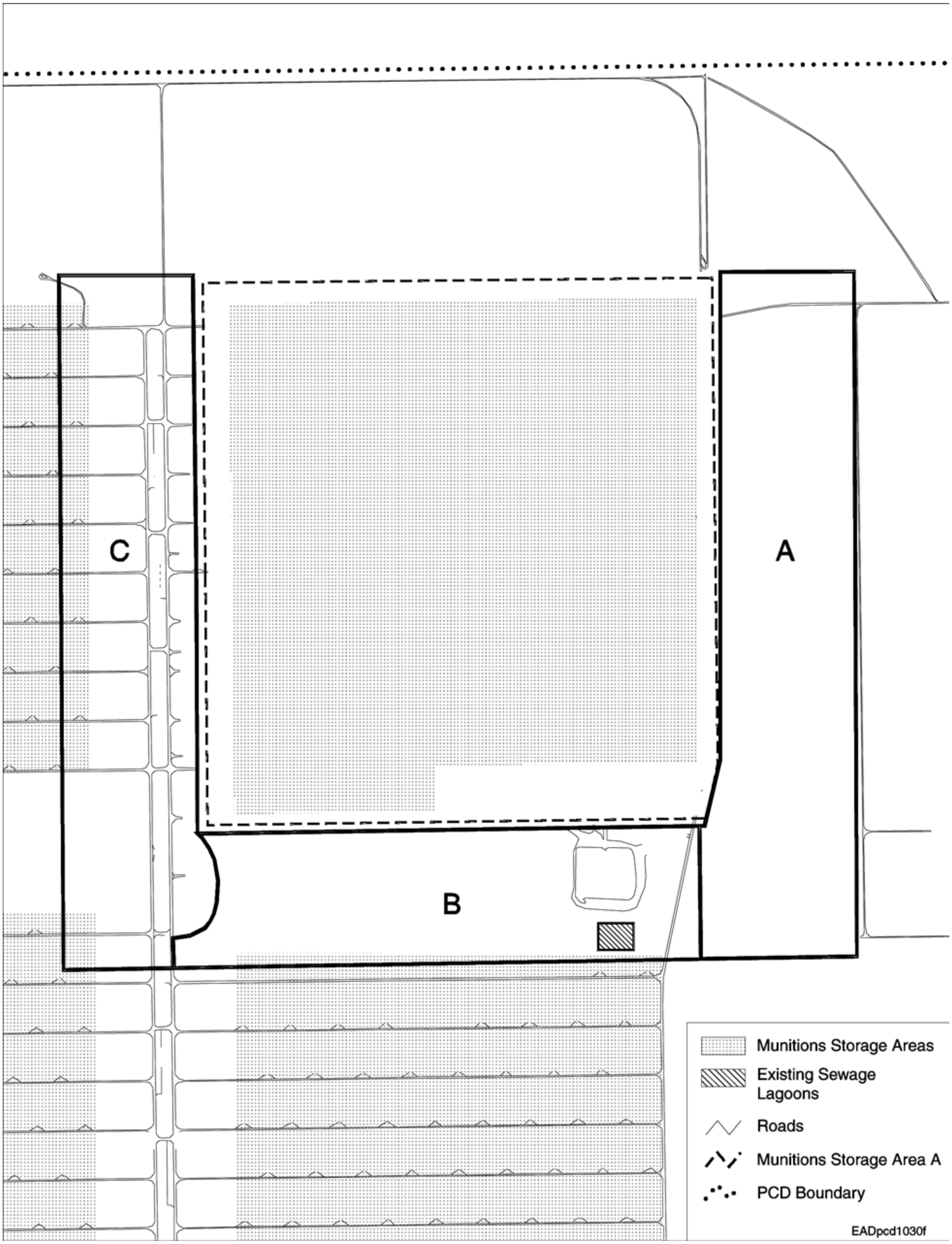

FIGURE 6.3-2 Locations of Sewage Lagoons at Munitions Storage Area A in PCD

6.3.3.4 Impacts of No Action

Under the no action alternative, water use at PCD would remain at current levels; however, water pipes would need replacement because of their age.

6.3.4 Communications

6.3.4.1 Current System

Phone and data lines are present in the main base administrative area. Analog phone lines to the other occupied buildings on post are also present. However, the phone lines to the Munitions Storage Area A area are at capacity. New phone and data lines would need to be run to the site of the proposed ACWA facilities.

6.3.4.2 ACWA Pilot Test Facility Requirements

Operation of the proposed ACWA pilot test facilities would require an upgrade of the current communication system. The upgrade would involve the installation of buried single-mode fiber-optic cable and the installation of new cables (25-pair and 100-pair) at existing interface points.

6.3.4.3 Impacts of the Proposed Action

Impacts of Construction. Construction of new communication lines would not affect existing service. Because the communication lines would follow existing, already disturbed rights-of-way, environmental impacts from ground disturbance would be minimal.

Impacts of Operation. Use of upgraded communication lines would have little if any effect on existing service. Use of these lines would also not affect redevelopment because the lines would serve only the Chem Demil area.

6.3.5.4 Impacts of No Action

Under the no action alternative, the installation of communication lines required by the ACWA Program would likely occur because of the current lines being at capacity.

6.4 WASTE MANAGEMENT

PCD currently generates a variety of solid and liquid hazardous and nonhazardous wastes, as described in Section 6.4.1. It also stores a large quantity of ACWs. While in storage, the ACWs are not considered wastes, but the residuals from processing and destruction become wastes. Wastes associated with operation of an ACWA facility would primarily be those from the residuals of ACW destruction.

6.4.1 Current Waste Management and Generation

6.4.1.1 Hazardous Wastes

PCD currently generates a variety of hazardous wastes associated with two of its missions: (1) storage of chemical munitions and (2) environmental restoration of the installation for future property transfer. Most hazardous wastes generated at PCD are packaged and transported off post to appropriately permitted treatment and disposal facilities. Activities that produce regulated wastes at PCD include:

- Facility maintenance (paints, solvents, water conditioners, etc.);
- Vehicle maintenance (used oil, batteries, coolant, etc.);
- Environmental restoration (contaminated soils, drill cuttings, personal protective equipment [PPE], etc.); and
- Chemical agent decontamination (field test materials, toxic chemical analysis reagents, personal protective equipment, etc.).

Hazardous wastes are stored at a number of locations around PCD (PCD 1999) (Figure 6.4-1). These storage sites include a permitted hazardous waste storage building with

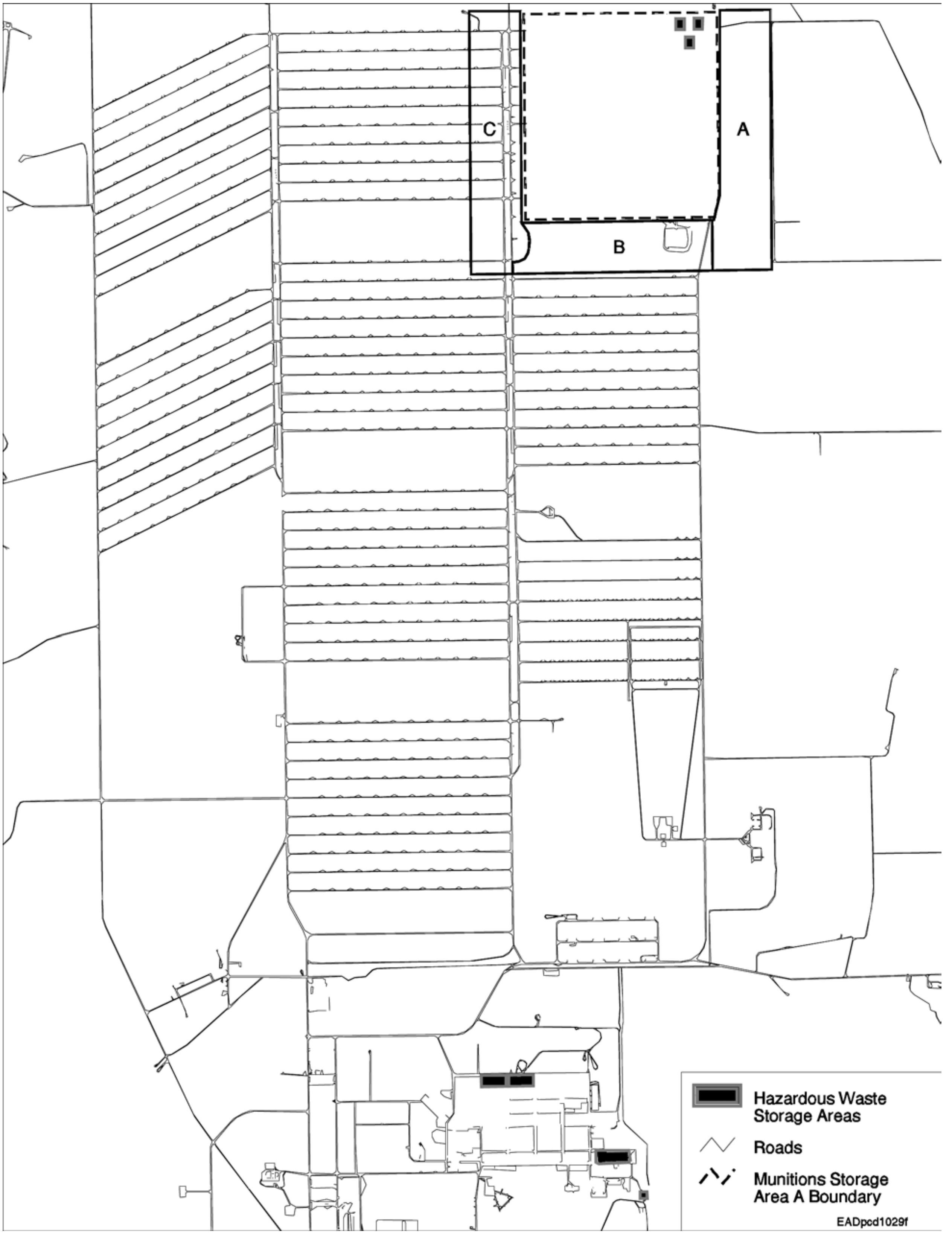

FIGURE 6.4-1 Locations of Hazardous Waste Storage Areas at PCD

secondary containment (Building 540), various temporary storage satellite accumulation points, investigation-derived waste storage areas for remediation wastes, and a temporary (90-day) drum storage area located outside and to the south of Building 529. Igloos G1009, G1109, and G1110 are permitted storage areas for liquid and solid chemical munitions wastes. Igloos G1107, G1109, and G1009 have secondary containment features because of their liquid waste storage capabilities. Building 591 and 592 are permitted for storage of contaminated soil containing explosive residues obtained from environmental restoration activities associated with the former TNT washout facility.

The amounts and types of waste generated at PCD during 1999 (U.S. Army 2000) are summarized in Table 6.4-1. Wastes that might be generated by lessees or tenants are not included in Table 6.4-1. The Master Lease prohibits lessees' generation of wastes without prior approval and stipulates the conditions of approved waste generation (PDADA 1996). (Currently, no lessees have approval to generate waste.) Tenants manage their own wastes, as outlined in various memorandums of understanding between PCD and its tenant organizations. None of the tenants generate significant quantities of hazardous wastes.

PCD has a hazardous waste management plan that outlines treatment of hazardous waste (PCD 1999). The PCD Environmental Management Division is responsible for implementing this plan. This division accepts and stores hazardous waste generated at PCD. U.S. Department of Defense (DOD) policy dictates that the Defense Reutilization and Marketing Office (DRMO) take physical custody of hazardous waste whenever its storage capabilities are greater than or equal to the generator's capabilities. The DRMO is also responsible for the ultimate disposal of hazardous waste stored at PCD and oversight of the transportation of hazardous waste off post to appropriately permitted disposal facilities.

6.4.1.2 Nonhazardous Wastes

PCD generates a variety of nonhazardous solid wastes, such as office trash, debris, used equipment and tools, and uncontaminated PPE. These wastes are collected and disposed off post by a licensed solid waste hauler, currently Waste Management of Pueblo. The site has a recycling plan that outlines procedures for recycling office paper and newspapers (PCD 2000a). Nonhazardous liquid effluent is discussed in Section 6.3.3 on water.

6.4.2 ACWA Pilot Test Facility Waste Generation and Treatment Requirements

The construction and operation of an ACWA pilot test facility would generate an array of solid and liquid wastes, both hazardous and nonhazardous. Estimates of waste generated during construction are based on waste generation from construction of comparable buildings, scaled by building size and number of construction workers (full-time equivalents or FTEs). The types and

TABLE 6.4-1 Hazardous Wastes Generated at PCD in 1999[a]

Type of Waste	Amount Generated	Shipped Off Post?
Hazardous liquids	33,870 lb[b]	Yes
Hazardous solids	12,200 lb[b]	Yes
Hazardous contaminated soils	83,000 lb	Yes
Hazardous contaminated soils[c]	~7,500 tons	No
Contaminated groundwater[d]	205,000,000 gal	No

[a] Unit conversions: 1 lb = 0.45 kg. 1 gal = 3.8 L.

[b] 1999 numbers for hazardous solids and hazardous liquids include one-time disposals of accumulated wastes (10,200 solid wastes) and expired decontamination fluid (2,100 liquid wastes). In 1997, annual accruals of hazardous solids and liquids were 8,300 lb and 21,000 lb, respectively.

[c] Contaminated soil is being composted at Building 591 (at a rate of approximately 7,500 tons/yr). The project that has been generating the contaminated soil (which is approved by the Colorado Department of Public Health and Environment [CDPHE]) is almost complete. Current plans call for the complete treatment of soil stored at Building 591 in 2001.

[d] Contaminated groundwater is generated by the on-post pump and treat system, ICAGRS (Interim Corrective Action Groundwater Remediation System).

Source: U.S. Army (2000).

amounts of waste generation expected from the operation of an ACWA test facility have been estimated by using the techniques of stoichiometric mass balance[1] for each unit process coupled with the analytical results obtained from initial demonstration tests for each technology. This technique relies on a number of assumptions that have not yet been fully verified (Kimmell et al. 2001). How sensitive these estimated results are to the various assumptions used in this procedure has not been determined.

The Neut/Bio facility is anticipated to be larger than the Neut/SCWO facility and thus projected to generate larger quantities of construction wastes (see Table 6.4-2). Current waste management facilities would be adequate to handle construction waste from either facility;

[1] Calculations are based on the principle of the conservation of mass in chemical reactions (i.e., the total mass in is equal to the total mass out).

however, the wastewater lagoon might need to be expanded to handle an increased amount of sanitary waste.

Wastes resulting from normal operations of an ACWA facility would include components from the treatment of metal parts and dunnage as well as process residues, such as contaminated salts generated from treating chemical agents and energetics (see Section 6.4.3.2). Current operating plans include recycling all process liquids obtained during the operations phase of both technologies back through the reaction vessel. Such recycling would eliminate these liquids from the waste streams. Either of the proposed ACWA technologies would produce significant quantities of potentially hazardous solid wastes. The Neut/SCWO technology would produce approximately 1,900 tons of brine salt waste annually, which would be 5% more than the total amount of brine salt waste generated by the Neut/Bio technology. The Neut/Bio technology would produce 1,000 tons of biomass; the Neut/SCWO technology would not produce this waste stream.

All of the proposed ACWA technologies would produce brine salts as solid waste. These salts could contain significant amounts of toxic heavy metals (e.g., lead). Such solid waste would probably fail the *Resource Conservation and Recovery Act (RCRA)* Toxicity Characteristic Leaching Procedure (TCLP). If so, the hazardous salt waste would need to be stabilized by a procedure that would reduce leaching of the heavy metal to a level that would allow it to be approved for land disposal as a hazardous solid waste. Salt wastes have proven somewhat difficult to stabilize, so additional studies might be required to identify an effective stabilization technology. If stabilization of the solid salt waste was required, either a waste management process for stabilizing the waste would be needed on post, or the waste would need to be shipped off post to an appropriately permitted waste treatment facility. Commercial facilities exist for managing this type of waste.

6.4.3 Impacts of the Proposed Action

6.4.3.1 Impacts of Construction

Estimates of waste generated during construction are based on waste generation from construction of comparable buildings, scaled by building size and number of construction workers (FTEs). The methodology and assumptions used to make waste generation estimates are described in Kimmell et al. (2001).

Hazardous Wastes. Construction activities would generate small amounts of both solid and liquid hazardous wastes such as solvents, paints, cleaning solutions, waste oils, contaminated rags, and pesticides (Table 6.4-2). The Neut/Bio facility is expected to be larger than the Neut/SCWO facility; thus, it is projected to generate larger quantities of construction wastes.

Current waste management facilities would be adequate to handle construction waste from either facility.

No important impacts would be expected from the generation of hazardous wastes during construction of the ACWA facilities. It is assumed that most wastes generated during construction would be collected and disposed of off post in accordance with U.S. Army, state, and federal regulations. Any wastes defined as hazardous in the RCRA regulations would be stored and disposed of off post as prescribed by the EPA and applicable state and local regulations. Existing on-post and off-post facilities would be adequate to handle the increased wastes generated by construction of the ACWA facilities, and no significant impacts would be expected to the internal, temporary storage facilities or to the off-post treatment facilities.

Nonhazardous Wastes. Construction activities would generate both solid and liquid nonhazardous wastes. Nonhazardous solid wastes would be primarily in the form of building material debris and excavation spoils (Table 6.4-2). The Neut/SCWO facility would be smaller than the Neut/Bio facility and consequently would generate less nonhazardous solid wastes. No significant impacts would be expected from the generation of nonhazardous solid wastes during construction of an ACWA facility. Nonhazardous solid wastes would be collected and disposed of by a licensed waste hauler.

Construction activities would generate liquid nonhazardous wastes as wastewater from washdowns and as sanitary wastes (Table 6.4-2). Construction of the Neut/SCWO facility would

TABLE 6.4-2 Wastes Generated during Construction of an ACWA Pilot Test Facility at PCD

Waste	Neut/Bio	Neut/SWCO
Hazardous wastes		
Solid (yd^3)	80	90
Liquid (gal)	31,000	35,000
Nonhazardous wastes		
Solid		
Concrete (yd^3)	200	200
Steel (tons)	32	36
Other (yd^3)	1,600	1,600
Liquid		
Wastewater (gal)	2,000,000	2,300,000l
Sanitary (gal)	4,500,000	5,100,000

Source: Kimmell et al. (2001).

be expected to generate as much as 5,100,000 gal (19,000 m^3) of sanitary waste (Kimmell et al. 2001). Construction of the Neut/SCWO facility would require a larger work force and therefore would generate slightly more sanitary waste than construction of the Neut/Bio facility (which would generate 4,500,000 gal or 17,000 m^3).

Sanitary sewage generated during construction would be disposed of on post in a lined evaporative lagoon facility. No important impacts would be expected from the generation of wastewater during construction of an ACWA facility. The existing evaporative lagoon might need to be expanded to handle the wastewater generated by the ACWA facility construction.

6.4.3.2 Impacts of Operations

Munitions are not generally considered wastes while they are in storage. Typically, munitions are considered wastes upon their removal from storage for treatment and disposal or if they are no longer usable. However, the Army has declared M55 rockets in storage as hazardous waste because of their obsolescence. Upon the destruction and processing of a munition, the residues do become wastes. Wastes resulting from the normal operations of an ACWA pilot facility would include components from the treatment of metal parts and dunnage as well as process residues (e.g., contaminated salts generated from treating chemical agents and energetics). An ACWA pilot test facility would also generate a number of nonprocess wastes (e.g., office trash, PPE, decontamination solution, spent carbon filters). The ACWA pilot test facility would recycle all process liquids obtained in the operation phase back through the reaction vessel. Such recycling would eliminate these liquids from the waste streams.

Hazardous Wastes. Wastes that would be generated from the operation of an ACWA pilot test facility are summarized in Table 6.4-3. The numbers in Table 6.4-3 account only for waste streams that would be produced by the two technologies and do not account for wastes that would be generated by storage, which would include primarily contaminated solids, such as PPE and pallets, and also a small quantity of contaminated liquids in the form of decontamination water. PCD would continue to generate wastes associated with storage at decreasing rates during ACWA facility operation until the stockpile was destroyed. Generally, these quantities of wastes would be small (see Section 6.4.4).

The brine salts produced by either of the proposed ACWA pilot test facilities could contain significant amounts of toxic heavy metals (e.g., lead). Such solid waste would probably fail the RCRA TCLP tests. If so, the hazardous salt waste would need to be stabilized by a procedure that would reduce leaching of the heavy metal to a level that would allow it to be approved for land disposal as a hazardous solid waste. Salt wastes have proven somewhat difficult to stabilize, so additional studies might be required to identify an effective stabilization technology. If stabilization of the solid salt waste would be required, either a waste management facility for stabilizing the waste would need to be constructed at PCD, or, alternatively, the waste

TABLE 6.4-3 Hazardous Wastes Generated Annually from the Operation of an ACWA Pilot Test Facility at PCD

	Amount of Waste Generated (tons/yr unless noted) per Technology	
Hazardous Waste	Neut/Bio[a]	Neut/SWCO[a]
Brine salts	1,800	1,900
Sodium sulfate	550	900
Sodium chloride	700	700
Sodium phosphate	-[b]	50
Sodium bisulfate	140	-
Ammonium phosphate	40	-
Water in salt cake	280	250
Other salts	50	-
Lead oxide	280 lb/yr	-
Biomass	1,000	-
Biomass solids	650	-
Water in biomass	350	-

[a] There are 276 d/yr of operation for both technologies.

[b] A hyphen means that the waste stream is not generated by the specific technology.

Sources: Mitretek (2001a,b); Kimmell et al. (2001).

would need to be shipped off post to an appropriately permitted waste facility (*Code of Colorado Regulations*, Title 6, Section 1007-3 [6 CCR 1007-3] Parts 262, 264, and 268). Commercial facilities exist for managing this type of waste.

If a generator produces waste streams that are listed as hazardous under federal or state law, that generator may choose to conduct a demonstration to show that the waste is nonhazardous (referred to as an exclusion; see 40 CFR 260.22). If the exclusion is granted, the waste is delisted and can then be disposed of as a nonhazardous solid waste, resulting in an important cost savings. Delisting a waste depends on the types and amounts of minor constituents in the waste and their variation with fluctuations in the operating parameters. The destructive efficiency of the ACWA process and the amounts of hazardous intermediates produced could vary significantly with operating conditions. In the case of PCD, it is known that the residuals from treating chemical agent would be defined and listed as hazardous waste by the Colorado hazardous waste regulations. However, information on the waste streams that could result from the ACWA technologies is not sufficient to determine if a delisting could be obtained.

The potential impacts of the ACWA technologies on waste management facilities would depend on the outcomes of the RCRA TCLP tests or potential delisting of the wastes. Treating all salt and/or biomass wastes as hazardous wastes would impact waste management procedures and facilities.

Neutralization/Biotreatment. A number of process-related waste streams would be generated from the Neut/Bio technology (Table 6.4-3). Salts and biomass would be extracted from the bioreactor effluents, treated further, and dried to be disposed of as solid hazardous waste. The liquids obtained from the further treatment of the bioreactor effluents would be recycled back through the bioreactor, thus eliminating the release of any process liquid wastes.

Various types of nonprocess wastes would be generated from the operation of this technology, including dunnage, PPE, spent carbon filters, pallets, and decontamination solution. These wastes could potentially be contaminated by an agent; such contamination would require treatment. The liquid wastes would be recycled back through the system. Nonprocess solid wastes would be treated by metal parts treatment, which would result in approximately 200 tons of residual brine waste; these wastes are included in the overall brine waste numbers shown in Table 6.4-3.

If the brine salt and biomass wastes would fail the RCRA TCLP tests, some type of stabilization of these wastes would be necessary. Depending on the technology chosen and the amount of loading of the wastes in the stabilization matrix, the amount of stabilized waste could easily exceed the hazardous waste estimates given in Table 6.4-3 by a factor of approximately 2.5. If stabilization of the solid salt waste would be required, either a waste management process for stabilizing the waste would be needed, or, alternatively, the waste would need to be shipped off post to an appropriately permitted treatment facility. Depending on the treatment chosen, a new facility might need to be constructed or an existing off-post commercial facility might need to handle the solid salt waste.

Neutralization/SCWO. Sources of operational wastes from the SCWO units would include various process wastes (see Table 6.4-3). These process effluents from the SCWO units would be combined, and brine salts (mostly sodium sulfate, sodium chloride, and sodium phosphate) would be extracted and dried for disposal as solid hazardous waste. No liquid wastes would be released from the process, since process liquids would be recycled back into the SCWO units.

The Neut/SCWO technology would also generate nonprocess operational wastes, including primarily dunnage, PPE, spent carbon filters, pallets, and decontamination solution. These wastes could potentially be contaminated by an agent; such contamination would require treatment. Current operating plans include recycling all nonprocess liquids obtained in the operation phase back through the reaction vessel. Such recycling would eliminate these liquids from the waste streams. Recycling of contaminated nonprocess solid wastes, which would also be recycled back into the system, would result in approximately 250 tons of brine waste; these wastes are included in the overall brine waste numbers shown in Table 6.4-3.

If the brine salts generated by the Neut/SCWO process would fail the RCRA TCLP tests, some type of stabilization of the salt would be necessary. Depending on the technology chosen and the amount of loading of the salt wastes, the amount of stabilized salt waste could easily exceed the salt waste estimate given in Table 6.4-3 by a factor of approximately 2.5. If stabilization of the solid salt waste would be required, either a waste management process for stabilizing the waste would be needed, or, alternatively, the waste would need to be shipped off post to an appropriately permitted treatment facility. Depending on the treatment chosen, a new facility might need to be constructed or an existing off-post commercial facility might need to handle the solid salt waste.

Nonhazardous Wastes. The operation of an ACWA pilot test facility would generate both solid and liquid nonhazardous wastes. Estimates of nonhazardous solid wastes associated with facility operations were made by scaling data on comparable buildings for the size of the operating work force (Kimmell et al. 2001) (Table 6.4-4). These numbers would be expected to be the nearly same for the two technologies, since the facilities would have similar work force

TABLE 6.4-4 Nonhazardous Solid Wastes Generated Annually from the Operation of an ACWA Pilot Test Facility at PCD

	Amount of Waste Generated per Technology	
Nonhazardous Solid Waste	Neut/Bio	Neut/SWCO
Recyclable wastes (yd^3)[a]	640	640
Metal waste (tons)	7,200	7,200
Other solid wastes (yd^3)[b]	1,600	1,600

[a] Recyclable wastes include paper and aluminum.

[b] Domestic trash and office waste.

Sources: Mitretek (2001a,b); Kimmell et al. (2001).

numbers. No significant impacts would be expected from the generation of nonhazardous solid wastes during operation of an ACWA facility. Nonhazardous solid wastes would be collected and disposed of by a licensed waste hauler. In each technology, recyclable metals would be generated from decontamination of various munition parts. These are listed in Table 6.4-4.

Nonprocess waste would also generate small quantities of metal waste, which are included in Table 6.4-4.

Liquid nonhazardous wastes (i.e., wastewater) would be similar for both of the ACWA technologies being considered. During normal operations, both the Neut/Bio facility and the Neut/SCWO facility would generate an estimated 7,500,000 gal/yr (28,000 m^3/yr) of sanitary sewage (Kimmell et al. 2001).

No impacts would be expected from the generation of wastewater during operation of an ACWA facility. Nonhazardous liquid wastes generated during operation would be disposed of on post in a lined evaporative lagoon facility. The existing evaporative lagoon might need to be expanded to handle the wastewater generated by the ACWA facilities, but there is land available for this purpose.

6.4.4 Impacts of No Action

6.4.4.1 Hazardous Wastes

Construction activities related to ACWA pilot facility testing would not occur under the continued storage alternative. Continued storage of munitions at PCD would generate relatively small quantities of hazardous wastes and contaminated solids associated with the cleanup of leaks and spills, such as PPE, pallets, and dunnage.[2] Storage generates an estimated 500 lb (230 kg) of liquid wastes (decontamination water) and less than 100 lb (45 kg) of hazardous solid waste from PPE and pallets (Smith 2000a). The continued degradation of agent containers over time would probably slowly generate increasing amounts of waste from leaks, but, again, these quantities would be relatively small.

Continued storage of chemical weapons at PCD would not adversely affect waste management. Hazardous wastes are collected and disposed of off post in accordance with U.S. Army, state, and federal regulations. Any wastes determined to be hazardous in the RCRA regulations are stored and disposed of off post as prescribed by the EPA and applicable state and local regulations.

6.4.4.2 Nonhazardous Wastes

Construction activities associated with pilot testing would not occur under the continued storage alternative. A small amount of nonhazardous solid waste and nonhazardous sanitary

---

[2] In 1999, PCD generated approximately 10,000 lb (4,536 kg) of solid wastes and 5,200 lb (2,359 kg) of uncontaminated decontamination liquid associated with munitions storage. These numbers are higher than average on the basis of one-time disposals of excess and stockpiled materials.

waste would be generated during activities associated with the storage of chemical weapons. These wastes would be handled by the existing systems. Continued storage of chemical weapons at PCD would not adversely affect waste management. Facilities exist to handle sanitary waste, and solid wastes would be hauled off post by a licensed contractor.

6.5 AIR QUALITY — CRITERIA POLLUTANTS

This section describes existing the meteorology and air quality at PCD and the air emissions and consequences on air quality that might result from constructing and operating a pilot test facility for ACW destruction at PCD. Potential air emissions and consequences on air quality under the no action alternative are also described. Potential impacts on human health as a result of air emissions during construction and normal operations are described in Sections 6.6 and 6.7. Potential impacts on air quality and human health as a result of air emissions from accidents involving explosives and chemical agents are described in Section 6.21.

The analysis of impacts on air quality from both construction and operation was conducted for Area A (see Figure 6.1-2), which is the area closest to the PCD installation boundary in the direction of the nearest off-post residence. The three potential locations for pilot test facilities are adjacent to one another and would require similar infrastructure. Therefore, the analysis of one location provided an adequate representation of the potential impacts from construction on air quality near PCD for any of the three facility locations.

Because the facility size, number of construction workers, and infrastructure required for each of the ACWA pilot test facilities proposed for pilot testing would be similar, only one model analysis of the impacts from construction on air quality was conducted. The facilities are expected to differ in the amount of fossil fuel they would combust to generate heat.

The analyses presented in the following sections conclude that the concentrations of particulates in the air that would result from fugitive dust emissions during construction would be below applicable standards. Concentration increments of air pollutants due to emissions from operations would also be within applicable standards, although because of the Neut/Bio system's lower process heat requirements, the emission levels from fossil fuel combustion would be less for the Neut/Bio technology than for the Neut/SCWO technology. However, operation of either technology, by itself or added to background, would be within applicable standards.

6.5.1 Current Meteorology, Emissions, and Air Quality

6.5.1.1 Meteorology

The climate of the area surrounding PCD is semiarid and marked by large daily temperature variations. The following description of climate is based on data recorded at Pueblo Municipal Airport located about 10 mi (16 km) west-southwest of PCD (National Oceanic and Atmospheric Administration [NOAA] 1999), except for wind data that were measured at the height of 33 ft (10 m) at the on-post meteorological tower.

The wind rose, which is based on the Chem Demil tower[3] data recorded on post at PCD for the two-year period 1998 through 1999, is shown in Figure 6.5-1 (Rhodes 2000). For the 1998–1999 period, average annual wind speed was about 8.5 mi/h (mph) (3.8 m/s), and the seasonal average wind speed of 9.8 mph (4.4 m/s) was highest in spring. The wind rose indicates that the prevailing wind at PCD is from the north-northwest, with a secondary peak from the southeast. Irrespective of the season, prevailing wind is from the southeast during the day and from the north-northwest during the night. In general, wind speeds at night tend to be lower than those during the day. During the 1998–1999 period, the highest wind speed measured at PCD was about 44 mph (20 m/s).

The average annual temperature at Pueblo Municipal Airport is 52°F (11°C). January is the coldest month, averaging 29°F (–2°C), and July is the warmest month, averaging 77°F (25°C). Extreme temperatures ranged from –31°F (–35°C) in February 1951 to 108°F (42°C) in June 1990. The number of freeze-free days per year (i.e., days when the daily-minimum temperature is greater than 32°F [0°C]) is about 209, and there are no freeze days in June through August. Temperatures of 90°F (32°C) or higher occur on an average of 65 days per year, with 55 of those days occurring during June, July, and August. Winter cold spells are sometimes broken after a few days by warm, dry winds from the west.

Average annual precipitation at Pueblo Municipal Airport is about 11 in. (28 cm). About 75% of the annual precipitation falls during April through September. July and August have the most precipitation, averaging about 2.1 in. (5.3 cm) and 2.0 in. (5.1 cm), respectively. The greatest amount of precipitation in a single month was 6.2 in. (15.7 cm) in April 1942, and the greatest amount in a 24-hour period was 3.8 in. (9.6 cm) in October 1957. Winter snowfall averages about 31.8 in. (80.8 cm). The greatest amount of snow reported in a single month was 29.3 in. (74.4 cm), which occurred in November 1946, and the greatest amount during a 24-hour period was 16.8 in. (42.7 cm) in April 1990.

---

[3] Currently, six meteorological towers (five Chemical Stockpile Emergency Preparedness Program [CSEPP] towers and one Chem Demil tower) are operating at PCD. Wind data from the Demil tower were selected to represent the conditions at PCD because the tower meets the EPA's siting criteria and because the instrument and associated data were checked for quality assurance/quality control (QA/QC) more comprehensively than were the data from CSEPP towers (Rhodes 2000).

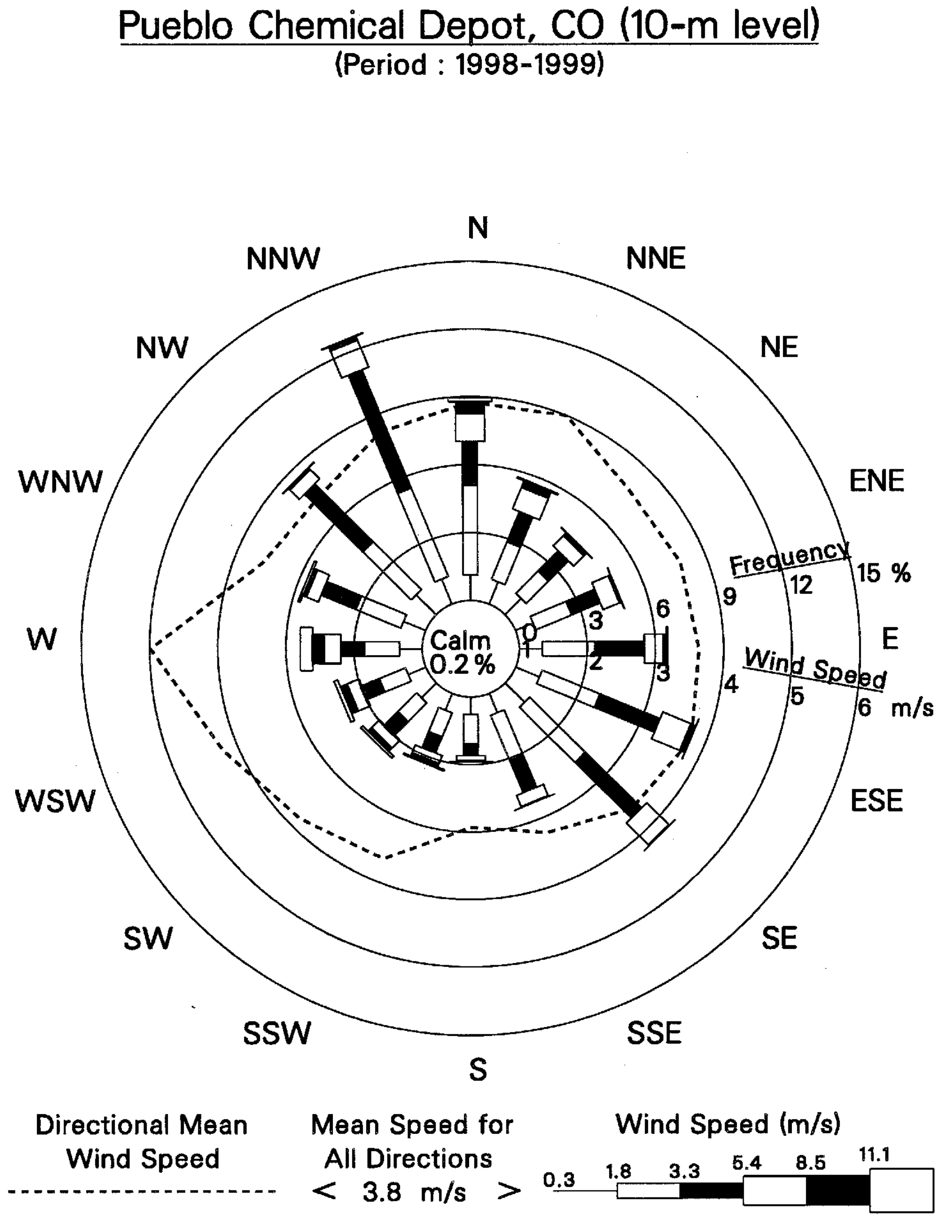

FIGURE 6.5-1 Annual Wind Rose for PCD in 1998–1999 (Source: Rhodes 2000)

Average annual relative humidity at the Pueblo Municipal Airport ranges from 36 to 41% for the daytime hours and from 58 to 68% for nighttime hours. Low humidity in the region limits the occurrence of heavy fog (when visibility is 0.25 mi [0.4 km] or less) to about 10 days per year. Fog in summer is very rare. Thunderstorms occur on an average of 41 days per year. More than 85% of the thunderstorms occur during the four-month period of May through August. Dust storms are frequent during the spring months of abnormally dry years, especially in areas where dry farming (farming without irrigation) is practiced.

Tornadoes are rare in the area surrounding PCD. For the 46-year period of 1950 through 1995, 1,161 tornadoes were reported in Colorado (tornado event frequency of $2.4 \times 10^{-4}/mi^2$ per year and an average of 25 tornadoes per year) (Storm Prediction Center 2000). For the same period, only 9 tornadoes were reported in Pueblo County (tornado event frequency of $8.2 \times 10^{-5}/mi^2$ per year). The mountain ranges west of the county provide a barrier to much of the westward flow of moist air that produces the thunderstorms that often lead to tornadoes.

6.5.1.2 Emissions

On the basis of its current emissions, PCD is classified as a "synthetic minor source" and operates under a synthetic minor permit from CDPHE (Pueblo Depot Activity 1995). This type of source is defined as an emission source with potential emissions of less than 250 tons/yr for all criteria pollutants or less than 100 tons/yr for each individual criteria pollutant. The synthetic minor permit is being updated to reflect fewer emission sources. Permitted emission sources at PCD include building heaters, emergency generators, and five boilers operating in the Chem Demil area (Whorton 2000a). There are also a number of small emission sources classified as insignificant activities within the PCD air permit. Other emissions include vehicle exhaust emissions and fugitive particulate emissions including road dusts. Emission estimates for these sources are presented in Table 6.5-1.

In 1994, the annual total emissions from all categories of PCD sources, including those with permits from the CDPHE, were about 1.91 tons of sulfur dioxide (SO_2), 1.98 tons of nitrogen oxides (NO_x), 5.04 tons of carbon monoxide (CO), 15.9 tons of volatile organic compounds (VOCs), 13.1 tons of coarse particulate matter (PM_{10}),[4] and less than 0.01 ton of lead (Pb). Annual estimates of air pollutants emissions in 1996 from Pueblo County and PCD are listed in Table 6.5-2. The significance of PCD emissions is expressed as a percentage of the total Pueblo County emissions. As the table indicates, PCD emissions account for very small fractions of the emissions released from the Pueblo County, that is, about 0.19%, 0.15%, 0.12%, 0.01%, and 0.01% of the total Pueblo County emissions for VOCs, PM_{10}, NO_x, SO_2, and CO, respectively.

6.5.1.3 Air Quality

PCD is located in Colorado State Air Quality Control Region (AQCR) 7, which covers the south central part of Colorado (Figure 6.5-2). The Colorado State Ambient Air Quality Standards (SAAQSs) reflect the pre-1997 federal standards for concentrations of six criteria pollutants — sulfur oxides (as SO_2), PM_{10}, CO, ozone (O_3), nitrogen dioxide (NO_2), and Pb.

[4] PM = particulate matter. PM_{10} = coarse, inhalable particulate matter with a mean aerodynamic diameter of 10 μm or less. PM = fine, inhalable $PM_{2.5}$ with a mean aerodynamic diameter of 2.5 μm or less.

TABLE 6.5-1 Estimated Emissions of Air Pollutants from Existing PCD Sources in 1994

	Emissions (tons/yr)					
Source Category	SO_2	NO_x	CO	VOC	PM_{10}	Pb
Stationary sources						
Boilers/heaters	0.6	1.1	0.5	0.1	0.2	< 0.01
Generators	0.05	0.78	0.18	0.06	0.06	-[a]
Fuel storage and dispensing	-	-	-	2.44	-	-
Degreasing and abrasive blasting	-	-	-	0.17	-	-
Woodworking	-	-	-	-	1.3	-
Miscellaneous[b]	-	-	-	0.12	< 0.01	-
Subtotal	0.65	1.88	0.68	2.89	1.56	< 0.01
Fugitive sources						
Open detonation	1.26	0.04	2.21	-	1.5	-
Firefighting	-	0.06	1.94	0.26	0.23	-
Landfills	-	-	0.21	12.7	-	-
Road dust	-	-	-	-	9.47	-
Miscellaneous[c]	-	-	< 0.01	0.02	0.34	-
Subtotal	1.26	0.1	4.36	12.98	11.54	-
Total	1.91	1.98	5.04	15.87	13.1	< 0.01

[a] A hyphen means that there was no emission, the emission was negligible, or the emission was not estimated.

[b] Includes emissions from the medical clinic, welding, vapor containment chamber, and other sources.

[c] Includes emissions from storage piles, the firing range, applications of pesticides and herbicides, and other sources.

Source: PDA (1995).

The Colorado SAAQS are identical to the National Ambient Air Quality Standards (NAAQS), except Colorado has stricter standards for 3-hour SO_2 and Pb (CDPHE 1999, 2001). In 1997, the EPA revised the NAAQS for O_3 and PM. The standards were challenged, and the lower court decision was appealed to the U.S. Supreme Court. On February 27, 2001, the U.S. Supreme Court unanimously upheld the constitutionality of the CAA as the EPA had interpreted it in setting the $PM_{2.5}$ and O_3 standards. However, the case was remanded back to the D.C. Circuit Court of Appeals to resolve the remaining issues, which include EPA's justification for the numerical levels. While the case is pending, the O_3 and fine particle standards remain in effect as a legal matter, because the D.C. Circuit Court decision did not vacate the standards. The EPA has not, however, started implementing the revised $PM_{2.5}$ and O_3 standards.

TABLE 6.5-2 Estimated Emissions of Air Pollutants from Pueblo County and PCD Sources in 1996

	Emissions (tons/yr)	
Air Pollutant	Pueblo County	PCD[a]
SO_2	13,898	1.9 (0.01)
NO_x	14,440	16.9 (0.12)
CO	52,302	4.1 (0.01)
VOCs	8,484	16.3 (0.19)
PM_{10}	10,674	16.5 (0.15)

[a] Actual emissions.

Source: EPA (2001a).

Colorado is currently designated as being in attainment for all criteria pollutants, except for CO in Colorado Springs, Denver, Fort Collins, and Longmont and except for PM_{10} in Aspen, Canon City, Denver, Lamar, Pagosa Springs, Steamboat Springs, and Telluride (40 CFR 81.306). The ambient air quality in the state is good and continues to improve. According to CDPHE (1999), there were no violations of the NAAQSs in Colorado for the last four years.

In Pueblo County, a major modification at a steel mill (shutdown of four blast furnaces and two basic oxygen furnaces) has resulted in significant improvement in air quality since the early 1980s. In fact, the measurement of CO was discontinued in Pueblo County in 1986 because the data that had been gathered were close to background levels or low with respect to applicable ambient standards. Only PM_{10} was monitored in the 1990s, and recently $PM_{2.5}$ measurements were initiated (Rink 2000). Particulates are primarily emitted from vehicular traffic on unpaved roads, agricultural activities, and mining. Pueblo has no record of exceeding the PM_{10} or $PM_{2.5}$ standards.

Table 6.5-3 presents the NAAQS, Colorado SAAQS, allowable PSD increments, and highest ambient concentrations measured at the monitoring stations nearest to PCD. Prevention of significant deterioration (PSD) regulations (40 CFR 52.21) limit the maximum allowable incremental increases in ambient concentrations above established baseline levels for SO_2, NO_2, and PM_{10}. The PSD regulations, which are designed to protect ambient air quality in attainment

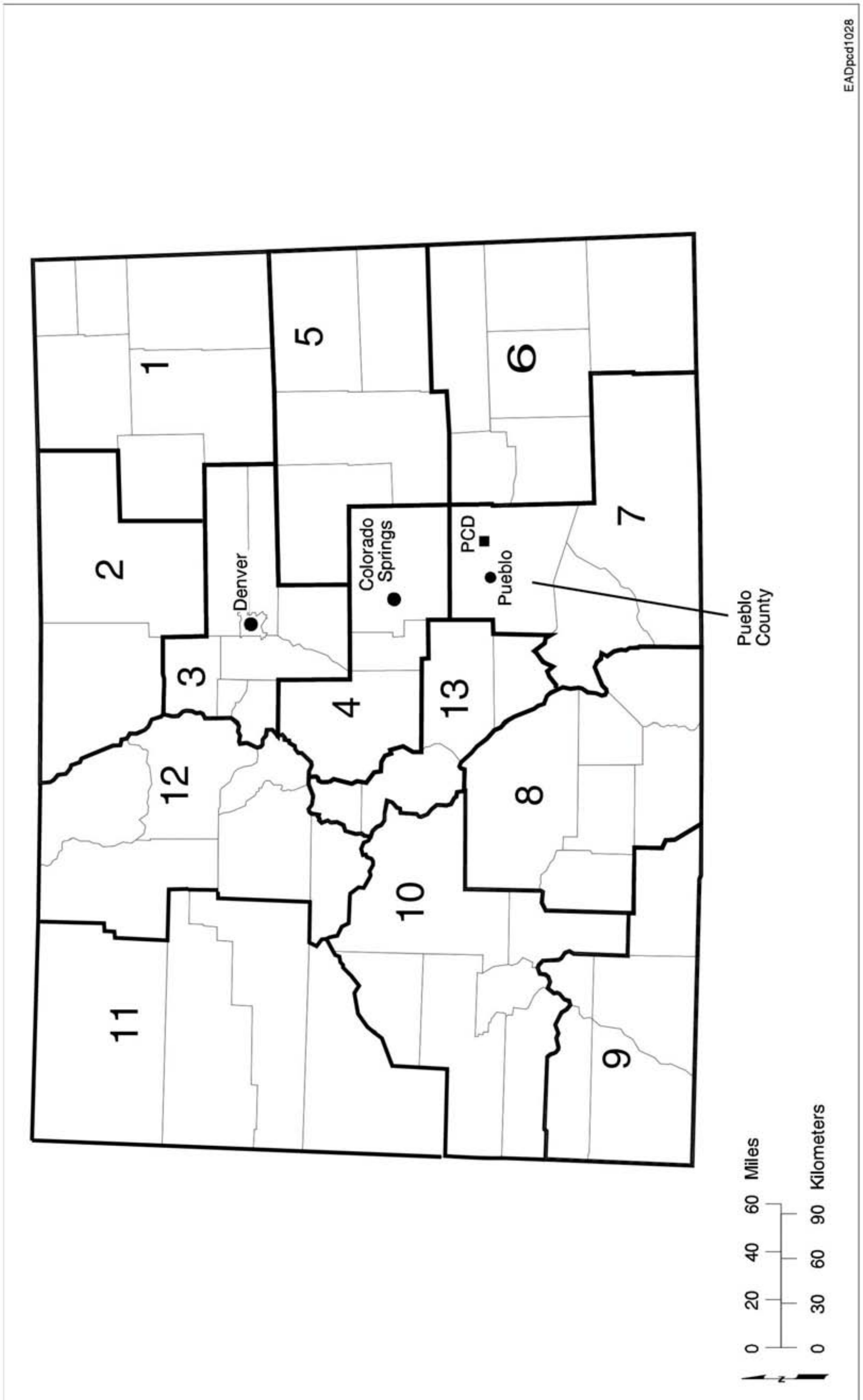

FIGURE 6.5-2 PCD and Air Quality Control Regions in Colorado

TABLE 6.5-3 National Ambient Air Quality Standards (NAAQSs), Colorado State Ambient Air Quality Standards (SAAQSs), Maximum Allowable Increments for Prevention of Significant Deterioration (PSD), and Highest Background Levels in the Urban Area near PCD[a]

		NAAQS (µg/m³)[b]			PSD Increment (µg/m³)		Highest Background Level		
Pollutant	Averaging Time	Primary	Secondary	SAAQS[c] (µg/m³)	Class I	Class II	Concentration (µg/m³)	Location	Year
SO_2	3 hours	-	1,300	700[d]	25	300[d]	190	Colorado Springs	1998
	24 hours	365	-	365	5	50[d]	65	Colorado Springs	1996
	Annual	80	-	80	2	10[d]	11	Colorado Springs	1999
NO_2	Annual	100	100	100	2.5	25	45	Colorado Springs	1996
CO	1 hour	40,000	-	40,000	-	-	14,971	Colorado Springs	1997
	8 hours	10,000	-	10,000	-	-	8,444	Colorado Springs	1996
O_3	1 hour	235	235	235	-	-	174	Colorado Springs	1999
	8 hours	157	157	157	-	-	137	Colorado Springs	2000
PM_{10}	24 hours	150	150	150	8	30	100	Pueblo	1995
	Annual	50	50	50	4	17	26.8	Pueblo	1997
$PM_{2.5}$	24 hours	65	65	65	-	-	15.7	Pueblo	2000
	Annual	15	15	15	-	-	7.8	Pueblo	2000
Pb	Calendar quarter	1.5	1.5	1.5[d,e]	-	-	0.01	Colorado Springs	1999

[a] A hyphen indicates that no standards exist.

[b] Refer to 40 CFR Part 50 for detailed information on the implementation of the new $PM_{2.5}$ and O_3 standards and the interim treatment of the existing standards.

[c] The procedures for determining attainment of state standards are the same as those for determining attainment of NAAQS.

[d] Colorado has stricter standards than the federal standards for SO_2 and lead, and it has no adopted the revised $PM_{2.5}$ and O_3 standards.

[e] Averaging time is a one-month period.

Sources: 40 CFR 50; CDPHE (1999, 2001); 40 CFR 52.21; EPA (2001b).

areas, apply to major new sources and major modifications to existing sources. The State of Colorado contains 12 Class I[5] PSD areas consisting of national parks and national wilderness areas. The PSD Class I area that is nearest to PCD is the Great Sand Dunes National Monument, located 75 mi (121 km) west-southwest of PCD. The monument is not located downwind of prevailing winds at PCD, and the Sangre de Cristo Mountains just east of this Class I area provide a partial barrier to the transport of pollutants from the area surrounding PCD under most meteorological conditions.

6.5.2 ACWA Facility Emissions

6.5.2.1 Emissions from Construction

Emissions of criteria pollutants (such as SO_2, NO_x, CO, PM_{10}, and $PM_{2.5}$) and VOCs during the construction period would include fugitive dust emissions from earth-moving activities and exhaust emissions from equipment and commuter and delivery vehicles. Exhaust emissions are expected to be relatively small when compared with fugitive dust emissions from earth-moving activities (Kimmell et al. 2001). Also, impacts from exhaust emissions would be smaller because these emissions have an elevated buoyant release, which is different than the release of round-level fugitive dust emissions. Accordingly, only the potential impacts of fugitive PM_{10} and $PM_{2.5}$ emissions from earth-moving activities on ambient air quality were analyzed. Emission factors and other assumptions used in estimating emission rates of PM_{10} and $PM_{2.5}$ are described in Appendix B.

6.5.2.2 Emissions from Operations

PCD is currently operating under a synthetic minor permit from CDPHE (PDA 1995). A synthetic minor source is one whose potential emissions are less than 250 tons/yr for all criteria pollutants or less than 100 tons/yr of each individual criteria air pollutant (See Section 6.5.1.2).

Neutralization/Biotreatment. In a Neut/Bio pilot test facility, air pollutants would be emitted from five types of stacks. Three would be similar to those of the Neut/SCWO facility (see next paragraph). The fourth stack would be a biotreatment vent (waste gas) instead of a SCWO stack. The fifth stack would be a laboratory filter area stack. (In other systems, the laboratory effluents are combined with other emission streams.) No emissions from the laboratory filter area stack would be expected during normal (incident-free) operations.

---

5 In 1975, the EPA developed a classification system to allow some economic development in clean air areas while still protecting air from significant deterioration. These classes are defined in the 1977 *Clean Air Act Amendments* (CAAA). Very little deterioration is allowed in Class I areas (e.g., larger national parks and wilderness areas). Class II areas allow moderate deterioration. Class III areas allow deterioration up to the secondary standard.

Neutralization/SCWO. In a Neut/SCWO pilot test facility, air pollutants would be emitted from four types of stacks: (1) three stacks for natural-gas-burning boilers (two operating, one on standby), (2) two stacks for diesel-powered generators used as a backup system, (3) a filter farm stack for building exhaust air, and (4) a stack for exhaust from the SCWO process. The boilers would be used to generate process steam and building heat, and the diesel generators would be used to provide emergency electricity. The filter farm stack would release emissions from filtered building circulating air, while the SCWO stack would release emissions from SCWO processing equipment. The principal sources of criteria pollutant and VOC emissions would be boilers and emergency generators. The primary sources of hazardous air pollutant (HAP) emissions would be the filter farm stack and the SCWO stack (HAPs are discussed in Sections 6.6 and 6.7).

Other Sources. Other sources of air pollution during operations would include vehicular traffic, such as cars, pickup trucks, and buses transporting personnel to and from the facility. Trucks and forklifts would be used to deliver supplies to the facility. Parking lots and access roads to the facility would be paved with asphalt concrete to minimize fugitive dust emissions. Other potential emissions would include VOCs from the aboveground and underground fuel storage tanks. However, these emissions would be negligible because diesel fuel has a low volatility and because facility operations would consume a low level of fuel and thus require infrequent refilling.

Emission factors and other assumptions used in estimating emission rates of criteria pollutants and VOCs during the operational period are described in Appendix B. Maximum short-term and annual total emission rates, along with stack parameters used in the dispersion modeling (i.e., heights, inside diameter, gas exit temperature, and gas exit velocity), are listed in Table 6.5-4 for the Neut/Bio system and in Table 6.5-5 for the Neut/SCWO system.

6.5.3 Impacts of the Proposed Action

Potential impacts from air pollutant emissions during pilot facility construction and operation were evaluated by estimating the maximum ground-level concentration increments of criteria air pollutants that would result from construction and operational activities, adding these estimates to background concentrations, and comparing the results with applicable ambient air quality standards. As indicated in Table 6.5-3, the Colorado SAAQS for criteria air pollutants are identical to the NAAQS, except the state standards for 3-hour SO_2 and Pb are stricter (CDPHE 1999, 2001).

To evaluate air quality impacts from PCD operations with respect to PSD requirements, estimated maximum increments in ground-level concentrations that would result from the operation of the proposed facility were compared with allowable PSD increments above the baseline, which are also summarized in Table 6.5-3.

TABLE 6.5-4 Emission Rates of Criteria Pollutants and Volatile Organic Compounds and Stack Parameters Associated with Normal Operations of the Neutralization/Biotreatment Technology at PCD

Stack Parameters and Estimated Peak Emission Rates	Steam Boilers	Emergency Diesel Generators
Stack parameters[a]		
Height	70 ft (21.3 m)	47 ft (14.3 m)
Inside diameter	1.1 ft (0.33 m)	0.67 ft (0.20 m)
Gas exit temperature	325°F (436 K)	925°F (769 K)
Gas exit velocity	60 ft/s (18.3 m/s)	323 ft/s (98.5 m/s)
Estimated peak emission rates[b]		
SO_2	0.02 lb/h (0.03 ton/yr)	3.2 lb/h (0.95 ton/yr)
NO_x	4.0 lb/h (6.6 tons/yr)	48.4 lb/h (14.5 ton/yr)
CO	2.4 lb/h (4.0 tons/yr)	10.4 lb/h (3.1 ton/yr)
PM_{10}	0.22 lb/h (0.36 ton/yr)	3.4 lb/h (1.0 ton/yr)
$PM_{2.5}$[c]	0.22 lb/h (0.36 ton/yr)	3.4 lb/h (1.0 ton/yr)
VOCs	0.16 lb/h (0.26 ton/yr)	4.0 lb/h (1.2 ton/yr)

[a] For the modeling analysis, emissions from the three boilers were assumed to come from one stack location. Similarly, emissions from the two emergency generators were assumed to come from one stack location.

[b] Estimated peak emission rates are for the simultaneous operations of three steam boilers and two emergency generators at full load.

[c] $PM_{2.5}$ emissions were conservatively assumed to be 100% of PM_{10} emissions for natural-gas-fired boilers and diesel generators (EPA 2000a).

Source: Kimmell et al. (2001).

The air quality dispersion model, model input data (meteorological data, source and receptor locations, and elevation data), and other assumptions used in estimating potential construction and operational impacts on ambient air quality at the PCD boundaries and surrounding areas are described in Appendix B.

6.5.3.1 Impacts of Construction

The modeling results for both PM_{10} and $PM_{2.5}$ concentration increments that would result from construction-related fugitive emissions are summarized in Table 6.5-6. At the installation boundaries, the maximum 24-hour and annual average concentration increments above background for both PM_{10} and $PM_{2.5}$ would occur about 0.9 mi (1.5 km) north of the

TABLE 6.5-5 Emission Rates of Criteria Pollutants and Volatile Organic Compounds and Stack Parameters Associated with Normal Operations of the Neutralization/SCWO Technology at PCD

Stack Parameters and Estimated Peak Emission Rates	Steam Boilers	Emergency Diesel Generators
Stack parameters[a]		
Height	70 ft (21.3 m)	47 ft (14.3 m)
Inside diameter	1.4 ft (0.42 m)	0.67 ft (0.20 m)
Gas exit temperature	325°F (436 K)	925°F (769 K)
Gas exit velocity	60 ft/s (18.3 m/s)	323 ft/s (98.5 m/s)
Estimated peak emission rates[b]		
SO_2	0.03 lb/h (0.04 ton/yr)	3.2 lb/h (0.95 ton/yr)
NO_x	6.3 lb/h (10.4 tons/yr)	48.4 lb/h (14.5 tons/yr)
CO	3.8 lb/h (6.3 tons/yr)	10.4 lb/h (3.1 tons/yr)
PM_{10}	0.34 lb/h (0.57 ton/yr)	3.4 lb/h (1.0 ton/yr)
$PM_{2.5}$[c]	0.34 lb/h (0.57 ton/yr)	3.4 lb/h (1.0 ton/yr)
VOCs	0.25 lb/h (0.41 ton/yr)	4.0 lb/h (1.2 tons/yr)

[a] For the modeling analysis, emissions from the three boilers were assumed to come from one stack location. Similarly, emissions from the two emergency generators were assumed to come from one stack location.

[b] Estimated peak emission rates are for the simultaneous operations of three steam boilers and two emergency generators at full load.

[c] $PM_{2.5}$ emissions were conservatively assumed to be 100% of PM_{10} emissions for natural-gas-fired boilers and diesel generators (EPA 2000a).

Source: Kimmell et al. (2001).

proposed facility and 1.2 mi (2 km) northwest of the proposed facility, respectively. At these locations, for PM_{10}, the maximum 24-hour and annual average concentration increments above background would be about 14% and 1.4% of the NAAQS, respectively. For $PM_{2.5}$, the maximum 24-hour and annual average $PM_{2.5}$ concentration increments above background would be about 17% and 2.0% of the NAAQS, respectively.

To obtain the overall concentrations for comparison with applicable NAAQS, the maximum 24-hour PM_{10} and $PM_{2.5}$ concentration increments (Table 6.5-6) were added to background values. For PM_{10}, the estimated maximum 24-hour and annual average concentrations would be about 41% and 35% of the NAAQS, respectively. For $PM_{2.5}$, the estimated maximum 24-hour and annual average concentrations would be about 55% and 49% of the NAAQS, respectively.

TABLE 6.5-6 Maximum Predicted Off-Post Concentration Increments and Total Concentrations of PM_{10} and $PM_{2.5}$ during Construction at PCD

		Concentration ($\mu g/m^3$)				
Pollutant	Averaging Time	Maximum Increment[a,b]	Background[c]	Total[d]	NAAQS	Percent of NAAQS[e]
PM_{10}	24 hours	21	40	61	150	41 (14)
	Annual	0.7	17	17.7	50	35 (1.4)
$PM_{2.5}$	24 hours	11	25	36	65	55 (17)
	Annual	0.3	7	7.3	15	49 (2.0)

[a] The maximum concentration increments were estimated by using the Industrial Source Complex (ISCST3) model (Version 00101; EPA 1995).

[b] The maximum modeled 24-hour and annual average concentrations occur at receptors about 0.9 mi (1.5 km) and 1.2 mi (2.0 km) to the north and northwest of the proposed facility, respectively.

[c] Background concentrations recommended by the State of Colorado near PCD (Chick 2001).

[d] Total equals maximum modeled concentration plus background concentration.

[e] The values are total concentration as a percent of NAAQS. The values in parentheses are maximum concentration increments as a percent of NAAQS.

In summary, the estimated maximum 24-hour and annual average concentration increments of PM_{10} and $PM_{2.5}$ that would result from construction-related fugitive emissions would be relatively small fractions of the applicable NAAQS. The total (maximum increments plus background) estimated maximum 24-hour and annual average concentrations of PM_{10} would be equal to or less than 41% of the applicable NAAQS. The total estimated maximum 24-hour and annual average concentrations of $PM_{2.5}$ would be less than 55% the applicable NAAQS.

6.5.3.2 Impacts of Operations

In the air quality analysis for the operational period, air quality impacts were modeled for each of the two technologies. The results are presented in tabular format for both cases. The modeling results for concentration increments of SO_2, NO_2, CO, PM_{10}, and $PM_{2.5}$ due to emissions from the proposed facility operations are summarized in Table 6.5-7 for the Neut/Bio system and in Table 6.5-8 for the Neut/SCWO system. The receptor locations where maximum concentration increments would occur are also listed in these tables.

TABLE 6.5-7 Maximum Predicted Off-Post Concentration Increments and Total Concentrations of Criteria Pollutants during Normal Operations of the Neutralization/ Biotreatment Technology at PCD

		Concentration ($\mu g/m^3$)					Receptor Location[e]	
Pollutant	Averaging Time	Maximum Increment[a]	Background[b]	Total[c]	NAAQS/ SAAQS	Percent of NAAQS/ SAAQS[d]	Distance [mi (km)]	Direction
SO_2	3 hours	5.8	101	107	700	15 (0.8)	1.0 (1.6)	NNW
	24 hours	1.5	39	41	365	11 (0.4)	1.5 (2.4)	NW
	Annual	0.009	8	8	80	10 (<0.1)	1.5 (2.4)	NW
NO_2	Annual	0.17	19	19	100	19 (0.2)	1.5 (2.4)	NW
CO	1 hour	59	3,429	3,488	40,000	9 (0.1)	1.8 (3.0)	NW
	8 hours	13	2,222	2,235	10,000	22 (0.1)	1.5 (2.4)	NW
PM_{10}	24 hours	1.7	40	42	150	28 (1.1)	1.5 (2.4)	NW
	Annual	0.011	17	17	50	34 (<0.1)	1.5 (2.4)	NW
$PM_{2.5}$	24 hours	1.7	25	27	65	41 (2.6)	1.5 (2.4)	NW
	Annual	0.011	7	7	15	47 (<0.1)	1.5 (2.4)	NW

[a] Maximum concentration increments were estimated by using the ISCST3 model (Version 00101; EPA 1995).

[b] Background concentrations recommended by the State of Colorado near the PCD (Chick 2001).

[c] Total equals maximum concentration increment plus background concentration.

[d] The values are total concentration as percent of NAAQS/SAAQS. The values in parentheses are maximum concentration increments attributable to the ACWA facilities as percent of NAAQS/SAAQS.

[e] Receptor locations (distance and directions) of maximum concentrations are from the center of the Neut/Bio facility.

The estimated maximum concentration increments due to operation of the proposed facility would contribute approximately 3% of applicable NAAQS and SAAQS for all pollutants (Tables 6.5-7 and 6.5-8). It is also expected that potential impacts from proposed facility operations on the air quality of nearby communities would be negligible. Short-term concentration increments for both the Neut/Bio and Neut/SCWO systems would be almost the same. Irrespective of the ACW destruction technology used, maximum concentration increments would primarily occur along the northern boundaries.

The maximum 3-hour, 24-hour, and annual SO_2 concentration increments predicted to result from the proposed facility operations (Tables 6.5-7 and 6.5-8) would be less than 2% of the applicable PSD increments (Table 6.5-3). The maximum predicted increments in annual average NO_2 concentrations due to the proposed facility operations would be about 1% of the applicable PSD increments. The 24-hour and annual PM_{10} concentration increases predicted to result from the proposed operations would be less than about 1% of the applicable PSD increments. The predicted concentration increment at a receptor located 30 mi (50 km) away

TABLE 6.5-8 Maximum Predicted Off-Post Concentration Increments and Total Concentrations of Criteria Pollutants during Normal Operations of the Neutralization/SCWO Technology at PCD

		Concentration (µg/m³)					Receptor Location[e]	
Pollutant	Averaging Time	Maximum Increment[a]	Background[b]	Total[c]	NAAQS/ SAAQS	Percent of NAAQS/ SAAQS[d]	Distance [mi (km)]	Direction
SO_2	3 hours	5.9	101	107	700	15 (0.8)	1.0 (1.6)	NNW
	24 hours	1.6	39	41	365	11 (0.4)	1.5 (2.4)	NW
	Annual	0.009	8	8	80	10 (<0.1)	1.5 (2.4)	NW
NO_2	Annual	0.19	19	19	100	19 (0.2)	1.5 (2.4)	NW
CO	1 hour	64	3,429	3,493	40,000	9 (0.2)	1.8 (3.0)	WNW
	8 hours	14	2,222	2,236	10,000	22 (0.1)	1.5 (2.4)	NW
PM_{10}	24 hours	1.8	40	42	150	28 (1.2)	1.5 (2.4)	NW
	Annual	0.012	17	17	50	34 (<0.1)	1.5 (2.4)	NW
$PM_{2.5}$	24 hours	1.8	25	27	65	41 (2.8)	1.5 (2.4)	NW
	Annual	0.012	7	7	15	47 (<0.1)	1.5 (2.4)	NW

[a] Maximum concentration increments were estimated by using the ISCST3 model (Version 00101; EPA 1995).

[b] Background concentrations recommended by the State of Colorado near the PCD (Chick 2001).

[c] Total equals maximum concentration increment plus background concentration.

[d] The values are total concentration as percent of NAAQS/SAAQS. The values in parentheses are maximum concentration increments attributable to the ACWA facilities as percent of NAAQS/SAAQS.

[e] Receptor locations (distance and directions) of maximum concentrations are from the center of the Neut/SCWO facility.

from the proposed facility (the maximum distance the Industrial Source Complex [ISCST3] model [Version 00101; EPA 1995] could reliably estimate concentrations) in the direction of the nearest Class I PSD area (Great Sand Dunes National Monument) would be less than 0.2% of the applicable PSD increments. Concentration increments at the Great Sand Dunes National Monument, which is located about 75 mi (121 km) west-southwest of PCD, would be much lower.

Concentration increments for the two remaining criteria pollutants, lead and ozone, were not modeled. As a direct result of the phase-out of leaded gasoline for automobiles, average lead concentrations in urban areas throughout the country have decreased dramatically. It is expected that emissions of lead from the proposed facility operations would be negligible and therefore would have no adverse impacts on lead concentrations in surrounding areas. Contributions to the production of ozone, a secondary pollutant formed from complex photochemical reactions involving ozone precursors (including NO_X and VOCs), cannot be accurately quantified. As discussed in Section 6.5.1, Pueblo County, including PCD, is currently in attainment for ozone (40 CFR 81.306). As shown in Tables 6.5-4 and 6.5-5, ozone precursor emissions from the proposed facility operations would be small, accounting for about 0.17% and 0.02% of the actual emissions of NO_x and VOCs, respectively, from Pueblo County in 1996. As a consequence, the cumulative impacts of potential releases from PCD facility operations on regional ozone concentrations would not be of any concern.

Potential impacts of air pollutant emissions during pilot facility operations were evaluated by estimating maximum ground-level concentration increments of criteria air pollutants resulting from operations, adding these estimates to background concentrations, and comparing the results with applicable ambient air quality standards. Maximum concentrations of SO_2, PM_{10}, and $PM_{2.5}$ were estimated to be less than or equal to 47% of the NAAQS (Tables 6.5-7 and 6.5-8). However, concentration increments due to operation of the proposed facility would contribute ≤ 3% of the NAAQS. Maximum estimated concentrations of NO_2 and CO would approach 19% and 22% of the NAAQS, respectively. However, background concentrations of NO_2 and CO would account for most of total concentrations. It is estimated that concentration increases due to the operation of the proposed facility would be less than 0.2% of the NAAQS.

6.5.3.3 Impacts of Fluctuating Operations

To assess the impacts that could result from possible fluctuations in operations that could occur during pilot testing, it was assumed that levels of organic compound emissions would be 10 times higher than the estimated annual average for 5% of the time and that levels of inorganic compound emissions would be 10 times higher than the estimated annual average for 20% of the time. These assumptions are based on EPA guidance (EPA 1994, as cited in National Research Council 1997a).

Over long time periods, such conditions would be assumed to increase organic emissions to 145% of their normal values and metal emissions to 280% of their normal values (National Research Council 1997a). VOCs contribute to the formation of ozone, a criteria pollutant; multiplying VOC emissions from the proposed facility by 1.45 would result in about 2 tons per year, or less than 0.03% of the 1996 VOC emissions in Pueblo County (EPA 2001a). Therefore, the potential increase in ozone concentration that could result from VOC emissions from the proposed facility operations under fluctuating operational conditions would be almost the same as that under normal operating conditions. Lead (Pb) is the only metal among criteria pollutants. Expected emissions of lead from the proposed facility are currently too small to quantify; therefore, increasing these emissions to 280% of their normal value would probably not cause any appreciable increase in atmospheric lead concentrations. Therefore, under fluctuating operational conditions, the impacts of the criteria pollutants involved on air quality are expected to be insignificant.

6.5.4 Impacts of No Action

The principal sources of air emissions associated with stockpile maintenance activities are exhaust and road dust generated by vehicles. These emissions contribute to the background air quality at the installation, which would remain at baseline levels as described in Section 6.5.1. Air pollutant emissions from these sources are small both in absolute terms and in comparison with emissions from other natural and anthropogenic sources on and off PCD. Therefore, impacts on air quality that would occur as a result of the continued storage of the stockpile are expected to be minimal.

6.6 AIR QUALITY — TOXIC AIR POLLUTANTS

6.6.1 Current Emissions and Air Quality

PCD is classified as a synthetic minor source. With respect to hazardous air pollutant (HAP) emissions, as defined in Section 112 of Title III of the *Clean Air Act* (CAA), this means that PCD does not emit more than 10 tons of any single HAP or 25 tons of total HAPs in any given year. As a part of Pueblo's synthetic minor permit application, HAP emissions for 1994 were tabulated (Pueblo Depot Activity 1995); these emissions are summarized in Table 6.6-1. Total HAP emissions for 1994 were 2.66 tons. Sources of these emissions included mainly fuel storage, degreasing activities, and landfills. Because of its synthetic minor source status, PCD is not required to report HAP emissions annually. However, HAP emissions have decreased since 1994 (Ross 2001).

6.6.2 ACWA Facility Emissions

A summary of estimated emissions of toxic air pollutants[6] from operation of an ACWA pilot facility at PCD is provided in Kimmell et al. (2001). Estimated emission levels from diesel generators, boilers, a Neut/Bio facility, and a Neut/SCWO facility are provided. Emission levels from destruction facility stacks (e.g., SCWO vent, biotreatment vent, filter farm stacks) were based on demonstration test data and site-specific munitions inventories compiled by Mitretek Corp. (2001a,b). Estimated emission levels from diesel generators and boilers were based on standard algorithms that used fuel consumption estimates as input (Kimmell et al. 2001). The estimated emission levels from a Neut/Bio pilot test facility at PCD are provided in Table 6.6-2; estimated emission levels from a Neut/ SCWO pilot test facility are provided in Table 6.6-3. For

[6] Many of the toxic air pollutants that would be emitted are HAPs as defined in Title III, Section 112 of the CAA. The term "toxic air pollutants" is broader in that it includes some pollutants that are not HAPs.

TABLE 6.6-1 Hazardous Air Pollutant Emissions from PCD in 1994[a]

Substance	Quantity (tons)	Source
Hydroquinone	0.05	Medical clinic
Methyl ethyl ketone	0.01	Landfills
Hexane	0.12	Fuel storage, landfills
Chlorine	0.54	Water treatment
Benzene	0.15	Fuel storage, landfills
Naphthalene	0.02	Fuel storage
Toluene	0.69	Degreasing, landfills
Xylenes	0.57	Fuel storage, landfills
Hydrogen chloride	0.02	Boilers/heaters
Chromium compounds	0.01	Boilers/heaters
Ethyl benzene	0.12	Fuel storage, landfills
Carbonyl sulfide	0.05	Landfills
Dichloromethane	0.04	Landfills
Perchloroethylene	0.02	Landfills
Trichloroethylene	0.01	Landfills
Vinyl chloride	0.02	Landfills
Bromodichloromethane	0.01	Landfills
Dichlorodifluoromethane	0.05	Landfills
Dichlorofluoromethane	0.02	Landfills
Hydrogen sulfide	0.11	Open detonation, landfills
Methyl mercaptan	0.02	Landfills
Total	2.66	

[a] Only emissions of greater than 0.01 ton/yr for any individual HAP are included.

Source: Pueblo Depot Activity (1995).

many substances (e.g., acetaldehyde, formaldehyde), the estimated emission levels from boilers and diesel generators would exceed the after-treatment emissions from destruction facility processes by many orders of magnitude (Tables 6.6-2 and 6.6-3).

The estimates of air emissions from operating the pilot facilities are based on the assumption that organic substances in all Neut/SCWO effluents would be filtered from stack emissions by a series of six carbon filters, each having a removal efficiency of 95%. For PM (e.g., dioxins and furans on PM and metals), it was assumed that two high-efficiency particulate air (HEPA) filters, each with a removal efficiency of 99.97%, would be used for treatment. For the Neut/Bio facility, it is not known whether the emissions from the biotreatment vent would require further treatment. The provider of the equipment used during the ACWA technology demonstrations has stated that further treatment would not be necessary. In this assessment, both treatment and no treatment of biovent stack emissions are assessed (see Table 6.6-2).

TABLE 6.6-2 Estimated Toxic Air Pollutant Emissions from Neutralization/Biotreatment Technology at PCD

	Emissions (µg/s)[b]				
Compound[a]	Diesel Generator	Boiler	Biotreatment Vent, Treated[c]	Biotreatment Vent, Untreated[c]	Filter Farm Stack[d]
1,1,1-Trichloroethane	-	-	-	-	1.1×10^{-10}
1,2,3,4,6,7,8,9-OCDD	-	-	1.6×10^{-9}	1.6×10^{-2}	3.2×10^{-13}
1,2,3,4,6,7,8,9-OCDF	-	-	3.2×10^{-10}	3.7×10^{-3}	7.4×10^{-13}
1,2,3,4,6,7,8-HpCDD	-	-	3.2×10^{-10}	3.7×10^{-3}	6.3×10^{-13}
1,2,3,4,6,7,8-HpCDF	-	-	3.7×10^{-10}	4.2×10^{-3}	6.3×10^{-13}
1,2,3,4,7,8,9-HpCDF	-	-	1.1×10^{-10}	1.1×10^{-3}	6.3×10^{-14}
1,2,3,4,7,8-HxCDD	-	-	1.6×10^{-11}	1.6×10^{-4}	6.3×10^{-14}
1,2,3,4,7,8-HxCDF	-	-	1.1×10^{-10}	1.1×10^{-3}	6.3×10^{-13}
1,2,3,6,7,8-HxCDD	-	-	3.2×10^{-11}	3.7×10^{-4}	2.1×10^{-13}
1,2,3,6,7,8-HxCDF	-	-	4.7×10^{-11}	5.3×10^{-4}	3.2×10^{-13}
1,2,3,7,8,9-HxCDD	-	-	5.3×10^{-11}	5.3×10^{-4}	2.1×10^{-13}
1,2,3,7,8,9-HxCDF	-	-	-	-	3.2×10^{-14}
1,2,3,7,8-PeCDD	-	-	1.6×10^{-12}	2.1×10^{-5}	6.3×10^{-14}
1,2,3,7,8-PeCDF	-	-	4.7×10^{-11}	5.3×10^{-4}	1.1×10^{-13}
1,2-Dichloroethane*	-	-	5.3×10^{-7}	3.7×10^{1}	2.1×10^{-5}
1,2-Dichloropropane*	-	-	-	-	3.2×10^{-10}
1,3-Butadiene*	1.1	-	-	-	-
1,4-Dichlorobenzene*	-	-	-	-	3.2×10^{-9}
2,3,4,6,7,8-HxCDF	-	-	4.7×10^{-11}	5.3×10^{-4}	3.2×10^{-13}
2,3,4,7,8-PeCDF	-	-	5.3×10^{-11}	1.1×10^{-3}	4.2×10^{-13}
2,3,7,8-TCDD*	-	-	2.6×10^{-12}	2.6×10^{-5}	-
2,3,7,8-TCDF	-	-	5.3×10^{-11}	1.1×10^{-3}	1.1×10^{-12}
2-Methylnaphthalene	-	8.6×10^{-2}	-	-	-
3/4-Methyl phenol*	-	-	-	-	1.1×10^{-9}
3-Methylchloranthrene	-	6.4×10^{-3}	-	-	-
Acenaphthene	3.9×10^{-2}	6.4×10^{-3}	-	-	-
Acenaphthylene	1.4×10^{-1}	6.4×10^{-3}	-	-	-
Acetaldehyde*	2.1×10^{1}	-	1.6×10^{-6}	1.1×10^{2}	-
Acrolein*	2.6	-	-	-	-
Aldehydes	1.9×10^{3}	-	-	-	-
Anthracene	5.2×10^{-2}	8.6×10^{-3}	-	-	-
Arsenic*	-	7.2×10^{-1}	-	-	-
Barium	-	1.6×10^{1}	-	-	-
Benz(a)anthracene	4.7×10^{-2}	6.4×10^{-3}	-	-	-
Benzene*	2.6×10^{1}	7.5	-	-	8.4×10^{-9}
Benzo(a)pyrene	5.2×10^{-3}	4.3×10^{-3}	-	-	-
Benzo(b)fluoranthene	2.8×10^{-3}	6.4×10^{-3}	-	-	-
Benzo(g,h,i)perylene	1.4×10^{-2}	4.3×10^{-3}	-	-	-
Benzo(k)fluoranthene	4.3×10^{-3}	6.4×10^{-3}	-	-	-
Beryllium*	-	4.3×10^{-2}	-	-	-
bis (2-Chloroethyl) ether*	-	-	4.2×10^{-7}	2.6×10^{1}	-

TABLE 6.6-2 (Cont.)

	Emissions (µg/s)[b]				
Compound[a]	Diesel Generator	Boiler	Biotreatment Vent, Treated[c]	Biotreatment Vent, Untreated[c]	Filter Farm Stack[d]
bis (2-Ethylhexyl) phthalate*	-	-	5.3×10^{-7}	3.7×10^{1}	8.4×10^{-9}
Bromomethane*	-	-	1.6×10^{-6}	1.1×10^{2}	2.1×10^{-7}
Butane	-	7.5×10^{3}	-	-	-
Cadmium*	-	3.9	-	-	-
Carbon disulfide*	-	-	-	-	2.1×10^{-7}
Carbon tetrachloride*	-	-	-	-	3.2×10^{-9}
Chlorobenzene*	-	-	-	-	3.2×10^{-7}
Chloroethane*	-	-	-	-	4.2×10^{-9}
Chloroform*	-	-	-	-	5.3×10^{-7}
Chloromethane*	-	-	1.6×10^{-6}	1.1×10^{2}	3.2×10^{-6}
Chromium*	-	5.0	-	-	2.1×10^{-7}
Chrysene	9.8×10^{-3}	6.4×10^{-3}	-	-	-
Cobalt*	-	3.0×10^{-1}	-	-	2.1×10^{-7}
Copper	-	3.0	-	-	-
Dibenzo(a,h)anthracene	-	4.3×10^{-3}	-	-	-
Dibenzofuran*	-	-	-	-	3.2×10^{-9}
Dichlorobenzene*	-	4.3	-	-	-
Diethylphthalate	-	-	5.3×10^{-7}	4.2×10^{1}	-
Dimethylbenz(a)anthracene	1.6×10^{-2}	5.7×10^{-2}	-	-	-
Dimethylphthalate*	-	-	-	-	2.1×10^{-8}
Ethane	-	1.1×10^{4}	-	-	-
Ethyl benzene*	-	-	4.7×10^{-6}	3.2×10^{2}	8.4×10^{-10}
Fluoranthene	2.1×10^{-1}	1.1×10^{-2}	-	-	-
Fluorene	8.1×10^{-1}	1.0×10^{-2}	-	-	-
Formaldehyde*	3.3×10^{1}	2.7×10^{2}	1.1×10^{-5}	1.1×10^{3}	-
Glycol ethers (2-butoxy ethanol)	-	-	4.2×10^{-6}	2.6×10^{2}	-
H (mustard)[e]	-	-	-	-	2.8×10^{2}
Hexane(n)*	-	6.4×10^{3}	-	-	-
Indeno(1,2,3-cd)pyrene	1.0×10^{-2}	6.4×10^{-3}	-	-	-
Lead*	-	1.8	-	-	7.4×10^{-9}
m,p-Xylene*	7.9	-	4.2×10^{-5}	2.6×10^{3}	3.2×10^{-8}
Manganese*	-	1.4	-	-	6.3×10^{-8}
Mercury*	8.4×10^{-3}	9.3×10^{-1}	1.6×10^{-4}	2.1×10^{1}	2.1×10^{-8}
Methyl ethyl ketone*	-	-	-	-	1.1×10^{-5}
Methyl ethyl ketone/butyraldehydes*	-	-	5.3×10^{-7}	3.2×10^{1}	-
Methylene chloride*	-	-	1.1×10^{-5}	1.1×10^{3}	2.1×10^{-8}
Molybdenum	-	3.9	-	-	-
Naphthalene*	2.4	2.2	3.7×10^{-7}	2.6×10^{1}	4.2×10^{-8}
Nickel*	-	7.5	-	-	1.1×10^{-7}
OCDD	-	-	3.2×10^{-10}	3.2×10^{-3}	-
OCDF	-	-	1.1×10^{-10}	1.6×10^{-3}	-
o-Xylene*	-	-	-	-	2.1×10^{-9}

TABLE 6.6-2 (Cont.)

	Emissions (μg/s)[b]				
Compound[a]	Diesel Generator	Boiler	Biotreatment Vent, Treated[c]	Biotreatment Vent, Untreated[c]	Filter Farm Stack[d]
Particulates	-	-	-	-	5.3×10^{-4}
Pentane(n)	-	9.3×10^{3}	-	-	-
Phenanthrene	8.1×10^{-1}	6.1×10^{-2}	-	-	-
Phenol*	-	-	1.6×10^{-7}	1.1×10^{1}	5.3×10^{-9}
Phosphorus*	-	-	-	-	2.1×10^{-8}
PAHs	4.7	-	-	-	-
POM (fluorene)*	-	-	-	-	3.2×10^{-8}
Propanal (propionaldehyde)*	-	-	5.3×10^{-7}	4.2×10^{1}	-
Propane	-	5.7×10^{3}	-	-	-
Propylene	7.2×10^{1}	-	-	-	-
Pyrene	1.3×10^{-1}	1.8×10^{-2}	-	-	-
Selenium*	-	8.6×10^{-2}	-	-	2.1×10^{-9}
Styrene*	-	-	-	-	8.4×10^{-13}
Tetrachloroethene*	-	-	-	-	2.1×10^{-10}
Toluene*	1.1×10^{1}	1.2×10^{1}	1.1×10^{-6}	5.3×10^{1}	4.2×10^{-8}
Total HpCDD	-	-	5.3×10^{-10}	5.3×10^{-3}	1.1×10^{-12}
Total HpCDF	-	-	5.3×10^{-10}	5.3×10^{-3}	8.4×10^{-13}
Total HxCDD	-	-	4.2×10^{-10}	4.7×10^{-3}	2.1×10^{-12}
Total HxCDF	-	-	3.7×10^{-10}	4.2×10^{-3}	2.1×10^{-12}
Total PeCDD	-	-	-	-	2.1×10^{-12}
Total PeCDF	-	-	5.3×10^{-10}	5.3×10^{-3}	4.2×10^{-12}
Total TCDD	-	-	1.6×10^{-11}	1.6×10^{-4}	1.1×10^{-12}
Total TCDF	-	-	2.6×10^{-10}	2.6×10^{-3}	2.1×10^{-8}
Vanadium	-	8.2	-	-	-

[a] Substances designated with an asterisk (*) are listed as HAPs under Title III, Section 112 of the CAA. PAHs = polycyclic aromatic hydrocarbons. POM = polycyclic organic matter. Polychlorinated dioxins/furans are as follows: HpCDD = heptachlorodibenzo-p-dioxin, HpCDF = heptachlorodibenzo-p-furan, HxCDD = hexachlorodibenzo-p-dioxin, HxCDF = hexachlorodibenzo-p-furan, OCDD = octachlorodibenzo-p-dioxin, OCDF = octachlorodibenzo-p-furan, PeCDD = pentachlorodibenzo-p-dioxin, PeCDF = pentachlorodibenzo-p-furan, TCDD = tetrachlorodibenzo-p-dioxin, and TCDF = tetrachlorodibenzo-p-furan.

[b] A hyphen indicates that the compound was not detected from this source during demonstration testing.

[c] For untreated values, it is assumed that compounds are released directly to the stack after being processed through the catalytic oxidation unit (CatOx). For treated values, it is assumed that after organics pass through the CatOx, they pass through six carbon filters in series, each at 95% efficiency. For treated values, it is assumed that PM passes through two HEPA filters in series, each at 99.97% efficiency.

[d] Filter farm stack emissions are assumed to be treated by using carbon filters to capture organics and by using HEPA filters to capture PM, as in footnote c above.

[e] The after-treatment emission rate from the filter farm stack for the mustard agent is a worst-case estimate; it assumes continuous emissions at the detection limit of 0.006 $\mu g/m^3$ during operations (Kimmell et al. 2001). It is assumed that no mustard would be emitted from the immobilized cell bioreactor (ICB) unit; none would be present after neutralization and ICB treatment.

TABLE 6.6-3 Estimated Toxic Air Pollutant Emissions from Neutralization/SCWO Technology at PCD

	Emissions (μg/s)[b]			
Compound[a]	Diesel Generator	Boiler	SCWO Vent[c]	Filter Farm Stack[d]
1,3-Butadiene*	1.1	-	-	-
2-Methylnaphthalene	-	1.4×10^{-1}	-	-
3-Methylchloranthrene	-	1.0×10^{-2}	-	-
Acenaphthene	3.9×10^{-2}	1.0×10^{-2}	-	-
Acenaphthylene	1.4×10^{-1}	1.0×10^{-2}	-	-
Acetaldehyde*	2.1×10^{1}	-	1.3×10^{-7}	-
Acrolein*	2.6	-	-	-
Aldehydes	1.9×10^{3}	-	-	-
Anthracene	5.2×10^{-2}	1.4×10^{-2}	-	-
Antimony*	-	-	2.5×10^{-7}	-
Arsenic*	-	1.1	8.8×10^{-8}	-
Barium	-	2.5×10^{1}	-	-
Benz(a)anthracene	4.7×10^{-2}	1.0×10^{-2}	-	-
Benzene*	2.6×10^{1}	1.2×10^{1}	-	-
Benzo(a)pyrene	5.2×10^{-3}	6.8×10^{-3}	-	-
Benzo(b)fluoranthene	2.7×10^{-3}	1.0×10^{-2}	-	-
Benzo(g,h,I)perylene	1.4×10^{-2}	6.8×10^{-3}	-	-
Benzo(k)fluoranthene	4.3×10^{-3}	1.0×10^{-2}	-	
Beryllium*	-	6.8×10^{-2}	1.3×10^{-8}	-
Butane	-	1.2×10^{4}	-	-
Cadmium*	-	6.2	1.3×10^{-8}	-
Chromium*	-	7.9	5.0×10^{-7}	-
Chrysene*	9.8×10^{-3}	1.0×10^{-2}	-	-
Cobalt*	-	4.8×10^{-1}	1.3×10^{-7}	-
Copper	-	4.8	-	-
Dibenzo(a,h)anthracene	1.6×10^{-2}	6.8×10^{-3}	-	-
Dichlorobenzene*	-	6.8	-	-
Dimethylbenz(a)anthracene	-	9.1×10^{-2}	-	-
Ethane	-	1.8×10^{4}	-	-
Ethyl benzene*	-	-	1.3×10^{-6}	-
Fluoranthene	2.1×10^{-1}	1.7×10^{-2}	-	-
Fluorene	8.1×10^{-1}	1.6×10^{-2}	-	-
Formaldehyde*	3.3×10^{1}	4.3×10^{2}	2.5×10^{-7}	-
H (mustard)[d]	-	-	-	2.8×10^{2}
Hexane(n)*	-	1.0×10^{4}	-	-
Indeno(1,2,3-cd)pyrene*	1.0×10^{-2}	1.0×10^{-2}	-	-

TABLE 6.6-3 (Cont.)

	Emissions (μg/s)[b]			
Compound[a]	Diesel Generator	Boiler	SCWO Vent[c]	Filter Farm Stack[d]
Lead*	-	2.8	2.5×10^{-7}	-
m,p-Xylene*	7.9	-	-	-
Manganese*	-	2.2	5.0×10^{-7}	-
Mercury*	8.3×10^{-3}	1.5	-	-
Methyl ethyl ketone/butyraldehydes*	-	-	6.3×10^{-8}	-
Molybdenum	-	6.2	-	-
m-Xylene*	-	-	1.5×10^{-6}	-
Naphthalene*	2.3	3.5	-	-
Nickel*	-	1.2×10^{1}	1.3×10^{-6}	-
Particulates	-	-	8.8×10^{-5}	-
p-Cresol (4-methylphenol)*	-	-	1.3×10^{-7}	-
Pentane(n)	-	1.5×10^{4}	-	-
Phenanthrene	8.1×10^{-1}	9.6×10^{-2}	-	-
Phosphorus	-	-	2.5×10^{-5}	-
PAHs	4.7	-	-	-
Propane	-	9.1×10^{3}	-	-
Propylene	7.1×10^{1}	-	-	-
Pyrene*	1.3×10^{-1}	2.8×10^{-2}	-	-
Selenium*	-	1.4×10^{-1}	8.8×10^{-8}	-
Toluene*	1.1×10^{1}	1.9×10^{1}	-	-
Total HpCDF	-	-	2.5×10^{-16}	-
Total TCDD	-	-	1.3×10^{-12}	-
Vanadium	-	1.3×10^{1}	-	-
Zinc	-	-	-	-

[a] Substances designated with an asterisk (*) are listed as HAPs under Title III, Section 112 of the CAA. PAHs = polycyclic aromatic hydrocarbons. HpCDF = heptachlorodibenzo-p-furan. TCDD = tetrachlorodibenzo-p-dioxin.

[b] A hyphen indicates that the compound was not detected from this source during demonstration testing.

[c] For SCWO vent stack emissions, organics are assumed to pass through six carbon filters in series, each at 95% efficiency. PM is assumed to pass through two HEPA filters in series, each at 99.97% efficiency.

[d] The after-treatment emission rate from the filter farm stack for the mustard agent is a worst-case estimate; it assumes emissions at the detection limit during operations (Kimmell et al. 2001). It was assumed that no agent would be emitted from the SCWO stack; none would be present after neutralization and SCWO treatment.

6.6.3 Impacts of the Proposed Action

6.6.3.1 Impacts of Construction

During construction, low-level emissions of potentially toxic air pollutants would result from the use of chemicals in items such as paints, thinners, and aerosols. These emissions would be expected to be minor and were not quantitatively estimated for this EIS. The main emissions from construction-related heavy equipment and from the commuter vehicles used by construction workers would consist of criteria pollutants and HAPs (Kimmell et al. 2001). HAPs emissions were not quantified for this assessment because of insufficient data (e.g., whether the engine type is two-stroke, four-stroke, or diesel) (EPA 2000b). Although not quantified, the emission levels would be expected to be less than reportable quantities and similar across the technology systems evaluated.

6.6.3.2 Impacts of Operations

Estimates of emissions of toxic air pollutants that would result from the operation of an ACWA pilot facility are provided in Tables 6.6-2 and 6.6-3. Many of the toxic air pollutants that would be emitted from the pilot test facility stacks would be HAPs as defined in Title III, Section 112 of the CAA. However, a pilot test facility would not be a major source of HAP emissions and would not fall into any of the source categories regulated by EPA National Emission Standards for Hazardous Air Pollutants (NESHAP), as adopted by the CDPHE (see Chapter 8). Therefore, no regulatory action under NESHAP would be necessary for the HAP emissions from a pilot test facility.

In order to assess health risks associated with toxic air pollutant emissions (Section 6.7), the locations of maximum on-post and off-post concentrations of the emitted compounds listed in Tables 6.6-2 and 6.6-3 were identified through air modeling. The ISCST3 model (EPA 1995) was used in the same way as it was used for criteria air pollutant emissions assessed in Section 6.5. Details on the modeling conducted are presented in Appendix C.

The main emissions from commuter vehicles and delivery trucks would be criteria pollutants (as summarized in Section 6.5); toxic air pollutant emissions were not quantified.

6.6.3.3 Impacts of Fluctuating Operations

To account for possible fluctuations in operations that could occur during pilot testing, it was assumed that levels of organic compounds would be 10 times higher than the estimated annual average for 5% of the time and that levels of inorganic compounds would be 10 times higher than the estimated annual average for 20% of the time. These assumptions were based on EPA guidance (EPA 1994, as cited in National Research Council 1997a) and were used to generate ambient annual air concentrations for exposure estimates, as detailed in Appendix C.

During fluctuating operations, agent could be released from the filter farm stack, which is the ventilation stack for the Munitions Demilitarization Building (MDB) process area. Regardless of the ACWA technology selected for implementation at PCD, the filter farm stack would be equipped with multiple carbon filter banks and with agent monitoring devices between banks. These devices would ensure that, in the unlikely event that some agent had not been destroyed in the neutralization process and subsequent treatment, the agent would be detected and the causes would be mitigated immediately.

For the purpose of estimating the maximum potential emissions of chemical agent, only the MDB process area was assumed to be a potential source. The filter systems would be designed to remove mustard agent from the ventilation air stream to a level below the detectable level (Kimmell et al. 2001). Therefore, if any agent were detected in the exhaust stream, alarms would sound, the cause would be identified and mitigated, and the emission of agent (if any) would be short-term and at low levels. Since no potential chemical agent emission levels were estimated on the basis of demonstration test results, it was conservatively assumed for this assessment that a chemical agent could hypothetically be emitted from a stack continuously at the detection limit level for that agent. Modeling dispersion from the source at these levels results in the maximum hypothetical on-post and off-post agent concentrations presented in Table 6.6-4. All these values are less than 1% of the allowable concentration of 0.1 $\mu g/m^3$ HD/HT for general public exposures established by the Centers for Disease Control and Prevention (CDC 1988). In practice, the facility stacks would have continuous agent monitoring devices that would sound if any agent was detected in the stacks, so that the reasons for the agent's presence could be identified and the agent could be eliminated.

TABLE 6.6-4 Maximum Annual Average Estimated On-Post and Off-Post Concentrations of Mustard Agent during ACWA Pilot Facility Operations at PCD[a]

Agent	Maximum Annual Average Off-Post Concentration ($\mu g/m^3$)	Maximum Annual Average On-Post Concentration ($\mu g/m^3$)	General Population Exposure Limit[b] ($\mu g/m^3$)	Percent of Limit off Post	Percent of Limit on Post
Mustard	5.6×10^{-5}	2.0×10^{-4}	1.0×10^{-1}	0.06	0.2

[a] Estimated concentrations account for fluctuating operations and are applicable to both the Neut/Bio and Neut/SCWO technologies.

[b] The general population exposure limits are for 72-hour time-weighted average exposures, as estimated by the CDC (1988).

6.6.4 Impacts of No Action

Activities associated with continued storage at PCD would include inspecting, monitoring, and conducting an annual inventory of all munitions; overpacking any leaking munitions discovered during inspections; and transporting any overpacked leakers to a separate RCRA-permitted storage igloo. All chemical munition storage igloos would continue to be routinely inspected and monitored in accordance with strict Army regulations. Inspection and monitoring of all of the permitted igloos containing the overpacked leakers would be done in accordance with applicable State of Colorado-issued RCRA permit conditions. Upon discovery of a leaker, a filter would be installed, and the entry door would be sealed. The amount of mustard agent that might spill from a leaking munition would probably be small, and any vapor that might form as a result of the spill would be likely to be contained within the igloo. These conditions would occur because mustard agent is less volatile and has a higher melting point than nerve agents. Air temperatures inside the earth-covered concrete igloos tend to be below 14.5°C (58°F) for most of the year. The mustard agent would therefore be likely to be in solid form most of the time, except during periods when the igloo temperature would rise above the agent's melting point. Any liquid that might leak from a munition would therefore tend to spill slowly over the munition(s) and then onto the igloo floor. Evaporation of the liquid would be at a slow rate because the air inside the igloo would be still and because the agent is not very volatile.

6.7 HUMAN HEALTH AND SAFETY — ROUTINE OPERATIONS

Impacts on human health from routine operations are generally assessed by estimating exposures to the toxic substances that are emitted from a facility on a routine basis and by estimating the potential for those exposures to cause adverse health effects. Because the degree of exposure is partially determined by where the human population is located with respect to the emission points, this section gives data on the locations of workers and the general public around the proposed facilities. Guidance for the estimation of exposure and risk from routine low-level exposures is available from the EPA. The assessment for this EIS generally followed the principles of the EPA's Risk Assessment Guidance for Superfund, which includes the estimation of risk for a reasonably maximally exposed individual (MEI) (EPA 1989, 1997). For example, the risk for the off-site public would be assessed by assuming that the MEI resided in the area of off-site maximum contaminant concentrations (generally but not always the fence line). Other assumptions on intake levels and susceptibility are made to ensure that, whenever possible, exposures and risks will be overestimated rather than underestimated. The reasoning is that if the MEI risk is found to be within acceptable limits, then the risk to the general public will be lower and also generally acceptable.

In addition to risks from exposures to facility emissions, occupational hazard risks of injury and fatality are presented for the facility workers. Some risk of on-the-job injury or fatality is associated with any industry, and a screening estimation of this risk is presented. The main determination of this type of risk is the type of work (construction or facility operation) being done and the number of employees who are doing it.

6.7.1 Current Environment

6.7.1.1 Existing Environmental Contamination and Remediation Efforts

Under RCRA, CDPHE and the EPA regulate environmental activities at PCD. The Base Realignment and Closure (BRAC) Environmental Restoration Program monitors them. Media that have been or are being monitored include soils, groundwater, surface water, and air. Ecological resources, such as vegetation, habitats, fish, and wildlife, are also monitored. Fifty-eight (58) solid waste management units (SWMUs) have been identified for cleanup at PCD; none are located in or near the areas proposed for construction of an ACWA facility. Environmental cleanup of contamination from past operations at PCD is being addressed in other environmental compliance documentation and is beyond the scope of this EIS.

6.7.1.2 On-Post Workers and Residents

PCD employs approximately 185 people, of whom 78 are associated with chemical stockpile maintenance (Marrero 2000). There are also approximately 30 employees working for on-post commercial and industrial tenants (Oburn 2000). In addition, 60 people currently reside on PCD in the housing area in the southwest section of the depot (see Figure 6.1-3) (Holland 2000).

The types of workers currently employed at PCD include environmental protection specialists, fire and emergency services specialists, facility management and maintenance workers, and administrative and office workers. The hazards associated with these jobs vary; workers receive training to address their specific job hazards. Although occupational hazards exist for all types of work (rates for various industry classifications are published; for example, see National Safety Council [1999]), these hazards can be minimized when workers adhere to safety standards and use protective equipment as necessary.

On-post workers and residents at the PCD site could be exposed to chemicals released to air, water, or soil. PCD does not currently emit any reportable quantities of HAPs as defined in Title III, Section 112 of the CAA. Contaminant levels in PCD releases to water are subject to applicable National Pollutant Discharge Elimination System (NPDES) regulations. Most nonhazardous solid wastes and hazardous liquids and wastes that are generated at PCD are sent off post for treatment (see Section 6.4). Sanitary waste is sent to holding ponds and is not discharged to nearby waterways. Therefore, any existing emissions or contamination at PCD should not result in increased health risks to workers or on-post residents.

6.7.1.3 Off-Post Public

Demographic information on the off-post public is contained in Section 6.19.1. No increased health risks to the off-post public are associated with normal PCD operations. Procedures are in place to minimize risks associated with accidents (see Section 6.7.1.4)

6.7.1.4 Emergency Response

Procedures for on-post emergency response actions involving toxic chemical munitions are contained in PCD's *Chemical Accident/Incident Response and Assistance Plan* (PCD 2001). This plan establishes policies and procedures that ensure adequately trained personnel and appropriate equipment are present on post at all times to respond to emergency situations.

The Chemical Stockpile Emergency Preparedness Program (CSEPP) has further enhanced the depot's ability to respond to a chemical accident by providing facilities and equipment and by supporting a framework for exchanging information and coordinating assistance with the state and county. As part of CSEPP, PCD operates an emergency operations center (EOC) in Building 2 for 24 hours a day, seven days a week. This facility enables the depot to respond expeditiously to any accident that might occur. In the unlikely event of a chemical accident or incident, EOC staff can readily run plume projections by using the Emergency Management Information System, determine the protective action recommendation (PAR), alert the off-post response community, signal depot staff to respond, and activate the outdoor warning system (made up of six on-post devices capable of emitting several tones and voice messages). Many of these activities can occur simultaneously.

CSEPP has also encouraged PCD, the county, and the state to cooperate with regard to communications, event classification and notification, exercises, public affairs, and planning. Joint communication links include telephones, radios, e-mail, and microwave transmissions. A memorandum of agreement (MOA) for notification allows for the rapid exchange of information and sounding of outdoor warning devices. The county has installed tone alert radios on post and off post, and it will provide emergency information to employees, tenants, contractors, and on-post residents. Joint exercises have been held annually since 1992. Public affairs efforts are coordinated and include a joint information center (formalized by a MOA), annual calendars, and quarterly newsletters. Finally, emergency response plans have been synchronized.

PCD also has plans for responding to other potential spill hazards. Procedures for responding to spills of oil or a hazardous substance are contained in PCD's *Installation Spill Contingency Plan* (PCD 2000b). Controls designed to prevent spills of oil or hazardous substances and to minimize the impact of spills on the environment are described in PCD's *Oil and Hazardous Substance Spill Prevention, Control, and Countermeasures Plan* (PCD 2000c). Emergency response plans establish policies and procedures to ensure that adequately trained personnel and appropriate equipment are present on post at all times to respond to emergency situations.

The PCD Fire Prevention/Protection Department is staffed at all times with five firefighters. Equipment present on post for use in emergency situations includes fire-fighting equipment and vehicles, an emergency response vehicle, heavy equipment, and spill kits.

PCD has mutual aid agreements with local fire departments and medical facilities to augment its emergency preparedness (PCD 2001). The agreements are with the Boone Volunteer Fire Department, TTC Fire Department, and Pueblo Rural Fire Department. These local fire departments have agreed to provide emergency response assistance to PCD, upon request, when it is possible to do so. In return, the PCD Fire Department has agreed to do the same for these local entities. In addition, MOAs have been established by the U.S. Army Medical Department Activity located at Fort Carson, Colorado, and PCD with two hospitals located in the city of Pueblo: Parkview Episcopal Medical Center and St. Mary Corwin Hospital. These MOAs address the treatment of casualties, illnesses, and injuries requiring off-post assistance.

6.7.2 Impacts of the Proposed Action

This section discusses the potential environmental consequences on human health and safety that could result from constructing and operating a pilot test facility for ACW destruction at PCD. Factors that would affect human health and safety include occupational hazards to workers during continued storage, construction, and operations and the potential release of chemical agent or other hazardous materials during routine operations.

6.7.2.1 Impacts of Construction

Facility Workers. Impacts from construction would include occupational hazards to workers. Although occupational hazards to workers can be minimized when workers adhere to safety standards and use protective equipment as necessary, accidents associated with construction work might still occur.

The expected number of worker fatalities and injuries that would be associated with the construction of an ACWA facility was calculated on the basis of rate data from the Bureau of Labor Statistics, as reported by the National Safety Council (1999), and on the basis of estimates of total worker hours required for construction activities for each option, as given in Kimmell et al. (2001). This analysis uses annual fatality and injury rates for the construction sector because that sector was assumed the most representative for the construction of an ACWA facility. Construction of the Neut/Bio facility would require approximately 480 FTEs per year. Construction of the Neut/SCWO facility would require approximately 390 FTEs per year.

Construction of either facility could require up to 34 months. The annual construction fatality and injury rates used were as follows: 13.9 fatalities per 100,000 full-time workers, and 4.4 injuries per 100 full-time workers. Annual fatality and injury risks were calculated as the product of the appropriate incidence rate (given above), and the number of full-time-equivalent (FTE) employees.

The annual fatality and injury rates for construction of ACWA facilities are shown in Table 6.7-1. No distinctions among categories of workers (e.g., supervisors, laborers) were made, because the available fatality and injury statistics by industry are not refined enough to warrant analysis of worker rates in separate categories. The estimated number of fatalities for both of the ACWA technology systems assessed is less than 1. The estimated annual number of injuries for construction of a Neut/Bio facility is 17 and for construction of a Neut/SCWO facility is 21.

TABLE 6.7-1 Annual Occupational Hazard Rates Associated with Continued Munitions Maintenance (No Action) and ACWA Facility Construction and Operations at PCD

Impact to Workers[a]	Neut/Bio	Neut/SWCO	No Action
Fatalities			
Construction	0.05	0.07	NA[b]
Systemization	0.01	0.01	NA
Operations	0.02	0.02	0.002
Injuries			
Construction	17	21	NA
Systemization	15	15	NA
Operations	30	30	4

[a] Impacts are based on the projected work force over the lifetime of the project. Fatality estimates of less than one should be interpreted as “no expected fatalities.” For the ACWA technologies, construction is estimated to require up to 34 months, and operations are conservatively estimated to require a maximum of about 3 years. Under the terms of the CWC, the no action alternative could not extend beyond 2012, or about 11 years.

[b] NA = not applicable; i.e., no construction and systemization phases are associated with the no action alternative.

The calculation of fatality and injury rates from industrial accidents was based solely on historical industrywide statistics and therefore did not consider a threshold (i.e., it was assumed that any activity would result in some estimated risk of fatality and injury). Whatever technology is implemented will be accompanied by best management practices, which should reduce fatality and injury rates.

Other On-Post Workers and Residents. The main pollutant emission associated with construction of the ACWA facilities would be PM (see Section 6.4). The levels of PM at the administrative and residential areas on post would be about 4% or less of the health-based NAAQS levels. Therefore, no adverse health impacts on on-post workers and residents would be expected from construction activities.

Off-Post Public. The main pollutant emission associated with construction of the ACWA facilities would be PM (see Section 6.4). The levels of PM at the nearest off-post residence (located about 1.7 mi [2.7 km] north of the proposed construction area) would be about 14% or less of the health-based NAAQS levels. Levels at residential areas located farther away would be lower. Therefore, no adverse health impacts on the off-post public would be expected from construction activities.

6.7.2.2 Impacts of Operations

Facility Workers

Occupational Hazards. Occupational hazards associated with systemization (i.e., preoperational testing) and operation of an ACWA pilot facility at PCD were estimated by using the same approach as that discussed above for construction (Section 6.7.2.1). Operation of both the Neut/Bio and the Neut/SCWO facilities would require approximately 635 FTEs/yr. This number includes a mix of contractor and government employees. Systemization would require 12 months with a peak work force of 315 FTEs (Kimmell et al. 2001). Annual fatality and injury rates for the manufacturing sector were used because this sector was assumed to be the most representative for systemization and operations work at an ACWA facility. The annual fatality and injury rates used were as follows: 3.2 fatalities per 100,000 full-time workers, and 4.8 injuries per 100 full-time workers.

The annual fatality and injury rates for systemization and operation of ACWA facilities are shown in Table 6.7-1. The estimated number of fatalities for all the technologies assessed is less than 1. The estimated annual number of injuries is the same for each technology: 15 per year for systematization and 30 per year for operations.

Inhalation Risks. For routine operations, inhalation exposures and risks to facility workers would depend in part on detailed facility designs that are not yet available. In this EIS, facility workers are generally excluded from health risk evaluation for occupational exposures because such exposures are covered by other guidance and regulations (EPA 1998b). Quantitative estimates of risks to ACWA facility workers from inhalation of substances emitted during facility operations were not generated for this EIS. However, the workplace environment would be monitored to ensure that airborne chemical concentrations were below applicable occupational exposure limits. Health risks from occupational exposure through all pathways would be minimized because operations would be enclosed insofar as possible and because protective equipment would be used if remote handling of munitions was not possible during processing.

Other On-Post Workers and Residents

Inhalation of Toxic Air Pollutants. Estimated maximum on-post concentrations of toxic air pollutants from ACWA facility pilot testing are discussed in Appendix C. The maximum on-post concentrations would occur close to Munitions Storage Area A at PCD; therefore, people most likely to be exposed would be on-post workers. (The residential area at the PCD site is removed from the location of maximum modeled air concentrations; it is approximately 5 mi (8 km) from the Munitions Storage Area A area on the south side of the site.) On-post exposures were modeled by using exposure assumptions typical for the maximum exposed individual (MEI) in the worker population. This person would be a worker present at the location of maximum on-post air concentration for 8 hours per day and 250 days per year, for the duration of the pilot test operations for each technology. Exposure estimates generated on the basis of these assumptions were compared with cancer and noncancer toxicity values to generate estimates of increased cancer risk and of the potential for noncancer health impacts. A summary of the results of this assessment is shown in Table 6.7-2. Details of the assessment are provided in Appendix C.

As shown in Table 6.7-2, estimated hazard indexes and carcinogenic risks from exposure to toxic air pollutants estimated for the on-post MEI were well below the benchmarks considered to be representative of negligible risk levels. The typical benchmark indicator for significant noncarcinogenic hazards is a hazard index of greater than 1, and for carcinogenic hazards, it is an increased lifetime carcinogenic risk level of greater than 10^{-6}. Although many more chemicals were detected in gas samples from Neut/Bio than from Neut/SCWO during the demonstration, the estimated risk levels for routine emissions from the two technologies were very comparable, generally on the same order of magnitude. Almost all of the estimated noncarcinogenic and carcinogenic risks were associated with the boiler emissions and not with the destruction facility processes (see Appendix C). Note that exposures and risks are slightly higher for the off-post MEI than for the on-post MEI because the annual exposure duration for the off-post MEI is assumed to be longer (see next subsection on off-post public).

TABLE 6.7-2 Toxic Air Pollutant Emissions and Impact on Human Health and Safety during Normal Operations at PCD[a]

Emissions and Impacts	Neut/Bio[b]	Neut/SCWO
Hazardous air emissions		
Number of chemicals	107	60
Number of chemicals with quantitative data on toxic, noncarcinogenic effects[c]	78	35
Number of chemicals with quantitative data on carcinogenic effects[d]	57	22
Impacts[e]		
Hazard index (*hazard index of <1 means adverse health impacts are unlikely*)		
For MEI in off-post general public	5×10^{-4} (1×10^{-3})	7×10^{-4}
For MEI in on-post population	1×10^{-4} (3×10^{-4})	1×10^{-4}
Increased lifetime carcinogenic risk *(risk of 10^{-6} is generally considered negligible)*		
For MEI in off-post general public	2×10^{-9} (5×10^{-9})	3×10^{-9}
For MEI in on-post population	2×10^{-9} (3×10^{-9})	6×10^{-10}
Increased lifetime carcinogenic risk to population due to worst-case mustard emissions *(risk of 10^{-6} is generally considered negligible)*[f]		
On post	7×10^{-9}	1×10^{-8}
Off post	2×10^{-7}	2×10^{-7}

[a] Based on emission estimates from demonstration testing (Kimmell et al. 2001) and model estimates of maximum on-post and off-post concentrations and adjusted to account for fluctuating operations. ISCST3 model was used. Estimates for general public assumed 24-h/d exposures for the duration of operations. Estimates for the on-post population assumed 8-h/d exposures and a 250-d/yr for the duration of operations. See Appendix C for details.

[b] For Neut/Bio, the value in parentheses assumes no further treatment of emissions from the biotreatment vent after processing in the immobilized cell bioreactor (ICB) unit.

[c] Potential noncarcinogenic impacts from some detected chemicals could not be evaluated quantitatively because toxicity data were not available. However, only 17 chemicals for Neut/Bio and 14 chemicals for Neut/SCWO could not be quantitatively evaluated for either noncarcinogenic or carcinogenic effects (see text discussion).

[d] All known carcinogens were evaluated for carcinogenic risk.

[e] Carcinogenic risks are less than 10^{-6} and hazard indexes are less than 0.01 for all technologies; thus, they are in the negligible range. Although calculated cancer risks range from approximately 10^{-10} to 10^{-7}, and calculated hazard indexes range from 10^{-4} to 10^{-3}, there is no significant difference in risk among the technologies. Thus, for all the technologies, increased cancer and noncancer risks from inhalation of emissions are in a range considered to be negligible.

[f] Although the facility would be designed to operate without mustard releases, these values were estimated as a worst case by assuming continuous emissions at the detection limit (Kimmell et al. 2001). The estimated concentrations are all less than 1% of the allowable concentration for general population exposures.

Some uncertainties in the demonstration test data used to estimate emissions of toxic air pollutants should be considered in interpreting the results. Some unit operations were not characterized in demonstration testing, so trace effluents were not estimated for all unit operations that make up the complete systems. Generally, data were available for unit operations that would be expected to generate the most gaseous emissions during actual operations (Mitretek 2001a,b). However, the emission levels and health risk estimates provided here should be considered only indicative of likely levels. They may need to be revised as the technology designs near completion and as estimates of process efficiencies become more reliable (Kimmell et al. 2001). Nevertheless, the values used for the risks from operations presented in this EIS were designed to be very conservative (i.e., potentially resulting in overestimates of risk) and to bound minor variations in the way that the ACWA destruction systems would be engineered.

In general, toxicity benchmark levels were available to allow quantitative risk estimates for the majority of toxic air pollutants detected. For Neut/Bio operations, 17 chemicals did not have established toxicity benchmark levels. For Neut/SCWO operations, 14 chemicals did not have established (i.e., peer-reviewed) noncarcinogenic or carcinogenic toxicity benchmark levels (see Appendix C). For most of the substances for which toxicity could not be quantitatively evaluated, emission levels were very low (e.g., less than 10 g/d). Although not quantitatively assessed, toxic effects would be highly unlikely in association with these very low emission levels. For several substances emitted from boilers and diesel generators (aldehydes, propane, butane, pentane, and ethane), emission levels were somewhat higher (up to about 1 kg/d). Although potential health effects from inhalation of these substances could not be quantitatively evaluated because of the lack of toxicity benchmark levels, such data would not distinguish among risks associated with the two alternative technologies, because both of them would use boilers and diesel generators.

Per Executive Order 13045 (1997), it is also necessary to consider whether sensitive subpopulations, such as children or the elderly, could be more affected than the general population by the estimated exposures to toxic air pollutants. The reference concentrations used to evaluate the noncarcinogenic toxicity of the emitted substances already include factors to account for the possible added sensitivity of certain subpopulations. Chemical-specific potency estimates for carcinogens also include conservative uncertainty factors and so can be used to assess risks for sensitive subpopulations. However, the exposure parameters used to estimate intake (i.e., 154 lb [70 kg] body weight; 20 m^3/d inhalation rate) are typical for adults. To consider intake for young children (less than 1 year old), an inhalation rate of 4.5 m^3/d and a body weight of 20 lb (9 kg) (EPA 1997) could be assumed. Use of these assumptions would result in an estimate of inhalation dose (in milligrams per kilogram of body weight per day) for a young child that is 1.7 times greater than the dose assumed for an adult, and overall hazard indices and cancer risks would also increase by a factor of 1.7. Since the hazard indices and cancer risks estimated for toxic air pollutant emissions during normal operations were low (Table 6.7-2), risk levels for sensitive subpopulations, such as children, would still be less than benchmark levels.

Inhalation of Chemical Agent. Maximum potential concentrations from emissions of mustard agent under fluctuating operations were discussed in Section 6.6.3.3. Modeling dispersion from the estimated maximum emissions resulted in a maximum estimated on-post concentration of 0.0002 $\mu g/m^3$ for the technologies evaluated. This value is less than 1% of the allowable concentration of 0.1 $\mu g/m^3$ HD/HT for general public exposures (CDC 1988). In practice, the facility stacks would have continuous agent monitoring devices that would sound if any agent was detected in the stacks, so that the source could be identified and eliminated quickly. Emissions would not be allowed to continue at the detection limit level, as was assumed in the modeling exercise.

Mustard has been classified as a known carcinogen (Agency for Toxic Substances and Disease Registry [ATSDR] 1992; also see Appendix C). The maximum incremental cancer risk for the on-post MEI due to hypothetical mustard emissions was estimated to be 1×10^{-8} (Table 6.7-2). This risk level is about 100 times lower than the benchmark risk value of 10^{-6}, and, as stated above, emission levels would not be allowed to continue at the emission limit level for more than a short time, so the exposure assumption of longer than two years is a large overestimate. Therefore, even under hypothetical worst-case emission levels, carcinogenic risks from mustard emissions associated with the destruction facilities would be very small.

Exposures from Other Pathways. Other potential exposure pathways to be considered are water (if effluent from the pilot facilities would be released to nearby waterways) and soil and food (if soil would become contaminated by releases to air and subsequent deposition). In order to use the ACW destruction systems for pilot testing, plans have been made to recycle all process water through the system. The facilities are not expected to generate any aqueous effluent except for the sanitary wastewater generated by employees. Also, exposure through soil and food chain pathways from deposition onto soil and/or water is expected to be very low, since the level of air emissions that would result from routine operations is expected to be very low and since the duration of operations would be short. All facility releases would be in conformance with applicable local and state permit requirements. Therefore, exposures through water, soil, or foodchain pathways would result in minimal, if any, additional risk to on-post workers and residents.

Off-Post Public

Inhalation of Toxic Air Pollutants. Maximum off-post concentrations of toxic air pollutants that would result from the destruction technologies are discussed in Appendix C. Off-post exposures were modeled by using exposure assumptions typical for the MEI in the off-post residential population. (This person is a hypothetical individual present at the location of maximum off-post air concentration for 24 hours per day and 365 days per year, for the duration of the pilot test operations for each technology.) Exposure estimates generated on the basis of these assumptions were compared with cancer and noncancer toxicity values to generate estimates of increased cancer risk and of the potential for noncancer health impacts. A summary of the results of this assessment is shown in Table 6.7-2. Details of the assessment are provided in Appendix C.

This assessment was limited to the estimation of risks associated with inhalation of emitted substances. For some of the emitted substances (e.g., dioxins and furans), exposure to the off-post public through the food-chain pathways could be as large or larger than exposure through inhalation, because these substances are bioaccumulative. Estimates of exposure through these alternate pathways can be highly uncertain and are beyond the scope of this EIS. However, for both technologies, the emission rates for these substances are quite low (less than 0.00001 lb/yr for all forms of dioxins and furans). For the purpose of this assessment (i.e., to compare the risks associated with pilot testing the alternate ACWA technology systems), estimation of the risk associated with inhalation should be indicative of the risk from all pathways.

As shown in Table 6.7-2, estimated hazard indexes and carcinogenic risks from exposure to toxic air pollutants estimated for the off-post MEI were well below levels considered to be hazardous. The typical benchmark indicator for significant noncarcinogenic hazards is a hazard index of greater than one, and for carcinogenic hazards, it is an increased lifetime carcinogenic risk level of greater than 1×10^{-6}. Although many more chemicals were detected in gas samples from Neut/Bio than from Neut/SCWO during the demonstration, the estimated risk levels for routine emissions from the two technologies were very comparable, generally on the same order of magnitude. Almost all the estimated noncarcinogenic and carcinogenic risks were associated with the boiler emissions and not with the destruction facility processes (see Appendix C). Note that exposures and risks were slightly higher for the off-post MEI than for the on-post MEI because the annual exposure duration was assumed to be longer for the off-post MEI (see previous subsection regarding on-post workers and residents). Even if it is assumed that children have up to 1.7 times greater exposure than adults (see Section 6.7.2.2), risks would still remain below levels of concern. A more detailed discussion of assumptions and data limitations for this assessment is provided in Appendix C.

Inhalation of Chemical Agent. Maximum potential concentrations from emissions of mustard agent under fluctuating operations were discussed in Section 6.6.3.3. Modeling dispersion from the estimated maximum emissions resulted in a maximum estimated off-post concentration of 0.00006 $\mu g/m^3$ for the technologies evaluated. This value is only 0.06% of the allowable concentration of 0.1 $\mu g/m^3$ HD/HT for general public exposures (CDC 1988). In practice, the facility stacks would have continuous agent monitoring devices that would sound if any agent was detected in the stacks, so that the source could be identified and eliminated quickly. Emissions would not be allowed to continue at the detection limit, as was assumed in the modeling exercise.

Mustard has been classified as a known carcinogen (ATSDR 1992; also see Appendix C). The maximum incremental cancer risk for the off-post MEI due to hypothetical mustard emissions was estimated to be 2×10^{-7} (Table 6.7-2). Note that the risk is slightly higher for the off-post MEI than for the on-post MEI because the annual exposure duration is assumed to be longer for the off-post MEI. This risk level is five times lower than the benchmark risk value of 10^{-6}, and, as stated above, emission levels would not be allowed to continue at the emission limit level for more than a short time, so the exposure assumption of more than 2 years is a large overestimate. Therefore, even under hypothetical worst-case emission levels, carcinogenic risks from mustard emissions associated with the destruction facilities would be very small.

Exposures from Other Pathways. Exposures through water, soil, or food-chain pathways would result in minimal, if any, additional risk to off-post residents (see previous discussion of exposure from other pathways for other on-post workers and residents).

6.7.3 Impacts of No Action

Munitions maintenance workers at PCD can be exposed to chemicals when conducting inspections or annual munitions inventories. Before a worker is allowed to enter any igloo, the air inside is monitored for the presence of agent. Workers are required to wear respiratory protection and protective clothing while in the storage igloos. No routine use of chemicals would be required for continued storage operations, so exposures to other chemicals would be limited. Another potential hazard is heat stress associated with the heavy protective clothing and equipment required for work. However, workers are trained to control this hazard. For the other on-post workers and residents and for the general public, no impacts to human health would be expected in association with the no action alternative.

Risk calculations for fatalities or injuries resulting from the no action alternative are shown in Table 6.7-1. The expected number of worker fatalities and injuries associated with continuing maintenance of the munitions stockpile at PCD was calculated on the basis of rate data from the BLS as reported by the National Safety Council (1999) and on an estimate of 78 total annual FTE employees required for munitions maintenance activities. Annual fatality and injury rates for the manufacturing sector were used because this sector was assumed to be the most representative for munitions maintenance work. The specific rates were as follows: fatality rate of 3.2 per 100,000 full-time workers, and injury rate of 4.8 per 100 full-time workers. Annual fatality and injury risks were calculated as the product of the appropriate incidence rate (given above) and the number of FTE employees. No distinctions were made among categories of workers (e.g., supervisors, inspectors, security personnel), because the available fatality and injury statistics by industry are not refined enough to warrant analysis of worker rates in separate categories. The estimated number of fatalities from no action is less than one. The estimated total number of injuries is four.

6.7.4 Impacts from Transportation

Chemical agent would not be transported on or off post for any of the alternative technologies evaluated. However, transportation can have adverse impacts on human health because of the associated emission of toxic air pollutants such as benzene, 1,3-butadiene, and formaldehyde. Emissions consist of engine exhaust from diesel- and gasoline-powered vehicles and fugitive dust raised from the road by transport vehicles. Increased incidence of lung cancer has been associated with prolonged occupational exposure to diesel exhaust (Dawson and Alexeeff 2001); toxic air pollutants are also emitted from gasoline-burning vehicles (EPA 2000e). Also, transportation results in some increased risk of injuries and fatalities from mechanical causes; that is, the transport vehicles may be involved in accidents. This type of risk is termed "vehicle-related." Both the chronic health hazard from inhalation of emissions from transport vehicles and the injury risk are directly proportional to the number of vehicle miles traveled.

For the transportation impacts in this EIS, the annual number of vehicle miles traveled by delivery vehicles (used for delivery of construction materials) and commuter vehicles (used to transport construction and operation workers) was compared for each of the alternative technologies and for the no action alternative. In addition, the annual number of shipments of raw materials and waste required for each alternative was tabulated. It was assumed that the distances for shipping raw materials and waste would be similar for each of the alternatives. This assumption was necessary because actual origination and destination locations had not been determined. Therefore, the data did not support risk calculations using diesel emission factors. The comparison of the number of vehicle miles traveled and the number of shipments by alternative is useful for an overall comparison of the potential transportation impacts to human health from each alternative.

The transportation impacts for PCB are summarized in Table 6.7-3. The number of miles traveled annually by construction and operations worker commuter vehicles is similar for both technologies. The Neut/SCWO technology would require about 30% more shipments annually than the Neut/Bio technology. The amount of transportation required for the no action alternative is very small.

6.8 NOISE

The *Noise Control Act of 1972*, along with its subsequent amendments (*Quiet Communities Act of 1978*, found in *United States Code*, Title 42, Parts 4901-4918 [42 USC 4901-4918]), delegates to the states the authority to regulate environmental noise and directs government agencies to comply with local community noise statues and regulations. The State of Colorado has quantitative noise-limit regulations. The maximum permissible noise limits for the various classes of source areas under the Colorado Noise Abatement Law are listed in Table 6.8-1. Pueblo and Pueblo County use the Colorado limits.

TABLE 6.7-3 Comparison of Annual Transportation Requirements for Construction and Routine Operations for Alternative Technology Systems at PCD[a]

Parameter	Neut/Bio	Neut/SCWO	No Action[b]
Number of vehicle miles traveled[c]			
Construction delivery vehicle	200,000	200,000	NA[d]
Construction worker commuter vehicle	3,700,000	4,600,000	NA
Operations worker commuter vehicle	7,000,000	7,000,000	900,000
Number of shipments[e]			
Mustard agent			
Raw materials	159	883	NA
Waste	1110	809	NA
Total	1,269	1,692	NA

[a] Number of vehicle miles traveled and number of shipments are used as indicators of potential transportation-associated health impacts, since emissions and vehicle-related risks increase with increasing transportation.

[b] No action alternative assumes 78 employees would be required for continued storage maintenance.

[c] Annual miles are calculated as the number of workers × 276 work days per yr × 40 mi per round trip.

[d] NA = not applicable.

[e] Raw material and waste shipments for nerve agent are the maximum annual for either GB or VX processing.

Input data sources: Kimmel et al. (2001).

The EPA guideline recommends an L_{dn} of 55 dBA to protect the public from the effect of broadband environmental noise in typically quiet outdoor and residential areas (EPA 1974).[7,8] For protection against hearing loss in the general population from nonimpulsive noise, the EPA guideline recommends an L_{eq} of 70 dBA or less over a 40-year period.[9]

---

[7] L_{dn} is the day-night A-weighted equivalent sound level, averaged over a 24-hour period.

[8] dBA is a unit of weighted sound-pressure level, measured by the use of the metering characteristics and the A-weighting specified in ANSI S1.4-1983 (the American National Standards Institute specification for sound level meters) and in ANSI S1.4A-1985, the amendment to S1.4-1983 (Acoustical Society of America 1983, 1985).

[9] L_{eq} is the equivalent steady sound level that, if continuous during a specific time period, would contain the same total energy as the actual time-varying sound. For example, L_{eq}(1-h) is the 1-hour equivalent sound level.

TABLE 6.8-1 State of Colorado Regulations on Maximum Permissible Noise Levels

	Maximum Permissible Noise Level (dBA)[a]	
Zone	7 a.m. to 7 p.m.[b]	7 p.m. to next 7 a.m.
Residential	55	50
Commercial	60	55
Light industrial	70	65
Industrial	80	75

[a] At a distance of 25 ft (8 m) or more from the property line. Periodic, impulsive, or shrill noises are considered a public nuisance when such noises are at a level of 5 dBA less than those listed. Construction activities are subject to the limits listed for industrial zones.

[b] For a period not to exceed 15 minutes in any one hour, the noise level may be exceeded by 10 dBA.

Source: *Colorado Revised Statutes*, Title 25 on Health, Article 12 on Noise Abatement.

6.8.1 Current Environment

An investigation of the noise environment at PCD (U.S. Army Environmental Hygiene Agency [USAEHA] 1990) indicated that noise levels within the potion of PCD encompassing Areas A, B, and C was less than 65 dBA. Measurements made in November 1999 at the TTC, located north of PCD, indicate that minimum background noise levels were around 34 dBA during mid-afternoon, with an average background L_{95} of 38 dBA for a 1½-hour period (White 2000).[10] The average nighttime background noise level was around 25 to 30 dBA, depending on wind conditions. These background levels are comparable to the residual sound levels of typical rural areas, which are approximately 30 to 35 dBA (Liebich and Cristoforo 1988).

Currently, the only residence or sensitive noise receptors (e.g., hospitals, schools, parks) in the immediate vicinity of PCD are the on-post residences located in the Administrative Area and Hi-Pardner Park, next to PCD's main gate (see Figure 6.1-2). The off-post residence closest to an area being considered for a pilot facility is located about 0.5 mi (0.8 km) north of the PCD boundary. The closest population centers with schools or town infrastructure are North Avondale

[10] L_{95} represents a sound level that is exceeded 95% of the stated time period.

and Avondale, which are about 0.4 mi (0.7 km) and 1.6 mi (2.6 km), respectively, from the south boundary of the PCD site.

6.8.2 Noise Sources for the ACWA Pilot Test Systems

Standard commercial and industrial practices for moving earth and erecting concrete and steel structures would be used to construct an ACWA pilot facility. Noise levels generated from these activities would be comparable to those from any construction site of similar size.

Pilot facility operations would involve a variety of equipment that would generate noise. Because of the nature of chemical agent destruction operations, most of the equipment would be housed in buildings designed to prevent the release of chemical agents and to contain potential explosions. These buildings would attenuate the noise generated by the activities within them. However, equipment such as fans and pumps used to convey treatment residues (e.g., pollution abatement systems), heating and air conditioning units, electrical transformers, and in-plant public address systems would generate noise, and these items might be located outside. In addition, vehicular traffic in and around the ACWA facility during both construction and operation would generate noise.

6.8.3 Impacts of the Proposed Action

6.8.3.1 Impacts of Construction

The operation of equipment and vehicles during construction and associated activities would result in noise. Activities such as land clearing, grubbing, excavation, and soil movement at a typical construction site generate noise levels in the 77–90 dBA range at a distance of about 50 ft (15 m) from the source (EPA 1979). Noise levels decrease about 6 dB per doubling of distance from the source because sound spreads over an increasing area. Thus, construction activities at the pilot test facility location would result in estimated noise levels of about 45–50 dBA at the PCD boundary closest to Area A and 40–45 dBA at the residence nearest to the site (i.e., at a distance of about 1.7 mi [2.7 km] north of the center of Area A).

This 45-dBA estimate is likely to be an upper bound because it does not account for other types of attenuation, such as air absorption and ground effects due to terrain and vegetation. The 45-dBA level is below Colorado and EPA standards for residential zones (see Table 6.8-1) and is in the range found within a typical residential community at night (Corbitt 1990). If other attenuation mechanisms were considered, noise levels at the nearest residence would decrease to near background levels of 30–35 dBA (see Section 6.8.1). Thus, potential noise impacts from construction activities at the pilot test facility location are expected to be minor or nonexistent at the nearest residence and well within local and state limits.

6.8.3.2 Impacts of Operations

The pollution abatement system being used at the baseline incinerator facility in Tooele, Utah, is similar in design to the pollution abatement systems being considered for use in the ACWA pilot facility. Sound level measurements taken during operation of this system were less than 73 dBA within 100 ft (30 m) of the abatement equipment (Andersen 2000). When the noise attenuation factors discussed in Section 6.8.3.1 are applied, it is estimated that noise levels from the proposed facility would be less than 35 dBA at the nearest residence, 1.7 mi (2.7 km) from the proposed facility. This noise level at the nearest residence is comparable to the ambient background level discussed in Section 6.8.1; it would be barely distinguishable from the background level. In conclusion, noise levels generated by plant operations should have a negligible impact on the residence that is located nearest to the proposed facility and be well within local and state limits.

6.8.4 Impacts of No Action

The levels of noise generated by current stockpile maintenance activities are part of the current background noise levels that reflect installation operation. These would not be expected to change under the no action alternative. Therefore, the conditions described in the affected environment would continue to exist. Existing noise levels are within legal limits and are not a significant concern.

6.9 VISUAL RESOURCES

Natural and man-made features give a particular landscape its character and aesthetic quality. The character of a landscape is determined by the elements of form, line, color, and texture; each element may influence the landscape's character to a varying degree. The stronger the influence of any one or all of these elements, and the more visual variety that the landscape can successfully incorporate, the more pleasing is the aesthetic quality of the landscape.

6.9.1 Current Environment

The viewshed within the vicinity of PCD consists primarily of rolling, open pasture land used for livestock grazing. Although there are signs of development around PCD, including residential homes, rail test facilities, roads, railways, and transmission lines, the overall visual character of the area is still the open plains typical of eastern Colorado. There are no areas of significant scenic quality (e.g., national or state parks, nearby mountain vistas).

PCD itself is largely industrial. Although there are some large undisturbed areas and a few small water bodies on the post, much of the installation has been disturbed by the construction of buildings, storage igloos, roads, rail lines, utility structures and corridors, and fences. The developed portions of the installation will continue to be used under the PCD Reuse Plan (PDADA 2000).

The industrial and other developed areas on the site, including utility corridors, are generally consistent with a BLM VRM Class IV designation (activities that lead to major modification of the existing character of the landscape). The remainder of the site fits a VRM Class III or IV designation (hosting activities that, at most, only moderately change the existing character of the landscape) (DOI 1986a,b).

The three potential sites for ACWA facilities are adjacent to the Munitions Storage Area A area, which is surrounded by a chain link fence. The igloo structures are low-profile but are visible, since the area is flat and has very little vegetation. A large tower, storage tanks, and several buildings are visible in the Munitions Storage Area A area. Although not presently developed, all of the potential sites for the ACWA facilities are within the Chem Demil area.

The state of Colorado has a visibility standard that limits the maximum permitted light extinction coefficient value to 0.076 per kilometer (equivalent to a minimum visual range of about 30 mi, or 50 km) averaged over a four-hour period between 8 a.m. and 4 p.m. local time. This standard applies when the relative humidity is less than 70% to a program area that includes the Denver metropolitan area but does not include PCD or any other areas in Pueblo County. The location subject to this visibility standard is about 15 mi (24 km) north of PCD, at the El Paso County line.

6.9.2 Site-Specific Factors

The general visual character of PCD could be affected by the

1. Visual character of the ACWA facility and its supporting components (other facilities, transmission lines, roads, parking areas),

2. Placement of the ACWA facility (its elevation, adjacent land use, resulting viewshed, etc.) and

3. Visibility impacts from fugitive dust emissions created by construction or from steam emissions created by the operating stacks.

6.9.3 Impacts of the Proposed Action

6.9.3.1 Impacts of Construction

Construction of an ACWA facility would not be expected to affect visual resources because (1) there are no significant visual resources in the area, (2) surrounding areas are used primarily for grazing, and (3) the effects would be intermittent and temporary.

6.9.3.2 Impacts of Operations

The presence of ACWA facilities is consistent with the surrounding land uses and would not adversely affect the visual resources in the area. Operation of the facilities would not create significant, visible emissions.

6.9.4 Impacts of No Action

Under the no action alternative, there would be no change to the existing visual character of PCD.

6.10 GEOLOGY AND SOILS

6.10.1 Current Environment

6.10.1.1 Geology

PCD is situated on a terrace in the western part of the Colorado Piedmont section of the Great Plains physiographic province. The gently rolling topography at PCD ranges in elevation from about 4,800 ft (1,500 m) above mean sea level (MSL) at the northern boundary to about 4,700 ft (1,500 m) above MSL at the southern boundary (Chafin 1996).

The upland alluvial terrace deposits underlying PCD consist of interlayered sand, gravel, and clay layers that were deposited during the Pleistocene Epoch (Watts and Ortiz 1990). Across the installation, these alluvial deposits range in thickness from 0 to 95 ft (30 m) (Chafin 1996). They unconformably overlie the Pierre Shale, a thinly bedded, dark gray to black shale/sandy shale unit of Upper Cretaceous age. The Pierre Shale, which is approximately 1,200 ft (370 m) thick in this area, is characterized by an irregular surface that was shaped by erosion before deposition of the alluvial terrace deposits (Watts and Ortiz 1990). Irregularities in the surface of the Pierre Shale account for the wide variability in thickness of the alluvial deposits at PCD. Weathered exposures of the Pierre Shale bedrock occur along the courses of Chico and Haynes Creeks (Scott et al. 1978), but these contacts are partially obscured by soils (Watts and Ortiz 1990). Economic geologic resources beneath PCD are limited to sand and gravel deposits. Mineral resources are not known to be present.

6.10.1.2 Seismicity

PCD is located within the Plains Seismotectonic Province as defined by Kirkham and Rogers (1981). Tectonic activity during the past 23 million years has been limited in this province; there is no evidence of major Neogene activity present (Kirkham and Rogers 1981). Only four faults in the Plains Province show evidence of Neogene activity: the Fowler Fault, Cheraw Fault, Valmont Fault, and Rocky Mountain Arsenal Fault.

The closest potentially active tectonic feature to PCD is Fowler Fault, located near the town of Fowler, Colorado. This fault trends northwest-southeast and, at its closest point, is located about 13 mi (20 km) east of the site. It has a length of about 8 mi (12 km). The most recent movement on this fault has been dated to the period of time between the mid-Pleistocene and Holocene Epochs (i.e., between 1 million and 11,000 years ago) (Kirkham and Rogers 1981; U.S. Army et al. 1987). A second potentially active fault, Cheraw Fault, is also located in the lower Arkansas River Valley region near Cheraw, Colorado. This fault trends northeast-southwest and, at its closest point, is located about 43 mi (70 km) east of PCD. It has an estimated length of 27 mi (44 km). Movement on this fault also has been dated to the Quaternary (10,000 years before present) (Kirkham and Rogers 1981; U.S. Army et al. 1987). The Valmont Fault lies about 5 mi (8 km) northeast of Boulder, Colorado. This fault has been described as minor, with a north, 50 degrees east trend (Kirkham and Rogers 1981). The Rocky Mountain Fault is an inferred linear northwest-trending zone in northeast Denver, Colorado. It is widely accepted that a series of earthquakes that begin in 1962 along this fault were triggered by deep fluid injection at the Rocky Mountain Arsenal well (Kirkham and Rogers 1981). Cheraw and Fowler Faults experienced movement during the Quaternary Epoch. They could be responsible for earthquakes up to intensity VI (U.S. Army et al. 1987). A modified Mercali intensity VI earthquake would be felt by all; windows, dishes, and glassware would break; furniture would move or overturn; and weak plaster and masonry would crack (Kirkham and Rogers 1981).

The nearest recorded earthquake to PCD that produced damage occurred on January 6, 1979 (Kirkham and Rogers 1981). This earthquake had a center at Divide, Colorado, approximately 60 mi (100 km) from the site. It had an intensity of V (small objects were displaced, pictures moved).

On the U.S. Army's behalf, Jacobs Engineering Group, Inc., and URS/John A. Blume & Associates jointly prepared a comprehensive assessment of the earthquake hazards at PCD. The results of this assessment and comprehensive discussions of regional geology, tectonics, and earthquake history are presented in a report issued by the U.S. Army (U.S. Army et al. 1987). On the basis of this assessment, it was determined that the maximum earthquake that could affect PCD would most likely occur on Fowler Fault (U.S. Army et al. 1987). The maximum earthquake magnitude for Fowler Fault was estimated to be a local magnitude of $M = 6.1$ (equivalent to $m_b = 5.7$).[11] An earthquake of this magnitude would produce a peak ground acceleration of 0.21 G at PCD. The earthquake duration was estimated to be eight seconds. The impacts on buildings that would result from an earthquake of this intensity would be damage to masonry, with a potential for a partial building collapse.

A recent probabilistic analysis was performed for the Army Chemical Disposal Facility at Pueblo, Colorado. This study indicated that the peak ground acceleration associated with the Cheraw and Sangre de Cristo Faults and the Great Plains and Denver Basin Source Zones would be approximately 0.1 G for an earthquake that would have a 100% probability of occurring once in 1,000 years. A peak ground acceleration of approximately 0.23 G was estimated for an earthquake that would have a 100% probability of occurring once in 10,000 years (Benjamin and Geomatrix 1996). This value agrees closely with the 0.21-G value previously estimated by the U.S. Army et al. (1987). However, the Benjamin and Geomatrix (1996) study did not include Fowler Fault in the analyses because recent data did not show any bedrock fault with significant displacement in the location of the postulated feature. The nearest capable fault for this study was Cheraw Fault, described above.

According to Army Technical Memorandum 5-809-10 (U.S. Army et al. 1992), PCD is located in seismic probability zone 1, a zone where minor earthquake damage may be expected to occur at least once in 500 years (or a 10% probability of occurrence in 50 years). This manual contains seismic design criteria that are in accordance with recommendations from the Structural Engineers Association of California, American Concrete Institute, American Institute of Steel Construction, and International Conference of Building Officials. In a report on the seismic fragility of structures and equipment that was done for the U.S. Army Pueblo Chemical Agent Disposal Facility in Pueblo, Colorado, designs were based on an earthquake that had a 100% probability of occurring once in 100,000 years (Shah and Reed 1996). The peak ground acceleration for this event was estimated to be 0.403 G.

6.10.1.3 Soils

Soil types at PCD vary (Table 6.10-1 and Figure 6.10-1) and are grouped into several soil associations on the basis of shared characteristics (USDA 1979). Within the areas at PCD designated for chemical demilitarization activities, the soils belong to the Valent, Olney-Vona, and Arvada-Keyner Associations. The soils along the utility corridors are basically the same as

---

[11] M (moment magnitude) represents the strength of an earthquake based on the concept of seismic moment. m_b (body-wave magnitude) is a measure of the energy released by an earthquake.

TABLE 6.10-1 Soil Associations at PCD

Association	Soil Type	Characteristics
Stoneham-Adena-Manzola	Sandy to clayey loams that form in loess and in loamy and clayey alluvium	Deep, well drained Slow or moderate permeability High available water capacity Medium runoff Moderate potential for erosion
Olney-Vona	Sandy loams and loamy sands that form in eolian sands	Deep, well drained Moderate to rapid permeability High available water capacity Slow runoff High potential for wind erosion
Limon-Razor-Midway	Silty clays, silty clay loams, clay loams, and clays that form in materials weathered from shale	Shallow to deep, well drained Slow permeability High to very low available water capacity Rapid to medium runoff Moderate to severe potential for erosion
Arvada-Keyner	Sandy to clayey loams that form on terraces in alluvium derived from mixed sedimentary rocks	Deep, well-drained Very slow permeability High available water capacity Slow runoff Slight potential for erosion
Valent	Loamy sands and sands that form in eolian sands	Deep, excessively well drained Very rapid permeability Low available water capacity Slow runoff Severe potential for wind erosion
Las Anima-Glenberg-Apishapa	Fine sandy loams and silty clays that form in alluvium on flood plains	Deep, somewhat poorly to well drained Slow to moderately rapid permeability Moderate to high available water capacity Slow runoff High potential for erosion

Source: Adapted from USDA (1979).

the soils encountered at Sites A, B, and C, except that Corridors 2, 3, and 4 also include soils from the Limon-Razor-Midway Association. The engineering properties of these soils are variable and must be accounted for in the design of any facilities built in these areas.

For the most part, the soils at Site A have been largely undisturbed, except along roadways and the Munitions Storage Area A fence line. Soils at Sites B and C have been disturbed by previous activities. Soils along Corridors 1 and 2 and most of 4 have been previously disturbed, whereas soils along Corridor 3 are largely undisturbed.

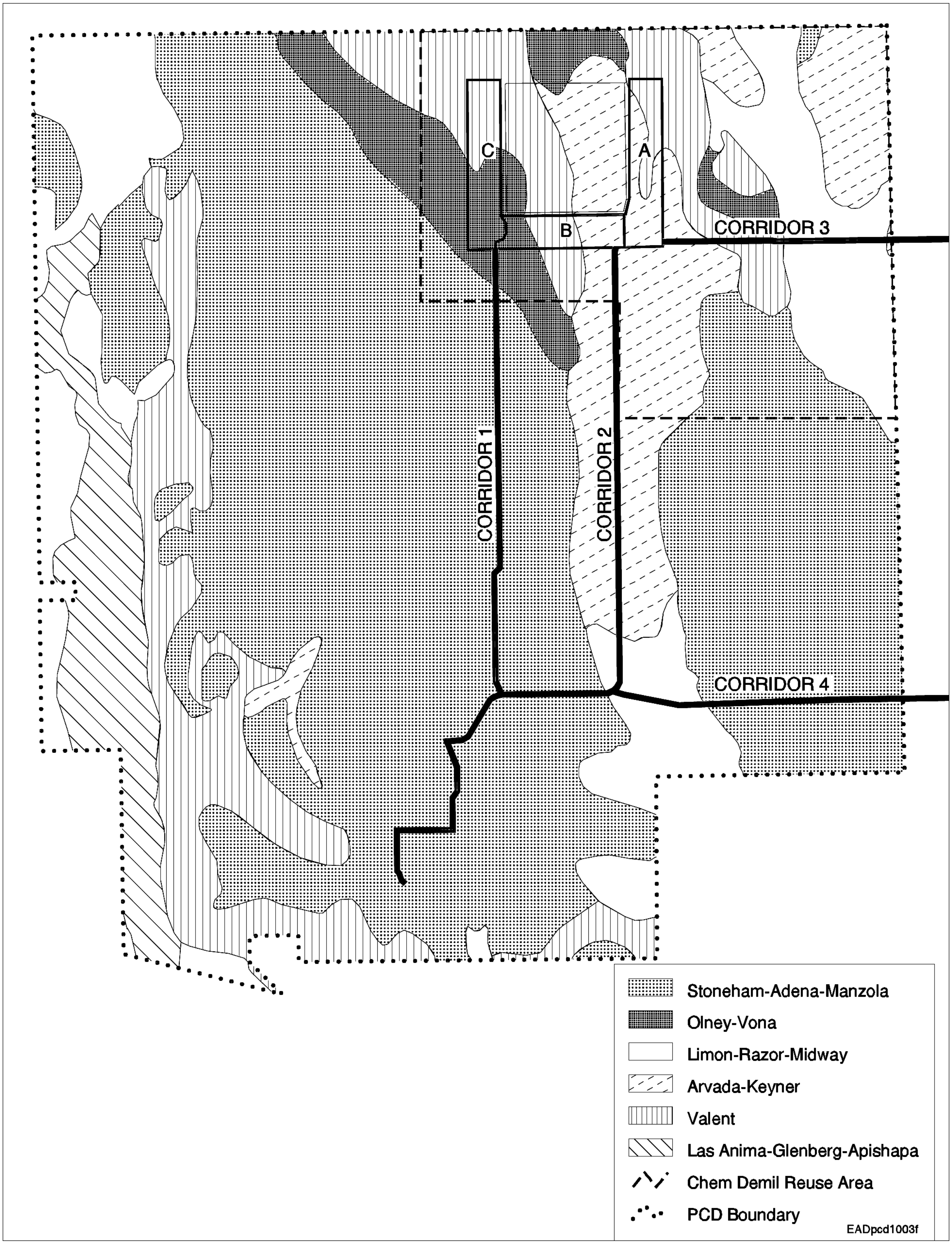

FIGURE 6.10-1 Soil Types at PCD

6.10.2 Site-Specific Factors

Because the proposed action would entail only shallow excavation and require only standard building materials, it would not affect the geologic resources at or in the vicinity of PCD. However, it could affect the soils at PCD, as a result of excavation, erosion, or accidental spills and releases of a variety of hazardous materials, including chemical agents. These potential impacts are discussed in the following sections on impacts of the proposed action and no action. Potential impacts on soils associated with a major accident resulting in catastrophic releases of agent are discussed in Section 6.21.

6.10.3 Impacts of the Proposed Action

6.10.3.1 Impacts of Construction

Approximately 25 acres (10 ha) of ground could be affected to some degree from construction of the pilot facilities, sewage lagoon, and a new substation to support pilot testing in either Site A, B, or C. As much as an additional 60 acres (24 ha) of ground could also be disturbed from development of the site infrastructure (e.g., installation of an electric transmission line, gas pipeline, and water pipeline) (Table 6.3-3). Soil disturbance could result in an increased potential for erosion, which could affect surface water bodies and biological resources. Best management practices (e.g., use of soil fences, berms, and liners; revegetation of disturbed land following construction) would be employed to minimize the potential for soil erosion.

In addition, soils could be affected during construction of the pilot facilities if there was an accidental spill or release of a hazardous material. Primarily, such events would be limited to spills of hazardous materials (e.g., paints, solvents) transported to the site and used during construction of the pilot facilities and to leaks of petroleum-based products (e.g., fuel, hydraulic fluid) from construction vehicles. In such an event, actions would be taken to contain the spill or leak to limit its migration. Any contaminated soils would be excavated and disposed of in accordance with applicable requirements.

6.10.3.2 Impacts of Operations

Impacts on soils could result from the operation of pilot facilities if there were an accidental spill or release of a hazardous material. Such events could include spills of any chemical transported to and used in the ACWA pilot facilities, spills of chemical agent during transport of an ACW from the storage bunker to the pilot facilities, and leaks of petroleum-based products from vehicles. In such an event, actions would be taken to contain the spill or leak to limit its migration. Any contaminated soils would be excavated and disposed of in accordance with applicable requirements.

Although operations would result in air emissions of a variety of contaminants, the concentrations of these contaminants would be so low (see Sections 6.5 and 6.6) that they would not have a significant impact on surface soils.

6.10.4 Impacts of No Action

Under the no action alternative for PCD (which is defined as continued storage of the ACWs), potential impacts on soils would be limited primarily to leaks of petroleum-based products from vehicles. Releases of other hazardous materials, including chemical agent, would be very unlikely, given the contained nature of stockpile maintenance activities.

6.11 GROUNDWATER

6.11.1 Current Environment

6.11.1.1 Geohydrology

This description of the geohydrology of PCD is compiled mainly from the 1996 U.S. Geological Survey (USGS) report (Chafin 1996). The USGS delineates two separate aquifers on PCD: (1) the terrace alluvial aquifer that underlies the majority of the site and (2) the Chico Creek aquifer that is located downgradient and west in Chico Creek Valley. The Chico Creek aquifer will not be affected by the proposed activities because it is separated from the main PCD post area by the incised drainage of Chico Creek. Therefore, this discussion focuses on the terrace alluvial aquifer because it is the only aquifer that can be affected by the proposed action. A third aquifer, the Arkansas River Valley aquifer, is located in the Arkansas River Valley south of PCD. This aquifer is significant and supplies agricultural irrigation wells, many of which are located downgradient of PCD. The terrace alluvial aquifer located under PCD and the Arkansas River Valley aquifer are not hydraulically connected (Ebasco Environmental 1990). However, Rust (1997) found some connection between aquifers in a narrow alluvial channel near Unnamed Creek in the south-central portion of PCD.

Hydraulic conductivity in the terrace alluvial aquifer, measured in a combination of pump and slug tests, covers a wide range, from 0.4 to 400 ft/d (0.12 to 122 m/d) (Chafin 1996). Under the assumption that porosity is 0.2, the estimated groundwater flow velocity ranges from 0.02 to 3 ft/d (0.12 to 122 m/d); the median is 0.8 ft/d (7.9 m/d) (Chafin 1996). In locations near the landfill, velocities as high as 11 ft/d have been estimated (Chafin 1996). The estimated hydraulic gradient ranges from 0.003 to 0.02 (Chafin 1996). Because the potential evaporation of 48 in. (120 cm) exceeds the precipitation of 11 in. (30 cm) by a large margin, potential recharge to the groundwater aquifer from rainfall on PCD is small (Chafin 1996). Rice et al. (1989) argues that under these types of conditions, recharge is approximately 1% of precipitation, or, in this case, 0.1 in. (0.25 cm) per year. Water, and any potential contamination, may migrate through thin, highly permeable layers in the terrace alluvium at velocities near the upper range of the estimates provided. In addition, in areas where eolian sands cover the surface, infiltration rates could be higher.

The terrace alluvial aquifer at PCD consists of interlayered sand, gravel, and clay from a Pleistocene deposit (see Section 6.10). According to Chafin (1996), drillers logs indicate that the alluvium is 1 to 10 ft (0.3 to 3 m) of sandy or silty clay, clayey or sandy silt, or clayey or silty fine- to medium-grained sand underlain by interbedded layers of poorly sorted, often clayey and gravelly, fine- to coarse-grained sand. Chafin (1996) indicated that the seven bores drilled to characterize the terrace alluvial aquifer penetrated 40 to 95 ft (10 to 30 m) of alluvium before reaching bedrock. The terrace alluvial aquifer is underlain by an almost impermeable Pierre Shale (bedrock), which is 1,200 ft (360 m) thick (Watts and Ortiz 1990). The shale effectively isolates the surface terrace alluvial aquifer from other groundwater resources in the area. The shale would also isolate deeper groundwater aquifers from any impacts that would result from the proposed activities. The uppermost significant water-bearing formation below the Pierre Shale is in the Dakota Sandstone, at least 2,200 ft (670 m) below the surface (Chafin 1996).

Below the terrace alluvial aquifer, the bedrock surface, shown in Figure 6.11-1, slopes about 0.5% to the south (Ebasco Environmental 1990) and is regular in the northern portion of PCD. The bedrock surface in the southern portion of PCD is irregular and has a series of hills, troughs, and ridges (Chafin 1996). The bedrock surface is inferred from limited data. The saturated thickness of the aquifer ranges from 0 to 45 ft (0 to 14 m). A bedrock trough starts near the center of the northern boundary and trends in a southern direction through the center of PCD. Four water supply wells are located in this trough because of the increased saturated thickness of the aquifer in this region (Chafin 1996).

The terrace alluvial aquifer is bounded on the west by a steep scarp caused by Chico Creek downcutting into the terrace deposits. On the south, it is bounded by the Arkansas River Valley, which has formed a similar scarp. The Boone Creek drainage, near the center of PCD, effectively separates the terrace alluvial aquifer into two hydrogeologically distinct units. The head of the Boone Creek drainage contains a bedrock alluvium contact spring located just to the southeast of Munitions Storage Area A. The eastern boundary of the terrace alluvial aquifer is formed by a scarp from the downcutting of Haynes Creek. Where the terrace alluvial aquifer does not encounter an exposed bedrock-alluvial boundary, the aquifer is bounded by local bedrock highs that reach above the groundwater table.

Figure 6.11-2 shows the groundwater surface profile. Groundwater flow generally follows the surface slope in a southerly direction. However, in the southwest area of PCD, flow directions are complex and dictated by the irregular bedrock surface and surface drainage features that cut into the terrace alluvial deposit. In addition, there are bedrock outcrops, and a series of seeps and springs discharge at the exposed bedrock-alluvial contact.

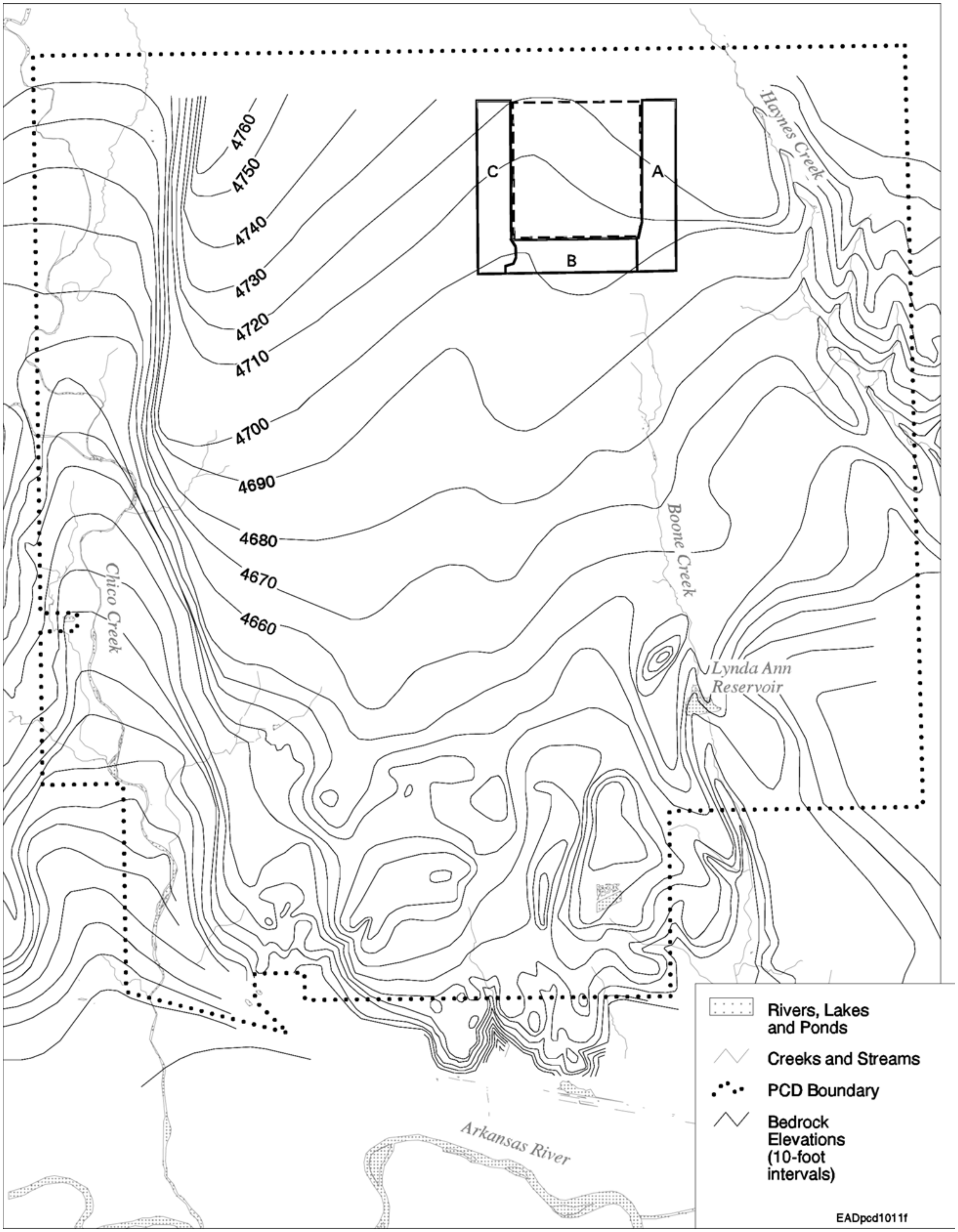

FIGURE 6.11-1 Bedrock Surface Elevations at PCD

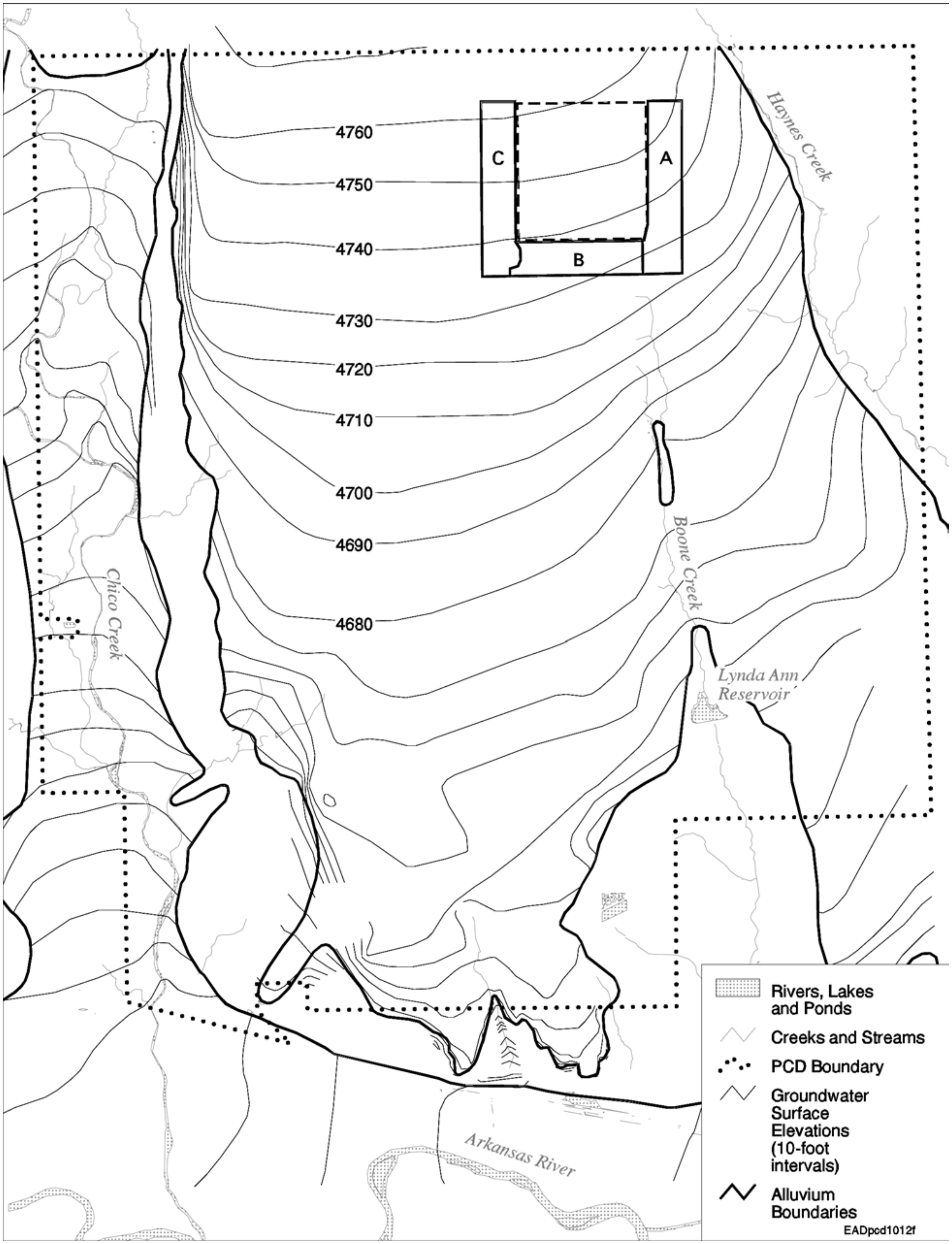

FIGURE 6.11-2 Groundwater Contours at PCD

6.11.1.2 Groundwater Quantity

The source for groundwater under PCD is primarily from underflow from the north (U.S. Army 1982). Estimated flow volumes range from 400 acre-ft/yr (490,000 m^3/yr) (Chafin 1996) to 900 acre-ft/yr (1,100,000 m^3/yr) (U.S. Army 1984). Both of these studies assume that little or no recharge takes place on PCD, even though the surface soil is generally permeable. The studies attribute this lack of infiltration to low precipitation and high evapotranspiration. Because the aquifer ends on the scarps and slopes that surround PCD, these estimates would also be the same for the total discharge of springs, seeps, and groundwater withdrawals on post and immediately off post (Chafin 1996).

Watts and Ortiz (1990) estimated discharge from the terrace alluvial aquifer along the southern edge of the landfill and areas south of the landfill to be 9,600 to 19,200 ft^3/d (80 to 160 acre-ft/yr or 99,000 to 197,000 m^3/yr). Groundwater along the southern boundary discharges in seeps and springs along the terrace edge, flows across the exposed Pierre Shale, and infiltrates into unconsolidated material adjacent to the terraces. Heavy plant growth in this area reduces water flow, and not enough water is discharged to reach the Arkansas River aquifer to the south (Watts and Ortiz 1990). However, there is a possibility that the Arkansas River aquifer may receive surface water flow from the terrace alluvial aquifer that originated as groundwater discharge (Ebasco Environmental 1990).

6.11.1.3 Groundwater Quality

Groundwater in the terrace alluvial aquifer is sodium-bicarbonate type and generally of good quality (U.S. Army 1994) north of the administrative area. Specific conductance is generally less than 800 µS/cm, with the smallest values in the north (Chafin 1996). Values increase to the south and toward seepage faces. Chafin (1996) reported a high value of 3,300 µS/cm near the landfill in the south and suggested that this was a result of contamination. Dissolved solids are generally at levels of less than 500 mg/L, except in water in the southern portion near the landfill (Chafin 1996) and in water in areas of known contamination.

In general, with the noted exception of the contaminated areas in the southern portion of PCD, groundwater below PCD meets the primary state and federal standards for drinking water, except for the selenium standard (U.S. Army 1984). Near the landfill, sulfate and nitrate levels exceed the secondary drinking water standards (Watts and Ortiz 1990). Selenium concentrations range from a low of 0.008 to a high of 0.02 mg/L (U.S. Army 1984). The federal standard for selenium in drinking water is 0.01 mg/L. The high selenium levels are derived from local geological materials that have naturally high selenium concentrations. Sulfate concentrations range from 222 to 720 mg/L near the landfill (Watts and Ortiz 1990), and several wells have exhibited high nitrate concentrations. Nine of fifteen wells sampled by Watts and Ortiz had nitrate levels above 10 mg/L (Watts and Ortiz 1990). The secondary drinking water standard for sulfate is 250 mg/L (40 CFR 143.3), and the primary maximum concentration level (MCL) for nitrate is 10 mg/L (40 CFR Part 141).

Near the landfill in the southern section of PCD, dissolved solids range from 700 to 1,800 mg/L (Watts and Ortiz 1990) and increase downgradient across the landfill. Watts and Ortiz (1990) identified two organic contaminants in the groundwater downgradient of the landfill: trichloroethylene (TCE) and trans-1,2-dichloroethylene (DCE). TCE concentrations ranged from 5.2 to 2,900 µg/L, and concentrations of DCE ranged from nondetectable levels (i.e., the detection limit is 5 µg/L) to 720 µg/L. Watts and Ortiz (1990) suggest that there is more than one source for the organic contamination: the landfill and another location to the north of the landfill. Rust (1997) indicates that the Plating Waste Drainage Ditch and sumps in former Building 547, both to the north of the landfill, are also sources of groundwater contamination. The findings from the Rust report support the CDPHE Compliance Order on Consent. The MCL for TCE is 5 µg/L, and the MCL for DCE is 100 µg/L (40 CFR Part 141).

Rust (1997) reports the presence of an organic contaminant groundwater plume south of the landfill that is being contained by the interim corrective action groundwater remediation system (ICAGRS) along the southern boundary of PCD. Explosive compounds have been identified in groundwater in the southwestern portion of PCD and at low concentrations at an off-post spring just north of Highway 96. While Rust, Inc. (1997) describes a connection between the alluvial aquifer and the Arkansas River Valley aquifer near Chico Creek and Unnamed Creek in the south-central portion of PCD, there is no evidence that water reaches the Arkansas River Valley aquifer from the alluvial aquifer as groundwater. However, surface flows from springs and seeps may reach the Arkansas River Valley aquifer. No organic contaminants were found in the Arkansas River Valley aquifer immediately south of the landfill; a plume of explosives has been identified to the east.

To address groundwater contamination in the southern portion of PCD, the ICAGRS was constructed and placed into operation in March 1995 (Cain 1999). The goals of this system are to stop off-post migration of contaminated groundwater, treat captured groundwater to meet regulatory guidelines, reduce existing off-post contamination levels, and produce a continued decrease in contaminant levels (Cain 1999). The system is located near the south-central section of PCD and includes 54 recovery wells along the southern boundary of PCD. Groundwater is treated by using air-stripping for organic contaminants and, if needed, carbon filters for inorganic contaminants. The majority of the treated water is infiltrated downgradient of the recovery well system through infiltration galleries. The remainder is released by surface discharge to Unnamed Creek (Cain 1999).

6.11.2 Site-Specific Factors

Construction-related impacts on water resources are expected to be essentially the same for each of the ACWA technologies being considered. Although there may be some variation between the technologies with regard to the amount of area disturbed by construction activities, until engineering design studies are completed, the exact acreage will not be known. A maximum of about 85 acres (34 ha) could be disturbed by construction, equal to about 0.4% of the total area of PCD (Table 6.3-3). Approximately half of this area would be disturbed as a result of site preparation, and the other half would be disturbed as a result of the installation of a gas pipeline and other utilities. These utilities might be installed in existing disturbed corridors, such as along roadways. Only 25 acres (0.1% of the total area of PCD) would be disturbed by construction of the pilot facilities.

The foreseeable impacts on groundwater resources from operation of the ACWA technologies would result from the use of water and the generation of sanitary sewage. These numbers are similar for the two technologies. Impacts from increased water usage are discussed in Section 6.3.3.2. Impacts from generation of sanitary sewage are discussed in Sections 6.4.3.1 and 6.4.3.2.

6.11.3 Impacts of the Proposed Action

6.11.3.1 Impacts of Construction

Estimated annual water use during the construction of ACWA facilities would be 2,800,000 gal (10,600 m^3 or 8.6 acre-ft) (Kimmell et al. 2001). This amount would represent almost a twofold increase above the current water usage of 4.3 acre-ft/yr. There is sufficient water in the alluvial terrace aquifer to meet increased demand. The impact of these additional withdrawals would be negligible, because withdrawals would be significantly less than historical withdrawals and be short-lived. Also, if impacts would occur, they would exist for only a short period. During incident-free construction activities, no contamination of groundwater would be expected. Standard precautions during equipment fueling and maintenance and other activities should be followed to prevent spills or leaks (see Section 6.7.1).

6.11.3.2 Impacts of Operations

Estimated annual water (potable and process) use during the operation of ACWA facilities would be 19,000,000 gal (73,000 m^3 or 59 acre-ft) for Neut/Bio and 24,000,000 gal (92,000 m^3 or 75 acre-ft) for Neut/SCWO (Kimmell et al. 2001). These quantities represent a large increase over current water use levels but would be well below historic water usage rates. There is sufficient water in the alluvial terrace aquifer to meet increased demand. The impact of these additional withdrawals would be negligible, because withdrawals would be significantly less than historical withdrawals and be short-lived.

The facilities would be designed to contain small accidental releases, and the entire site is surrounded by a berm. Accidents during routine operations or fluctuating operations would not result in releases to groundwater. The operations of a facility would not release water or other substances to groundwater. Potential impacts from an accidental release of agent are discussed in Section 6.21. Such an accident would be extremely unlikely.

6.11.4 Impacts of No Action

Continued storage of chemical weapons at PCD would not adversely affect groundwater. Procedures are in place to preclude chemical spills and to address them if they do occur (see Section 6.7.1). Accidents that would result in the release of an agent are discussed in Section 6.21. Such an accident would be extremely unlikely.

6.12 SURFACE WATER

6.12.1 Current Environment

PCD is located in the Arkansas River drainage basin, on an alluvial terrace deposit, north of the river and approximately 150 ft (45 m) in elevation above it. The alluvial terrace is underlain by the relatively impermeable Pierre Shale (see Section 6.10). Surface runoff is low because of the low precipitation, at 11 in. (30 cm) per year, and the potentially high rate of evaporation, at 48 in. (120 cm) per year (Chafin 1996). The surface of the alluvial terrace slopes at a grade of approximately 1% (U.S. Army 1984) southward toward the Arkansas River; surface runoff is also generally to the south.

The Arkansas River is a major source of potable, industrial, and agricultural water in the area. In the basin, numerous canals divert water from the river for irrigation and other uses. These diversions significantly affect flow in the river. Pueblo Reservoir, located approximately 5 mi (8 km) upstream from the City of Pueblo, is used for water storage and flood regulation on the Arkansas River. The Arkansas River east of the City of Pueblo has a large number of diversion structures and water withdrawals.

Figure 6.12-1 shows the three surface drainages on PCD. Chico Creek near the western border of PCD controls drainage in the western portion of PCD. Boone Creek, which begins on post near the Munitions Storage Area A igloos, controls drainage from the central portion of PCD. Haynes Creek, which crosses the northeast corner of PCD and continues along the eastern border of the post, controls drainage from the eastern portion of PCD. Chico and Haynes Creeks are ephemeral and generally flow only after rainfall or snowmelt events (Ebasco Environmental 1990). Boone Creek is a spring-fed perennial stream near its head. It was fed with sewage treatment plant effluent in its southern portion (Ebasco Environmental 1990). However, the sewage treatment plant is no longer in use. Also, a small creek (called Unnamed Creek in this document) begins on post near the landfill and exits the post near the ICAGRS on the south central boundary. Water from Boone, Chico, and Haynes Creeks eventually enters the Arkansas River south of PCD, although Unnamed Creek has no channel south of Highway 96 (Ebasco Environmental 1990).

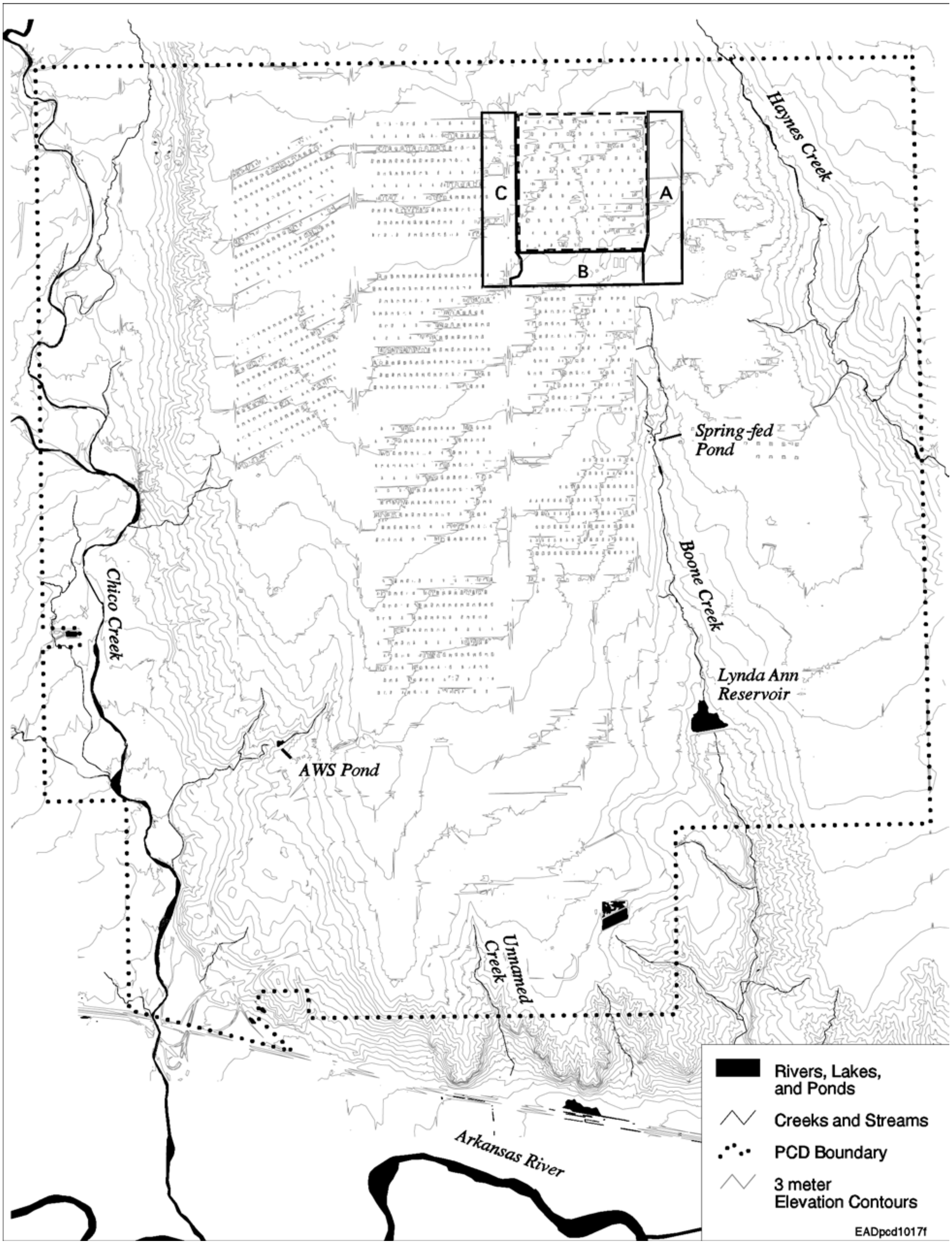

FIGURE 6.12-1 Surface Water Features at PCD

One reservoir and one small pond exist on post (Figure 6.12-1). Two other small ponds exist; one is near Haynes Creek outside the eastern boundary of PCD, and the other is near Chico Creek just outside the western boundary of PCD. Lynda Ann Reservoir is created by a small dam approximately 6 m (20 ft) high on Boone Creek. It is used primarily for runoff control. The reservoir is approximately 17 acres (6.9 ha) in size and is fed by Boone Creek and small seeps and springs that occur at the alluvium-bedrock contacts in the incised stream bed near the reservoir. A second pond is the Ammunition Workshop (AWS) Pond. There is a spring-fed pond in the Boone Creek watershed located about 0.5 mi (0.8 km) from the potential construction Area A.

6.12.2 Site-Specific Factors

Because no routine releases to surface water are anticipated during construction or normal operations, impacts on surface waters would result only from erosion, spills, or leaks.

6.12.3 Impacts of the Proposed Action

6.12.3.1 Impacts of Construction

Construction-related impacts on water resources would be expected to be essentially the same for each ACWA technology being considered. Although there may be some variation between the technologies with regard to the amount of area disturbed by construction activities, until engineering design studies are completed, the exact acreage will not be known. A maximum of about 85 acres (34 ha) could be disturbed by construction, equal to about 0.4% of the total area of PCD (Table 6.3-3). Approximately half of this area would be disturbed as a result of site preparation, and the other half would be disturbed as a result of the installation of a gas pipeline and other utilities. These utilities might be installed in existing disturbed corridors, such as along roadways. Only 25 acres (0.1% of the total area of PCD) would be disturbed by construction of the pilot facilities, evaporative lagoon, and electrical substation.

Construction-related impacts on surface water flow would be none to negligible because water use would be relatively small when compared with historical usage. Also, if impacts would occur, they would exist for only a short period. During incident-free construction activities, no contamination of surface water would be expected. Standard precautions during equipment fueling and maintenance and other activities should be followed to prevent spills or leaks (see Section 6.7.1).

6.12.3.2 Impacts of Operations

There would not be any foreseeable impacts on surface water, since no releases are anticipated. If treated sewage were released rather than being treated in evaporative ponds, flow in Boone Creek or another receiving stream might increase. In general, this increased flow would be beneficial, although there would be a slight chance of increased erosion.

6.12.4 Impacts of No Action

Continued storage of chemical weapons at PCD would not adversely affect surface water. Controls are in place to minimize soil erosion, although some erosion is expected to occur in areas kept clear of vegetation for security purposes and on dirt roadways within the storage block. Procedures are in place to preclude chemical spills and to address them if they do occur. Potential impacts from a highly unlikely accident resulting in releases of an agent during no action are discussed in Section 6.21.

6.13 TERRESTRIAL HABITATS AND VEGETATION

6.13.1 Current Environment

PCD encompasses 22,822 acres (9,240 ha) characterized as gently sloping prairie or shortgrass steppe (Rust and E-E Management 1999). A total of 215 plant species in six major vegetative types have been identified on PCD. The vegetative types are (1) shortgrass prairie (it is the most common vegetation on the basis of total acreage), (2) northern sandhill prairie, (3) greasewood scrub, (4) wetlands, (5) riparian woodland, and (6) disturbed/landscaped areas. Data on their distribution over the entire PCD are included in Rust and E-E Management (1999). Figure 6.13-1 is a map of vegetation, including areas of transitional vegetation in the northern portion of PCD adjacent to Munitions Storage Area A. The areas include northern sandhill prairie, greasewood scrub, and northern sandhill prairie/shortgrass prairie/rabbitbrush transition vegetative types.

Different types of vegetation occur at the alternative locations (Areas A, B, and C) for the proposed pilot plant. Area A is in a transitional area having floral components of both shortgrass prairie and northern sandhill prairie. Area B includes floral components of shortgrass prairie and greasewood scrub. Area C is shortgrass prairie. There are no survey data on vegetation in these three areas; however, the areas are representative of ungrazed areas in northern portions of PCD that were surveyed in 1995 (Rust and E-E Management 1999). Areas B and C have been heavily disturbed by past activities. Area A, which is located in an ungrazed and otherwise undisturbed area transitional between northern sandhill prairie and shortgrass prairie, is characterized by the

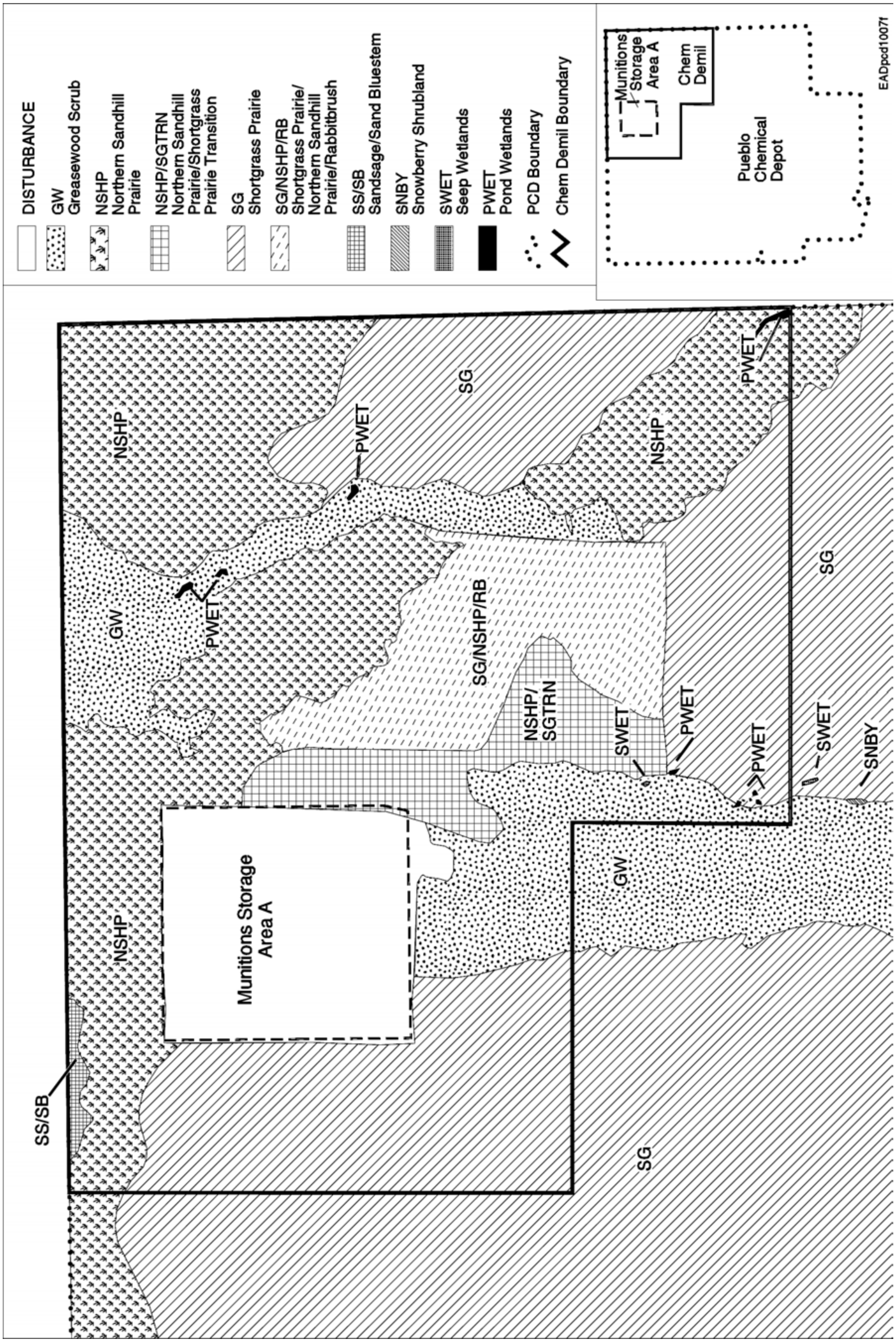

FIGURE 6.13-1 Vegetation at PCD

occurrence of sand sagebrush (*Oligosporus filifolius),* sand bluestem (*Andropogon hallii),* sandreed (*Calamovilfa longifolia),* blue grama (*Chondrosum gracile),* and cholla cactus (*Cylindropuntia imbricata*). The dominant grasses of ungrazed northern sandhill plant communities at PCD are blue grama, needle-and-thread (*Stipa comata),* and purple three-awn (*Aristida purpurea).* Where mechanical disturbance or overgrazing occurred on northern sandhill prairie, forb and shrub species increased in both cover and composition (Rust and E-E Management 1999). Examples of species that are more common in northern sandhill prairie communities at PCD where disturbance has occurred include little rabbitbrush (*Chrysothamnus viscidiflorus),* broom snakeweed (*Gutierrezia sarothrae),* and plains prickly pear cactus (*Opuntia polyacantha).*

Shortgrass prairie and greasewood scrub vegetative types are present along the south boundary of Munitions Storage Area A at Area B. This area is ungrazed and is characterized by several grass species that are short (i.e., generally less than 2 ft or 0.6 m). The dominant grasses in terms of percent cover and composition are blue grama and purple three-awn. Other grasses occurring on shortgrass prairie sites surveyed included squirreltail (*Elymus elymoides),* needle-and-thread, and sand dropseed (*Sporobolus cryptandrus).* Forbs and shrubs collectively made up 10 to 20% of the total plant cover on shortgrass prairie sites surveyed during 1995 (Rust and E-E Management 1999).

The greasewood scrub vegetative type on PCD is characterized by the presence of the shrubs, black greasewood (*Sarcobatus vermiculatus),* and three rabbitbrush species (*Chrysothamnus viscidiflorus, C. nauseosus,* and *C. pulchellus).* The plant community is more diverse in this type of vegetation than it is in northern sandhill prairie or shortgrass prairie. Surveys in 1995 showed that grasses made up about 65–70% of the total plant cover of ungrazed greasewood scrub areas, although shrubs visually appeared to be more dominant than grasses. The dominant grass species recorded were galletagrass (*Hilaria jamesii),* blue grama, and alkali sacaton (*Sporobolus airoides).*

Area C is located in shortgrass prairie vegetation within Munitions Storage Area B and immediately southwest of the current entrance to Munitions Storage Area A. The composition of plant species reflects the effects of revegetation after mechanical disturbance, but it is expected to be similar to that of other shortgrass prairie plant communities in the northern one-third of PCD. Some sand sagebrush has invaded the eastern portion of Area C. The southern third of Area C is entirely shortgrass prairie.

6.13.2 Site-Specific Factors

It is expected that impacts on vegetation resulting from construction would be the same regardless of the technology evaluated, given the similarity in space requirements, construction activities, and time requirements for constructing the pilot test facilities. Routine pilot testing during operations would generate emissions that would be deposited on vegetation downwind of the facility.

ACWA pilot test facility factors that would affect terrestrial habitats and vegetation would include construction activities, releases and spills, and accidents, as discussed in the following sections. These factors would include activities associated with constructing the test facility complex and activities associated with installing utilities, communication cables, and other support areas (such as parking lots and material laydown areas). Transportation of the work force and building materials to the site would also be considered an impacting factor during construction.

6.13.3 Impacts of the Proposed Action

The following sections address the impacts of construction and operations on vegetation and terrestrial habitats. Routine operational impacts consider the impacts of the on-site work force and effects of airborne emissions during operations.

6.13.3.1 Impacts of Construction

Construction of an ACWA pilot facility would disturb about 25 acres (10 ha) for the buildings and landscaped space around the buildings. An additional 60 acres (24 ha) could be disturbed for site infrastructure, temporary offices, holding basins for surface water, parking lots, and construction lay-down areas. The total area disturbed would be approximately the same, about 85 acres (34 ha), regardless of whether the site would be located in Area A, B, or C (Table 6.3-2).

The following discussion of construction impacts identifies the potential impacts from building a facility within the three large regions around Munitions Storage Area A identified as possible sites for the pilot facilities — Areas A, B, and C (Figure 6.1-4) — and the potential impacts from developing the associated infrastructure (e.g., electric power supply, gas and water pipelines, access roads). Mitigation measures that could minimize or prevent impacts on ecologically sensitive communities in these areas are presented in Section 6.24.

Construction impacts would mainly result from clearing vegetation to prepare the site for the pilot facilities; installing a 115-kV transmission line, a new substation, and a sewage lagoon; and building pipelines for water and gas supplies (see Section 6.3.1).

Construction of the pilot facilities in Area A would affect a vegetation transition area that consists of species typical of northern sandhill prairie and shortgrass prairie communities (Figure 6.13-1). The northern sandhill prairie community, which occurs in the northern portion of Area A and immediately north of Munitions Storage Area A, is classified by the Colorado Natural Heritage Program (CNHP) as a sensitive community type that is declining statewide (CNHP 1999). By siting facilities in southern portions of Area A and limiting construction traffic and equipment in northern portions, impacts on northern sandhill prairie could be avoided.

Construction of the pilot facilities in Area B would affect greasewood scrub vegetation. The central and eastern portions of Area B contain the most concentrated areas of shrubs, which consist mainly of sand sagebrush and greasewood.

Construction in Area C would affect low shrub and shortgrass communities west of the paved road that parallels the west boundary of Munitions Storage Area A. Constructing pilot facilities near the center of Area C would avoid losses of the shortgrass prairie habitat that occurs in the southern portion of the area and that supports a colony of black-tailed prairie dogs. The black-tailed prairie dog is a candidate species under consideration for listing as threatened by the U.S. Fish and Wildlife Service (USFWS) (65 FR 24, February 4, 2000) under the *Endangered Species Act*. Also, siting facilities west of the entrance to Munitions Storage Area A would allow construction on vegetated areas previously disturbed by igloo construction.

6.13.3.2 Impacts of Operations

During routine operations, a portion of the material released from the facility stacks would be deposited on the soils surrounding the site. Deposition from atmospheric emissions would result in very low concentrations of trace metals and organic compounds.

A soil screening-level ecological risk assessment was conducted to assess the risk to terresterial biota from air emissions expected from the Neut/Bio and Neut/SCWO technologies. The deposition of emissions from a pilot facility using either of the two ACWA technologies was shown to pose no ecological risks to terrestrial vegetation (Section 6.14.3.2).

6.13.4 Impacts of No Action

Continued storage of chemical agent at PCD would not adversely impact plant communities or wildlife populations in the vicinity of Munitions Storage Area A under normal maintenance and monitoring of the storage bunkers, vegetated areas, and cleared areas. Periodic mowing of vegetation between the bunkers has precluded establishment of shrub species. This type of vegetation control would likely continue into the future. No impacts from continued storage would occur on threatened, endangered, or sensitive species or to wetlands.

6.14 WILDLIFE

6.14.1 Current Environment

Quantitative surveys were conducted at PCD in 1995 for big game, small mammals, and birds. Survey techniques included live trapping, mark and release of small mammals, direct counts of birds along transects made by using the method to estimate density developed by Emlen (1971), and direct counts of big game herds. The following discussion presents data on common wildlife occurring throughout the site and on species that are known to be highly dependent on shortgrass prairie, northern sandhill prairie, and greasewood scrub plant communities.

6.14.1.1 Amphibians and Reptiles

Four amphibian species have been observed at PCD. The great plains toad (*Bufo cognatus)* and western Woodhouse toad (*Bufo woodhousei)* are the most widely distributed species, occurring in all vegetative types. The bullfrog (*Rana catesbeiana)* was abundant at Lynda Ann Reservoir, located about 3 mi (5 km) southeast of Munitions Storage Area A. The northern leopard frog (*Rana pipiens)* was observed in pools along Chico Creek and in effluent from the PCD water treatment plant south of the PCD boundary. Breeding habitat for amphibians exists in Lynda Ann Reservoir, in the Spring Fed Pond about 2 mi (3 km) upstream of Lynda Ann Reservoir, along Chico Creek near the western boundary of PCD, and in the Ammunition Workshop (AWS) Pond located about 4 mi (6 km) southwest of Munitions Storage Area A. The tiger salamander (*Ambystoma tigrinum*) and plains leopard frog (*Rana blairi*) have been observed along Boone Creek drainage since the 1995 surveys were conducted (Canestorp 2000).

Ten reptilian species have been observed at PCD. Species include one turtle, five snakes, and four lizards. Lizards are the most abundant reptile group. The checkered whiptail (*Cnemidophorus tesselatus),* six-lined racerunner (*C. sexlineatus)*, and lesser earless lizard (*Holbrookia maculata)* were observed in all vegetative types except riparian woodland (Rust and E-E Management 1996). The red-lipped plateau lizard (*Sceloporus undulatus)* was observed in all vegetative types. The ornate box turtle (*Terrapene o. ornata)* was documented from northern sandhill prairie at PCD. Hammerson (1999) reports that the ornate box turtle inhabits grasslands and sandhill habitats in Colorado. The prairie rattlesnake (C*rotalus v. viridus)* was observed in all vegetative types, as was the bull snake (*Pituophis catenifer).* The central coachwhip (*Masticophis flagellum testaceus)* and eastern yellow-bellied whipsnake (*Coluber constrictor flaviventris)* were observed in the northern sandhill prairie and shortgrass prairie communities. The wandering garter snake (*Thamnophis elegans vagrans*) was observed in wetland, riparian, and disturbed sites on PCD.

6.14.1.2 Birds

Quantitative surveys of birds were conducted in August 1995 along five 0.5-mi-long (0.8-km-long) transects in shortgrass prairie, northern sandhill prairie, riparian woodlands, and wetland habitats at PCD (Rust and E-E Management 1999). On the basis of the transect data, grassland-shrubland habitats supported a total estimated bird density of 977 (number of birds per 50 acres [20 ha]).

No surveys were conducted at Areas A, B, and C. However, data collected in grassland- and shrub-dominated communities elsewhere on PCD are likely to be representative of the plant communities in the vicinity of Munitions Storage Area A. The most commonly observed bird species in the three major plant community types in the northern portion of PCD were as follows:

- Shortgrass prairie
  Lark sparrow *Chondestes grammacus*
  Lark bunting *Calamospiza melanocorys*
  Horned lark *Eremophila alpestris*
  Mourning dove *Zenaidura macroura*
  Western meadowlark *Sturnella neglecta*

- Northern sandhill prairie
  Sage thrasher *Oreoscoptes montanus*
  Western meadowlark *Sturnella neglecta*
  Lark bunting *Calamospiza melanocorys*
  Vesper sparrow *Prooecetes gramineus*
  Western kingbird *Tyrannus verticalis*

- Greasewood scrub
  Lark sparrow *Chondestes grammacus*
  Western meadowlark *Sturnella neglecta*
  Western kingbird *Tyrannus verticalis*

Species observed only in shortgrass prairie communities during the ecological surveys include the ferruginous hawk (*Buteo regalis*), mountain plover (*Charadrius montanus*), and burrowing owl (*Athene cunicularia*). The burrowing owl uses burrows of the black-tailed prairie dogs for nesting and cover (Robbins et al. 1966). The western meadowlark was frequently observed in shortgrass prairie in the igloo areas. The rock wren (*Salpinctes obsoletus*) nests in rocky areas of berms adjacent to the igloos and also in the munition storage areas.

Raptors observed at PCD include the American kestrel (*Falco saprverius*), northern harrier (*Circus cyaneus*), red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*B. swainsoni*), ferruginous hawk, great-horned owl (*Bubo virginianus*), barn owl (*Tyto alba*), and burrowing owl. The kestrel, red-tailed hawk, and Swainson's hawk were observed throughout PCD during the course of the ecological surveys. These three species nest in plains cottonwood trees at several locations. Northern harriers, barn owls, and great-horned owls nest on PCD. With the exception of Swainson's hawk, these raptors are permanent residents at PCD.

The mourning dove and scaled quail are the only upland game birds at PCD. Scaled quail were observed in flocks of about 5, 10, and 20 individuals in areas dominated by greasewood scrub and rabbitbrush within the igloo areas, around Lynda Ann Reservoir, and along Chico Creek.

Several species of waterfowl and shorebirds use the AWS Pond and Lynda Ann Reservoir during the summer breeding season and migration periods. Nine waterfowl and shorebird species were recorded during surveys conducted in August and September 1995 and from incidental observations made in the spring and fall (Rust and E-E Management 1996). The most common summer residents included the mallard (*Anas platyrhynchos),* blue-winged teal (*A. discors*), American coot (*Fulica americana*), and killdeer (*Charadrius vociferus*). The great blue heron (*Ardea herodias*) frequents the Lynda Ann Reservoir and ponds on PCD during the winter. Large flocks of Canada geese (*Branta canadensis*) have been observed during the fall migration on Lynda Ann Reservoir. Snow geese (*Chen caerulescens*) also use the reservoir during fall migration. One commentor on the draft version of this EIS provided a photograph showing waterfowl use of the Boone Creek Watershed downstream of Lynda Ann Reservoir and noted the importance of the area to migratory, wintering, and breeding ducks and geese.

6.14.1.3 Mammals

Twenty six mammalian species were recorded at PCD during field surveys in 1995 (Rust and E-E Management 1999). As a group, rodents are the most abundant; 19 species were recorded during the surveys. Common rodent species of the shortgrass prairie included the black-tailed prairie dog (*Cynomys ludovicianus)*, thirteen-lined ground squirrel (*Spermophilus tridecemlineatus)*, and spotted ground squirrel (*S. spilosoma)*. Up to 10 prairie dog towns were inhabited in any one season within the shortgrass prairie. Black-tailed prairie dog populations have fluctuated dramatically from year to year because of plague (Canestorp 1999). One active prairie dog town located immediately west of Area B, extending on each side of the north/south access road to the west entrance of Munitions Storage Area A, was observed in February 2000.

Other common rodent species captured during the small mammal live-trapping surveys (Rust and E-E Management 1996) included Ord's kangaroo rat (*Dipodomys ordii)*, plains pocket mouse (*Perognathus flavescens)*, western harvest mouse (*Reithrodontomys megalotis)*, northern grasshopper mouse (*Onychomys leucogaster)*, and deer mouse (*Peromyscus maniculatus)*. The western harvest mouse occurred in greatest numbers in all vegetative types having a dense grass cover. This species probably occurs in the dense, grass-covered areas within the munitions storage complex at PCD, but no trapping was conducted in these areas to confirm this assumption. Northern grasshopper mice were captured frequently in both grazed and undisturbed habitats in all vegetative types except ungrazed greasewood scrub. The Ord's kangaroo rat was captured in shortgrass prairie, northern sandhill prairie, and greasewood scrub communities. Population density was estimated at 15 individuals per acre on the basis of 1995 live-trapping data (Rust and E-E Management 1999).

Both the black-tailed jackrabbit (*Lepus californicus)* and white-tailed jackrabbit (*L. townsendii)* were observed during the field surveys. Jackrabbits were most common in shrub-dominated areas of riparian woodland and greasewood scrub but were not abundant at PCD. The desert cottontail (*Sylvilagus audubonii)* was observed in all habitat types but was not abundant enough to allow density calculations.

No surveys for bats have been conducted at PCD. Individual bats were observed foraging in the vicinity of Lynda Ann Reservoir and along Chico Creek during the evening.

Five carnivores recorded during the surveys were the coyote (*Canis latrans)*, swift fox (*Vuples velox)*, raccoon (*Procyon lotor)*, badger (*Taxidea taxus)*, and striped skunk (*Mephitis mephitis)*. The coyote is the most abundant carnivore; it occurred in all habitats and frequently was seen in the igloo areas of the munitions storage areas. The striped skunk probably occurs in all habitats at PCD, while the raccoon is likely to be more common in riparian woodland and wetland habitats.

The pronghorn (*Antilocapra americana)* is the most abundant big game mammal at PCD. Pronghorns are commonly observed in shortgrass prairie. Herds of up to 35 individuals occur in the eastern and western portions of PCD. Their presence in the munitions storage areas is limited because of their inability to traverse the 8- to 10-ft-high (2- to 3-m-high) security fences that surround these areas. Mule deer (*Odocoileus hemionus)* and whitetail deer (*O. virginianus)* are most common in riparian woodland along Chico Creek. During the early evening, deer move to greasewood scrub and northern sandhill prairie when foraging (Rust and E-E Management 1999).

6.14.2 Site-Specific Factors

It is expected that impacts from construction on wildlife would be the same regardless of the technology evaluated, given the similarity in space requirements, construction activities, and time requirements for constructing the pilot test facilities. During construction, impacts on wildlife might result from clearing vegetation for an ACWA pilot test facility and associated infrastructure. Increased activity from the presence of the on-post work force, noise from facility operations, and increases in vehicular traffic may also affect wildlife. Operations would result in emissions of organic compounds and trace metals and the discharge of sewage effluents, all of which could affect wildlife.

6.14.3 Impacts of the Proposed Action

6.14.3.1 Impacts of Construction

Loss of habitat, increased human activity in the Munitions Storage Area A area, increased traffic on local roads, and noise would be the most important factors from construction of an ACWA facility that would affect wildlife species. The presence of construction crews and increased traffic in the Munitions Storage Area A area would cause some wildlife species to avoid areas next to the construction site during the 30-month construction period. Wildlife inhabiting the area rely on native shrubs and grasses for food, cover, and nesting and therefore would be affected by vegetation clearing. Less mobile and burrowing species (such as amphibians, some reptiles, and small mammals) would be killed during vegetation clearing and other site preparation activities. Amphibian and reptile species likely to be affected by loss of habitat would include the great plains toad, Woodhouse toad, ornate box turtle, checkered whiptail lizard, lesser earless lizard, and six-lined racerunner. Small mammals that would be affected by vegetation clearing include Ord's kangaroo rat, plains pocket mouse, western harvest mouse, deer mouse, and northern grasshopper mouse. However, because similar habitat is abundant next to cleared areas, no impacts on the continued survival of local populations of these species would be expected.

Construction in the southern portion of Area C could affect an existing black-tailed prairie dog colony located nearby. Increased construction traffic would increase the potential for roadkills to species such as prairie dogs, thirteen-lined ground squirrels, and spotted ground squirrels along the north-south road from the west entrance to Munitions Storage Area A. Scaled quail and mourning doves, important game birds in Colorado, would be adversely affected by loss of shortgrass prairie and shrub/grass transition habitat in Areas A and C. Kingery (1998) reported that scaled quail rely heavily on shortgrass prairie with cholla cactus and are more abundant in these areas than in shrub-dominated communities. Other birds that inhabit shortgrass prairie and northern sandhill prairie communities that would be affected by vegetation clearing include the burrowing owl (often associated with prairie dog colonies), lark sparrow, and western meadowlark.

Birds of prey at PCD would probably not be adversely affected by loss of a prey base associated with up to 85 acres (34 ha) of vegetation clearing, but they might avoid foraging in areas next to construction sites because of increased human activity. Species such as the ferruginous hawk, red-tailed hawk, and kestrel might benefit from the H-frame towers that would be constructed for the transmission line; they could use the towers as perch sites. Suitable raptor perches are generally absent on PCD, except for the trees and shrubs around Lynda Ann Reservoir, along Chico Creek, and in the housing area.

Raptor electrocution from simultaneous wing contact with two conductors or a conductor and ground wire on the 115-kV transmission line would not be expected. The largest raptors expected to visit PCD, the golden eagle and bald eagle, have a maximum wingspan of about

7.5 ft (2.3 m) (Avian Power Line Interaction Committee 1996). A wooden H-frame tower for a 115-kV transmission line is typically designed with a 12.5-ft (3.8-m) space between conductors; thus, an eagle could not contact both conductors simultaneously while in flight. The distance between a conductor and ground wire is normally longer than 9 ft (2.7 m). Plans for supplying power to ACWA facilities do not include electric distribution lines, which account for most raptor electrocutions. Instead, underground cables would be used; they would extend from the substation to the various facilities requiring power. The design of the 115-kV transmission line would follow suggested practices for protecting raptors (Avian Power Line Interaction Committee 1996).

Noise levels generated by construction equipment would be expected to range from 85 to 90 dBA at the proposed ACWA facilities (see Section 6.8.3.1). Levels would diminish to about 55 to 60 dBA at the northeast boundary of PCD. Numerous published studies indicate that small mammals might be adversely affected by the maximum noise levels that could result from the use of construction equipment (Manci et al. 1988; Luz and Smith 1976; Brattstrom and Bondello 1983). The Manci et al. (1988) article, which reviews the effects of noise on wildlife and domestic animals, reports that sudden sonic booms of 80 to 90 dB startled seabirds, causing them to temporarily abandon nest sites. The startle response of the birds to abrupt noise and continuous noise and the birds' ability to acclimate to noise seemed to vary with species (Manci et al. 1988). Pronghorn antelope in New Mexico responded to helicopters that generated noise levels of 60 to 77 dB by running when a helicopter's altitude approached 150 ft (50 m) and its horizontal distance from the antelope was about 500 ft (150 m) (Luz and Smith 1976). In the laboratory, the hearing of desert kangaroo rats (*Dipodomys deserti)* was affected when individuals were exposed to recorded dune buggy noise of 78 to 110 dB (Brattstrom and Bondello 1983). It took three weeks for their hearing to recover after exposure. Rodents within about 300 ft (100 m) of the ACWA site during construction might experience some temporary hearing loss, which could reduce their ability to detect predators. Pronghorn antelope and mule deer would likely respond to noise and human activity by avoiding areas within 0.5 mi (0.8 km) of ongoing construction.

6.14.3.2 Impacts of Operations

A screening-level ecological risk assessment was conducted to assess the risk from air emissions generated by an ACWA pilot test facility at PCD for the Neut/Bio and Neut/SCWO technologies. Screening-level risk assessments typically are based on very conservative assumptions that are intended to be protective of environmental resources; use of such assumptions enables chemicals that pose negligible risk to be eliminated from further consideration, while chemicals that do pose potential significant threats can be examined further. Soil concentrations from the deposition of airborne emissions during normal operations were compared with ecotoxicological benchmark values that are based on conservative ecological endpoints developed by the EPA (EPA 2001). For chemicals for which EPA has not developed soil screening values, values developed by state agencies were used in the analysis. Table 6.14-1 lists the number of chemicals evaluated from the air emissions for each ACWA technology. No

TABLE 6.14-1 Chemical Emissions of Potential Concern Based on a Screening-Level Ecological Risk Assessment of Air Emissions from Routine Operation of an ACWA Pilot Facility at PCD

Technology	No. of Chemicals Evaluated	Chemicals of Potential Concern from Stack Emissions[a]
Neut/Bio	65	None
Neut/SCWO	45	None

[a] Chemical emitted for destruction of mustard with an HQ of >1 based on 12-h/d, 6 d/wk operation.

chemicals resulted in an HQ of >1. Chemicals or elements for which no ecotoxicological benchmark values were known could not be evaluated in the screening-level ecological risk assessment.

The risks to ecological receptors (soil invertebrates, plants, and wildlife) were considered to be negligible if the screening-level risk assessment showed negligible effects on soils at PCD. The comparison of soil deposition and a chemical-specific benchmark value is expressed as a HQ — that is, a number generated by dividing the soil concentration by the soil benchmark value. Soil concentrations resulting in an HQ of ≤1 are considered to pose negligible risk to ecological receptors; chemicals having an HQ of >1 are considered contaminants of potential concern that might affect ecological receptors and should be further evaluated.

A total of 45 chemicals in the ACWA emission inventory were subjected to the screening-level ecological risk assessment for the Neut/SCWO technology. A simple model (the same one as that used for Neut/Bio) was used to estimate soil concentrations of emissions from the Neut/SCWO pilot test facility. Several conservative measures were used in the model. All stack emissions from the boiler, diesel generator, filter farm stack, and SCWO vent were assumed to be deposited within the PCD installation boundaries. Deposition quantities were assumed to be proportional to the annual wind frequency, with four equal quadrants in a circular pattern around proposed Areas A, B, and C. Other assumptions and a detailed description of the analysis are provided elsewhere (Tsao 2001a).

None of the chemicals evaluated exceeded the soil benchmark values and thus would not result in an HQ of >1. The highest HQ (for cadmium [HQ = 0.38]) is almost three times less than the soil benchmark value. The next highest HQ (for toluene) is almost 20 times below the benchmark value. For any of the toxic air pollutants emitted from the stacks to achieve an HQ of >1, the deposition radius would have to be limited to 0.50 mi (0.80 km), a distance not physically possible given the stack heights and existing wind characteristics, which would result in metals and organic compounds being carried much greater distances.

Air concentrations and deposition emission constituents from a pilot test facility using either of the two technologies being considered for PCD would pose negligible ecological risk to terrestrial biota. Consequently, routine operations of a pilot test facility would result in negligible impacts on terrestrial habitat and vegetation.

Operation of Neut/Bio or Neut/SCWO would result in increased human activity in the northeast quadrant of PCD. An increase in traffic along access roads caused by worker vehicles and the periodic delivery of supplies would increase the number of roadkills of rodents and reptiles. Anticipated noise levels of 55 to 60 dBA near the facility boundary would have only minor impacts on birds and mammals. Any abrupt noise levels would startle birds and might cause them to temporarily abandon their nests. These levels would probably not interfere with the auditory function of birds and mammals.

During full operation, an estimated maximum of 5,100,000 million gal (19,000 m^3) of sanitary effluent would be generated each year. It is anticipated that sanitary effluent would be discharged into a lined evaporative lagoon next to the test facility. Some water would be present at all times in the lagoon, which could attract resident songbirds and shorebirds such as killdeer and spotted sandpiper. Waterfowl would not be likely to use the lagoon, since it would have only small areas of standing water and would not support wetland vegetation.

6.14.4 Impacts of No Action

Continued storage of chemical agents at PCD would not adversely affect plant communities or wildlife populations in the vicinity of Munitions Storage Area A during normal maintenance and monitoring of the storage bunkers, vegetated areas, and cleared areas. Periodic mowing of vegetation between the bunkers has prevented shrub species from establishing there. This type of vegetation control would probably continue in the future.

6.15 AQUATIC HABITATS AND FISH

6.15.1 Current Environment

Aquatic resources at PCD include species typically associated with ponds and creeks. The only permanent bodies of standing water on PCD are Lynda Ann Reservoir, the AWS Pond, and Spring Fed Pond located in the northeastern part of PCD (see Figures 6.12-1 and 6.17-1). Chico Creek is an intermittent stream located in the western portion of PCD. Boone Creek and

Haynes Creek are also intermittent streams located in the eastern portion of PCD. They are typically dry during the summer (Rust and E-E Management 1999).

The largest water body on PCD is Lynda Ann Reservoir (surface area of about 18 acres [7 ha]), which is located near the southeastern portion of the munitions storage area within the Boone Creek drainage. Recharge of the reservoir is from surface drainage and a small upstream spring. Approximately 90% of the shoreline is covered by cattails and bulrushes. The reservoir provides recreational fishing opportunities for PCD personnel and the public. It is stocked periodically with channel catfish (*Ictalurus punctatus)* and stocked annually with cutthroat trout (*Salmo clarkii)*. The plains killfish (*Fundulus zebrinus)*, fathead minnow (*Pimephales promelas*), and brassy minnow (*Hybognathus hankinsoni*) were the most abundant species collected during seining (Rust and E-E Management 1999).

The AWS Pond is a 2-acre (0.8-ha) impoundment near the former TNT Washout Facility located in the southwestern portion of PCD, approximately 3.5 mi (5.6 km) southwest of Munitions Storage Area A. In 1987, all fish were removed from the pond with rotenone. In 1988, the USFWS stocked the pond with 36 southern redbelly dace (*Phoxinus erythrogaster)*, a Colorado state endangered fish species (Rust and E-E Management 1999). This species has become well established, as evidenced by the number of individuals captured by dip nets in 1995. A school of 750–1000 individuals was observed in the AWS pond on several occasions during 1995 (Rust and E-E Management 1999). The USFWS does not consider AWS Pond to be suitable for fishing.

The Spring Fed Pond is about 0.1 acre (0.4 ha) in size and is located 2 mi (3 km) southeast of Munitions Storage Area A. The pond periphery is composed of cattails and bulrushes. Submergent vegetation is quite dense and includes algae (*Chara spp.)*, pondweed (*Potamogeton spp.)*, and coontail (*Ceratophyllum spp.)*. The only two fish species collected from Spring Fed Pond were the fathead minnow and brassy minnow.

Chico Creek flows during spring snowmelt and after summer rains; low flows occur during the remainder of the year. The aquatic biota of Chico Creek are similar to those of intermittent streams in semiarid ecosystems of the Great Plains. Wetland and aquatic vegetation in areas protected from grazing occurs along the periphery of the creek. Green and blue-green algae and diatoms form mats on the surface of small pools within the creek during fall and winter. Native fish captured during seining of Chico Creek included mostly herbivorous, cyprinid species that are typically small (i.e., less 6 in. [15 cm] at adult size). Fish species recorded included longnose dace (*Rhinichthys cataractae)*, sand shiner (*Notropus stramineus)*, bigmouth shiner (*N. dorsalis)*, red shiner (*Cyprinella lutrensis)*, plains minnow (*Hybognathus placitus*), brassy minnow, fathead minnow, and central stoneroller (*Campostoma anomalum)*.

6.15.2 Site-Specific Factors

Aquatic organisms, including fish, are not expected to be affected by any factors related to the construction or operation of an ACWA pilot test facility. Potential ecological risk from the indirect effects of air emissions is discussed in Section 6.15.3.

6.15.3 Impacts of the Proposed Action

6.15.3.1 Impacts of Construction

No aquatic resources occur in the areas that would be affected by construction, so they are not considered in the assessment of construction-related impacts.

6.15.3.2 Impacts of Operations

Projections of air emissions were evaluated to determine ecological impacts that might result from the normal (i.e., incident-free) operation of either pilot test facility technology.

Neutralization/Biotreatment. Potential ecological impacts from normal test facility operations under the Neut/Bio technology would be the same as those under the Neut/SCWO technology, except for the differences in the kinds of organic compounds released and slight differences in the quantities of trace metals released (Kimmell et al. 2001). Concentrations of organic compounds and trace metals would not be at levels that would adversely affect ecosystems downwind of the pilot test facilities during normal operations.

Neutralization/SCWO. Metals and organic compounds in emissions from normal test facility operations would be deposited on the ground in very low concentrations and would not adversely affect aquatic biota. Annual emission rates of all trace constituents (Kimmell et al. 2001) and particulates would be well below levels that would affect ecosystems through biouptake and biomagnification in the food chain. Given such low emissions, a screening-level ecological risk assessment would not be warranted. Potentially harmful trace metals such as mercury, lead, selenium, chromium, and cadmium would be released at rates of less than 2×10^{-9} lb/yr (0.9 µg/yr) if test facilities would operate 12 hours per day and six days per week continuously for one year (estimate was derived from values in Kimmell et al. 2001). Trace elements would be dispersed over a large geographic area, resulting in deposition amounts that would be nondetectable or below levels known to be harmful to aquatic communities. These emission estimates are very conservative, since facilities would not operate continuously for more than a few months at any one time during pilot testing. Releases of organic compounds would also be very low; they would range from 1×10^{-8} to 2×10^{-17} lb/yr (estimate was derived from values in Kimmell et al. 2001). They would not result in any adverse impacts on aquatic ecosystems located downwind of the facilities.

6.15.4 Impacts of No Action

Continued storage of chemical agents at PCD would not adversely affect aquatic communities during normal maintenance and monitoring of the storage bunkers, vegetated areas, and cleared areas.

6.16 PROTECTED SPECIES

6.16.1 Current Environment

The information presented here on threatened and endangered species is based largely on surveys by Rust and E-E Management (1999). The USFWS provided a list of protected species that are known to occur in Pueblo County (Carlson 2000). The Colorado Natural Heritage Program database (CNHP 1999) was also used to determine sensitive species and plant communities that have been documented. Table 6.16-1 provides information on protected species and sensitive plant communities occurring at PCD in 1995 and 1997. The table reflects recent changes in status that occurred for some species since the survey report was published. It also lists protected species that were not observed during the surveys but may occur on PCD as occasional visitors or transients. No federally endangered or threatened animal or plant species are known to occur at PCD (Rust and E-E Management 1999). The USFWS (Carlson 2000) reported that the bald eagle (*Haliaeetus lencocephalus*) and Mexican spotted owl (*Strix occidentalis lucida*) (both federal threatened species) and the endangered whooping crane (*Grus americana*) "could occur" in Pueblo County, Colorado. There is no habitat at PCD suitable for the Mexican spotted owl, which typically inhabits coniferous forested areas in mountainous terrain and canyons with rock cliffs (Kingery 1998). The whooping crane and bald eagle have not been observed at PCD but may occur as transients or occasional visitors.

The mountain plover (*Charadrius montanus*), a federal proposed threatened species, occurs at PCD in shortgrass prairie habitats. Mountain plovers typically prefer sparsely vegetated areas or disturbed sites (Knopf 1996). Plovers were observed on overgrazed shortgrass prairie sites during the summer breeding season; they were located about 0.5 mi (0.8 km) east of Lynda Ann Reservoir and approximately 3 mi (5 km) southeast of Area A.

TABLE 6.16-1 Federal and State Protected Species and Sensitive Communities Observed and Potentially Occurring at PCD[a]

Scientific Name	Common Name	Federal Status[a]	State Status[b]	CNHP Status[c]
Documented Occurrence				
Plants				
Gaura neomexicana coloradensis	None	T	-	-
Asclepius uncialis	Dwarf milkweed	-	-	S1, S2
Animals				
Zapus hudsonius preblei	Preble's meadow jumping mouse	LT	T	S1
Cynomys ludovicianus	Black-tailed prairie dog	C	SC	
Athene cunicularia	Burrowing owl	FS	T	S3B, S4B
Buteo regalis	Ferruginous hawk	FS	SC	S3B, S4N
Charadrius montanus	Mountain plover	PT	SC	S2B, SZN
Chilidonias niger	Black tern	FS	-	S3B, S4B, SZN
Lanius ludovicianus	Loggerhead shrike	FS	-	S3B, S4B, SZN
Rana blairi	Plains leopard frog	-	SC	S3
Rana pipiens	Northern leopard frog	FS	SC	S3
Sistrurus catenatus	Massasauga	-	SC	
Phoxinus erythrogaster	Southern red-belly dace	FS	E	S1
Hybognathus placitus	Plains minnow	-	SC	SH
Hybognathus hankinsoni	Brassy minnow	-	T	-
Plant Communities				
Sarobatus vermiculatus/ Sporabolus aeroides	Black greasewood/alkali socaton community	-	-	SU
Oligosporus filifolia/Andropogon hallii	Sand sagebrush/sand bluestem community	-	-	S2
Populus deltoides – Salix amygdaloides/Salix exigua	Plains cottonwood – Peachleaf willow/coyote willow community	-	-	S3
Symphoricarpos occidentalis	Snowberry community	-	-	S3
Not Observed at PCD but May Occur as Occasional Transients or Introduced Species				
Grus americana	Whooping crane	LE	E	SZN
Haliaeetus leucocephalus	Bald eagle	LT	T	S1B, S3N
Plegadis chihi	White-faced ibis	FS	-	S2B, SZN
Typanuchus pallidicinctus	Lesser prairie chicken	FS	T	S2
Etheostonia cragini	Arkansas darter	C	T	S2
Fundulus sciadicus	Plains topminnow	FS	SC	S2
Machybopsis (Hybopsis) aestivalis tetranemus	Speckled chub (Arkansas River population)	FS	SC	S1
Bufo punctatus	Red-spotted toad	-	SC	S3, S4

See next page for footnotes.

TABLE 6.16-1 (Cont.)

---

[a] C = federal candidate species: taxa for which the U.S. Fish and Wildlife Service has on file sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened
FS = federal sensitive species: species considered to be sensitive by the U.S. Forest Service or U.S. Bureau of Land Management because of significant current or predicted downward trends in population numbers or density, or downward trends in habitat capability to support the species' existing distribution
LE = federal endangered
LT = federal threatened
PT = federal proposed threatened

[b] E = state endangered species
SC = state species of concern
T = state threatened species

[c] Colorado Natural Heritage Program
S1 = critically imperiled in the state because of extreme rarity (five or fewer occurrences, or very few remaining individuals) or because of biological factors making the species vulnerable to extirpation from the state
S2 = imperiled in the state because of rarity (6 to 20 occurrences) or because of other factors demonstrably making it very vulnerable to extirpation from the state
S3 = vulnerable = rare in state (21 to 100 occurrences)
G3 = vulnerable throughout its range or found locally in S (state) restricted range (21 to 100 occurrences)
G4 = apparently secure globally, although it might be quite rare in parts of its range, especially at its periphery
S1B = breeding season imperilment; not a permanent resident; extreme rarity
S2B = breeding season imperilment; not a permanent resident
S3B = breeding season vulnerable; not a permanent resident
S4B = breeding season imperilment; not a permanent resident
S4N = nonbreeding season secure; not a permanent resident
S3, S4 = watch listed; specific occurrence data are collected and periodically analyzed to determine whether more active tracking is warranted
SH = historically known from the state; not verified for an extended period
SU = unable to assign rarity, often because of low search effort or cryptic nature of the community
SX = unranked; some evidence that species may be imperiled, but awaiting formal rarity ranking
SZN = migrant whose occurrences are too irregular, transitory, and/or dispersed to be reliably identified, mapped, and protected

Sources: Rust and E-E Management (1999); Colorado State University (1999); Carlson (2000); Canestorp (2000); Kaczmarek (2000).

The black-tailed prairie dog (*Cynomys ludovicianus*), a federal candidate species, has been observed in shortgrass prairie habitats at PCD. Prairie dogs have been observed at several locations on PCD, typically in colonies of 3–15 individuals.

The burrowing owl (*Athene cunicularia*), ferruginous hawk (*Buteo regalis*), northern harrier (*Circus cyaneus*), black tern (*Chilidonias niger*), and loggerhead shrike (*Lanius ludovicianus*) are all considered federal sensitive species by the U.S. Bureau of Land Management (BLM) and the U.S. Forest Service. The black tern and burrowing owl are migratory species that inhabit the PCD during the summer breeding season. The other three species are permanent residents and breed at PCD. The ferruginous hawk and burrowing owl were observed mostly in shortgrass prairie habitat, while the northern harrier was observed in all habitat types except riparian woodland. Ferruginous hawks nested in a tamarisk tree in shortgrass prairie on the northeast portion of PCD. The black tern was observed twice during the summer at Lynda Ann Reservoir.

6.16.2 Site-Specific Factors

It is expected that impacts from construction on protected species would be the same regardless of the technology evaluated, given the similarity in space requirements, construction activities, and time requirements for constructing the pilot test facilities. Impacts on protected species might result from the clearing of vegetation during construction of an ACWA pilot test facility and associated infrastructure. Increased human activity from the presence of the on-post work force and increases in vehicular traffic might also affect federal and state protected or sensitive wildlife species.

6.16.3 Impacts of the Proposed Action

6.16.3.1 Impacts of Construction

The following discussion identifies the impacts on protected species that might result from building a facility within Area A, B, or C (Figure 6.1-4) and from developing the associated infrastructure (e.g., electric power supply, gas and water pipelines, access roads). Mitigation measures that could minimize or prevent impacts on ecologically sensitive communities in these areas are presented in Section 6.24.

Because no federal-listed threatened or endangered species are known to occur at PCD, they would not be affected by construction activities. One federal candidate species (the black-tailed prairie dog) and one proposed threatened species (mountain plover) are known to occur in shortgrass prairie at PCD. They could be affected by construction noise, the presence of construction crews, and habitat loss. A black-tailed prairie dog colony was observed during site visits in December 1999 and February 2000 in an area located about 0.25 mi (0.4 km) southwest of Area C. Prairie dogs could be affected by construction activities occurring in the southern portion of Area C, particularly if construction equipment, parking areas, or laydown/assembly areas disturbed shortgrass prairie habitat within or immediately next to the active colony. Noise levels during construction periods and increased human activity would also affect prairie dogs.

Although mountain plovers have not been documented in the vicinity of Area A, B, or C, they have occurred during the breeding season on grazed shortgrass prairie communities in southeastern portions of PCD. Their occurrence suggests they could inhabit similar habitat next to the southern boundary of Area C. Noise and loss of habitat in the vicinity could adversely affect mountain plovers during the breeding season.

Federal sensitive species that could be affected by habitat loss from construction include the loggerhead shrike and the northern plains leopard frog. The loggerhead shrike would be affected by loss of shrubland habitat used for food and cover in Areas A and B. The leopard frog is known to occur in the Boone and Haynes Creek watersheds and would probably not be affected by loss of habitat resulting from the construction of an access road or the electric transmission line in Corridor 3. If an access road were constructed along this corridor, mitigation measures would be taken to avoid work in areas where standing water accumulates during rainy periods; such measures would reduce the potential for impacts on leopard frogs.

The southern red-bellied dace, a Colorado state endangered species inhabiting the AWS Pond, would not be affected by construction of pilot test facilities and infrastructure upgrades. No other state sensitive species are known to occur in northern portions of PCD in the three areas considered for siting pilot test facilities (Kazmarek 2000).

6.16.3.2 Impacts of Operations

No impacts on endangered, threatened, or candidate species would result from normal test facility operations.

6.16.4 Impacts of No Action

Continued storage of chemical agents at PCD would not adversely affect protected species during normal maintenance and monitoring of the storage bunkers, vegetated areas, and cleared areas.

6.17 WETLANDS

6.17.1 Current Environment

National wetland inventory maps (DOI 1999) were examined to obtain current information on the wetlands occurring along the Haynes Creek, Boone Creek, and Chico Creek watersheds in the northern portion of PCD. Wetland surveys were conducted at PCD in June 1998 by using criteria developed by the COE (1987) for jurisdictional (i.e., naturally occurring) wetlands. On the basis of indicators set forth in the criteria for vegetative, soil, and hydrologic conditions that must be present for an area to be classified as a wetland, wetland sites were identified and mapped. The national wetland inventory maps and results of the 1998 wetlands surveys were used to create Figure 6.17-1. The proximity of wetlands to potential utility corridors and access roads is discussed in the sections below for each of the three watersheds. Table 6.17-1 shows acres of wetlands and water and total acres in each of the wetland types identified at PCD. Wetlands at PCD are commonly associated with ponds, seeps, and streams (Rust and E-E Management 1999). Common plants occurring in PCD wetlands include cattails (*Typha latifolia, T. angustifolia)*, sedges (*Carex spp.)*, spikerushes (*Eleocharis spp.)*, rushes (*Juncus balticus, J. effusus)*, bulrushes (*Scirpus spp.)*, three-square bulrush (*Schoenoplectus pungens)*, skunkbrush (*Rhus aromatica trilobata)*, western snowberry (*Symphoricarpos occidentalis)*, and smooth scouring rush (*Equisetum hyemale)*.

6.17.1.1 Haynes Creek

Six small palustrine wetlands with emergent or aquatic bed type vegetation occur within the portion of Haynes Creek watershed that traverses the northeast section of PCD (Figure 6.17-1). None of these wetlands exhibits characteristics typical of wetlands that surround open water. These wetlands are semipermanently or permanently flooded. A total wetland area of 20.6 acres (8.3 ha) was documented at these locations (Rust and E-E Management 1996). Most sites had a single-stratum vegetative structure and showed impacts from grazing pressure such as soil compaction and trampled vegetation. Vegetation was not distributed in a zonal pattern that was observed elsewhere along drainage areas within PCD. Only 3 acres (1 ha) of open water was present at the six sites during the June 1998 surveys.

The six small palustrine wetlands are located about 6,500 ft (2 km) northeast of the southern boundary of Area A. The closest wetland to utility Corridor 3 is about 0.3 mi. (0.5 km) southeast of the point where the utility corridor crosses the Haynes Creek drainage (Figure 6.17-1). Several wetlands occur in the Haynes Creek watershed northeast of the PCD boundary and beyond the eastern boundary. Some wetlands northeast of PCD within the Haynes Creek watershed are associated with livestock watering ponds on adjacent private property. An additional 10 small wetlands (<0.1 acre) occur above and below the three larger wetlands. All these wetland areas are about 0.9–1.0 mi. (1.5–1.6 km) downstream of Areas A and B and are within 500 ft (150 m) of utility Corridor 2.

6.17.1.2 Lynda Ann Reservoir and Boone Creek

The Boone Creek watershed has five wetlands on PCD that total 13.7 acres (5.5 ha). The largest contiguous wetland is associated with Lynda Ann Reservoir located about 3.5 mi (5.6 km) south-southeast of Area A. An estimated 4.2 acres (1.7 ha) of wetlands and 14 acres (5.7 ha) of open water make up the Lynda Ann Reservoir. A multilayered vegetative structure is present; plains cottonwood (*Populus deltoides)* dominates the canopy. Coyote willow (*Salix exigua)* is in the mid-canopy layer, and great bulrush (*Scirpus validus)* and yellow sweet clover

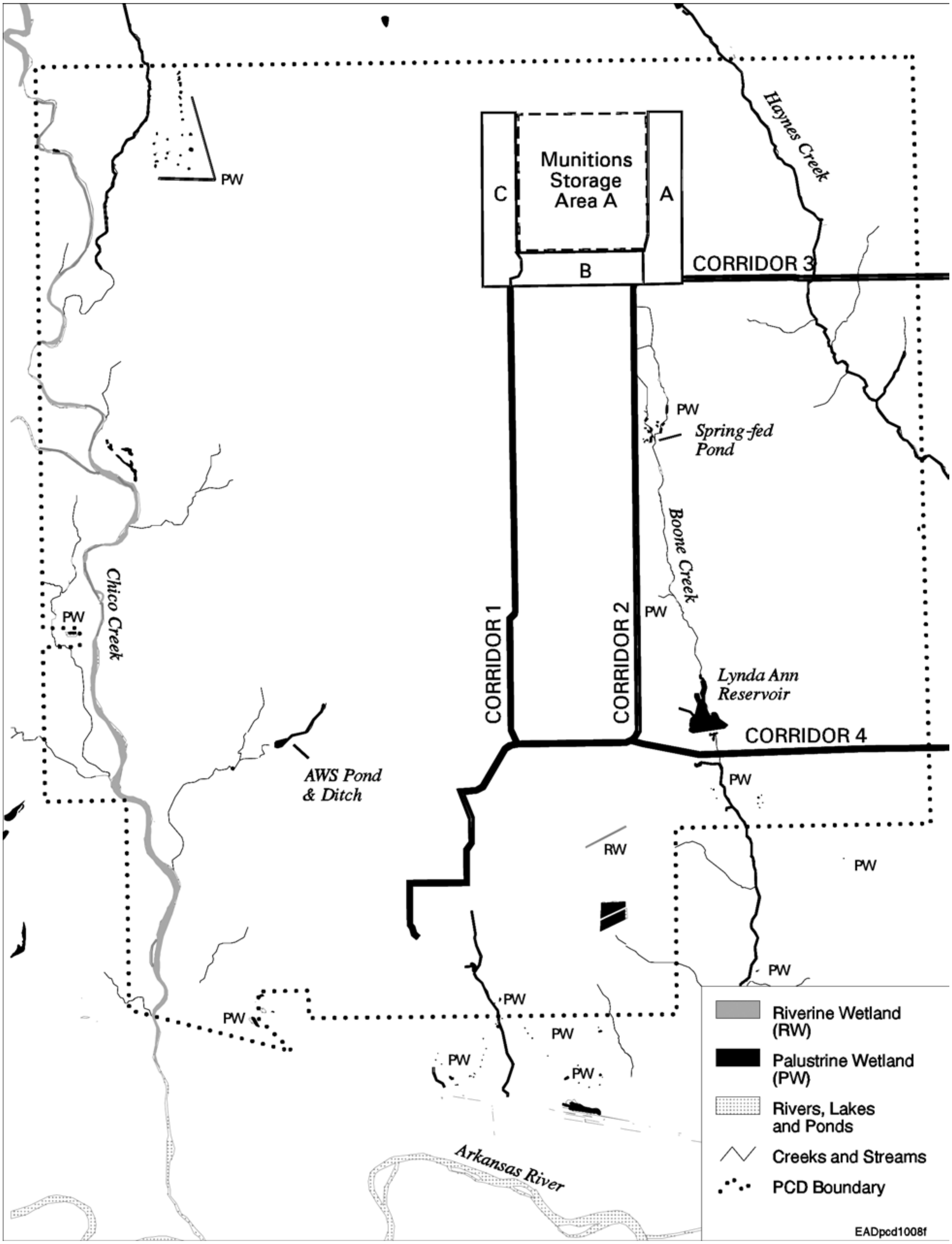

FIGURE 6.17-1 Wetlands at PCD as Identified in U.S. Fish and Wildlife Service National Wetland Inventory Maps

TABLE 6.17-1 Wetlands at PCD Identified during the 1998 Surveys

	Approximate Area (acres)[a]		
Site	Wetland	Water Surface	Total
Haynes Creek	21	3	24
Lynda Ann Reservoir	4	14	18
Boone Creek north of Lynda Ann Reservoir[b]	7.5	0.5	8
Boone Creek south of Lynda Ann Reservoir	2	0	2
Ammunition Workshop (AWS) Pond	0.3	0.5	0.8
Ammunition Workshop (AWS) Ditch	0.8	0	0.8
Hillside seeps	0.9	0	0.9
Chico Creek	No estimates	No estimates	No estimates
Total	36	18	54

[a] 1 acre = 0.4 ha.

[b] Includes acreage of wetlands around Spring Fed Pond.

Source: Rust and E-E Management (1999).

(*Melilotus officinalis)* make up the dominant vegetation in the herbaceous layer. Three wetlands totaling 7.5 acres (3 ha) occur in the Boone Creek drainage above Lynda Ann Reservoir. Two of the Boone Creek wetlands have multilayered vegetative communities. Common species at these locations include the plains cottonwood, tamarisk (*Tamarix sp.*), greasewood, and great bulrush.

6.17.1.3 Seepage Areas

Numerous seepage areas occur along bluffs of drainageways at PCD. These areas were estimated to include about 0.9 acre (0.4 ha) of wetlands vegetation. These wetlands are located in the northwestern portion of the PCD, downstream of Lynda Ann Reservoir, downgradient of the pond near the remediation facility, and in the southwestern corner of PCD. Just south of the PCD boundary, several seeps occur along bluffs above the Arkansas River Valley (Rust and E-E Management 1999). A 2-acre (0.8-ha) spikerush-dominated wetland is located about 0.5 mi (0.8 km) south of Lynda Ann Reservoir. Most of the wetland vegetation at this location was destroyed or damaged by cattle grazing in late summer and fall of 1997. The vegetative zones in seep wetlands consist of saltgrass (*Distichlis spicata)*, saltgrass/rushes, three-square bulrush, and cattails/bulrushes. Ground cover is nearly 100% in many seep areas, which range in size from a few square feet to irregularly shaped strips along bluffs that are 200 to 300 ft (60 to 90 m) long.

6.17.1.4 Chico Creek

No quantitative wetland surveys were conducted in Chico Creek, located along the western section of PCD. The nearest palustrine emergent wetlands to Area C are located along Chico Creek about 2.0 mi (3.2 km) west of the center of Area C (see Figure 6.17-1). Wetland areas associated with the Chico Creek watershed include vegetation around shallow pools, in old bends, and in high water channels. During 1995, lower portions of Chico Creek on PCD that had been heavily grazed were eroding. Common riparian wetland vegetation found there includes cattails, great bulrush, three-square bulrush, spikerush, coyote willow, and scouring rush. The southern portions of Chico Creek are characteristically flatter and contain more open floodplain and braided channel. The development of wetland vegetation is limited by stream scouring during occasional high flows. Dominant species include cattails, great bulrush, three-square bulrush, and coyote willow. The Chico Creek watershed does not include drainage from Area C.

6.17.2 Site-Specific Factors

Site-specific ACWA pilot test facility factors include construction activities, releases, and spills, as discussed in the following sections. These factors are associated with construction of the proposed test facility on about 25 acres (10 ha) and installation of the infrastructure, parking lots, and sanitary waste treatment facility. Transportation of the workforce and building materials to the site and vehicular traffic during facility operations are also considered to be factors.

6.17.3 Impacts of the Proposed Action

6.17.3.1 Impacts of Construction

No wetlands would be affected by construction activities. Construction of an access road along Corridor 3 would avoid any wetlands in the Haynes Creek and Boone Creek watersheds. All wetlands at PCD are too far from potential pilot test facility construction sites to be affected (Figure 6.17-1). The wetland nearest to potential construction activities is the Spring Fed Pond in the Boone Creek watershed located more than 0.5 mi (0.8 km) from Area A. Impacts from construction of an access road and power lines along utility corridors would not result in erosion or change the surface water flow to adversely affect a small wetland located on Haynes Creek drainage, about 0.3 mi (0.5 km) below Corridor 3. Runoff from construction activities would be contained, if necessary, by using erosion control measures.

6.17.3.2 Impacts of Operations

Wetlands downwind of test facilities would not be affected by emissions from normal operations.

6.17.4 Impacts of No Action

Continued storage of chemical agents at PCD would not adversely affect wetlands during normal maintenance and monitoring of the storage bunkers, vegetated areas, and cleared areas.

6.18 CULTURAL RESOURCES

6.18.1 Current Environment

6.18.1.1 Archaeological Resources

Between 1994 and 1996, approximately 11,300 acres (4,600 ha) of PCD were surveyed for archaeological sites to complete the current inventory of archaeological resources at PCD (Figure 6.18-1). Forty-five sites and 128 isolated finds[12] were recorded. Three sites — 5PE1719, 5PE1930, and 5PE2093 — were recommended as eligible for listing on the National Register of Historic Places (NRHP); however, further testing was recommended for 32 of the sites (Larson and Penny 1995; Foothill Engineering Consultants [FEC] 1998).

More than 80% of the sites recorded (37 of 45) are located along Chico, Boone, and Haynes Creeks, within or near the edges of the creek valleys (Larson and Penny 1995; FEC 1998). These sites are predominately lithic scatters containing flaked stone debris and tools and small, open camps with evidence of possible features such as hearths. The majority of sites date between the Late Archaic (1,000 B.C. to A.D. 100) through the Middle Ceramic. Two localities contain artifacts dating as early as the Late Paleo-Indian period. Additional prehistoric sites may be present in the undisturbed portions of the facility.

Archaeological survey results indicate that there are few sites pertaining to the historic period at PCD, and none of the recorded sites have been directly attributed to the ethnohistoric

[12] An isolated find is defined as one stone tool, five or fewer pieces of lithic debris, a single historic artifact type (e.g., lass, ceramic), or a scatter of glass or ceramics where all the sherds appear to be from the same vessel.

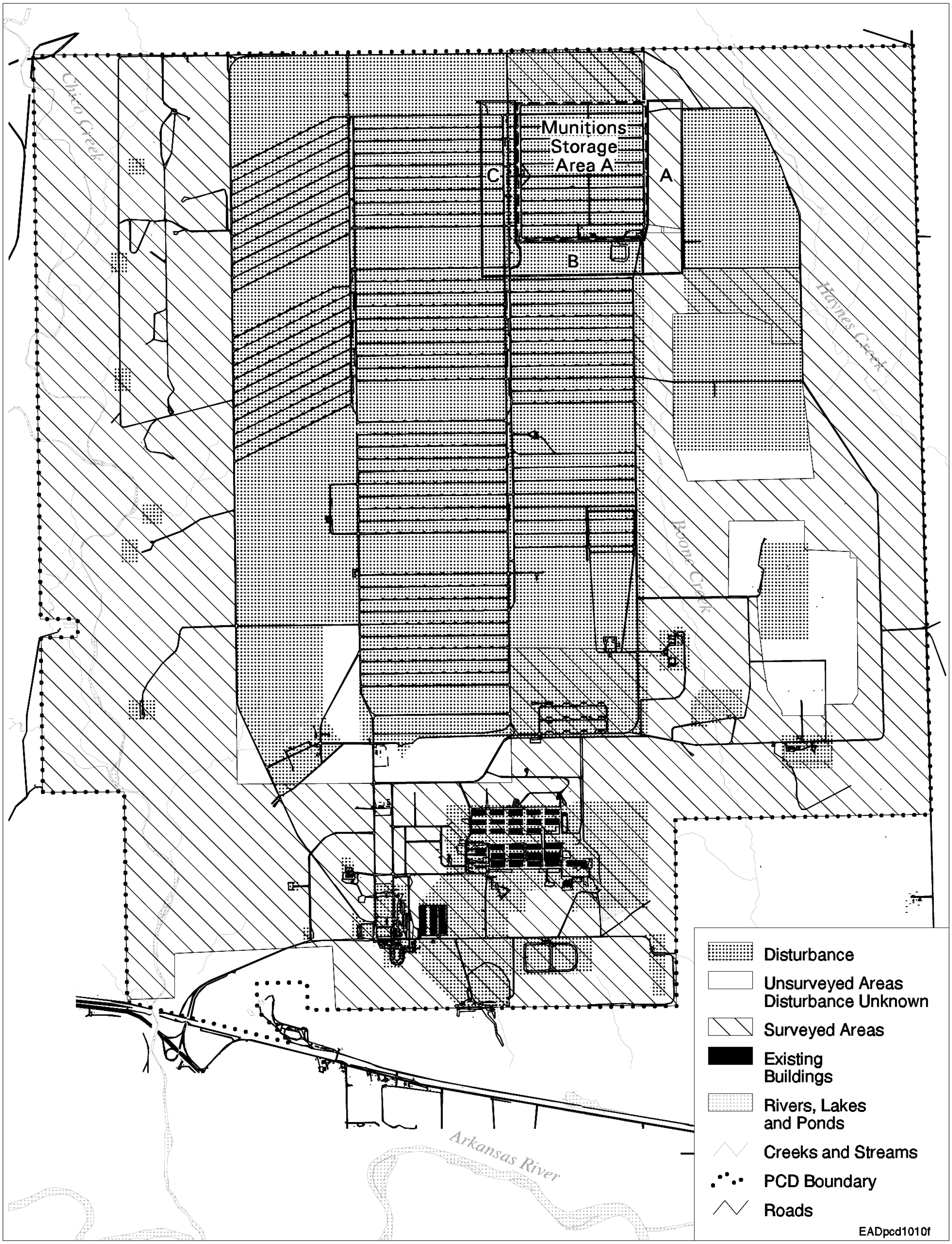

FIGURE 6.18-1 Archaeological Survey Areas and Areas of Disturbance at PCD

period. The three historic sites that have been recorded at PCD date between 1880 and 1942 (when the property was acquired by the government). Twelve of the isolated finds are historic, consisting of glass or historic ceramic sherds. Additional testing of one site (5PE1735) was recommended. This site, which has visible foundations, appears to have been an early twentieth century ranch. The other historic archaeological resources were considered not eligible for the NRHP (Larson and Penny 1995; FEC 1998).

6.18.1.2 Traditional Cultural Properties

A traditional cultural property is defined as a property "eligible for inclusion in the National Register because of its association with the cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community" (Parker 1995). No traditional cultural properties are known to occur within the proposed facility locations. Interested Native American governments have been consulted regarding the proposed action.

6.18.1.3 Historic Structures

A survey and evaluation of historic structures at PCD was initially completed in 1984 (McDonald and Mack Partnership 1984). The result of this assessment of 27 buildings at PCD was that none of them was eligible for listing on the NRHP. The Colorado State Historical Preservation Officer (SHPO) found this assessment inadequate and recommended that all structures on PCD be reevaluated. In 1996, Front Range Research Associates, Inc. (FRRA) finalized a survey of historic structures at PCD (Simmons and Simmons 1998). The contractor concluded that four districts and one building were potentially eligible for listing on the NRHP. The districts included one World War II district, consisting of earthen-covered igloos, aboveground igloos, warehouses, and administration and support buildings, and three Cold War era districts: Hi Pardner Park, the Pershing missile demilitarization area, and the nuclear weapons storage area (within Munitions Storage Area B). Building 1, the post headquarters, was the only individual building recommended as being eligible for the NRHP. A programmatic agreement (PA) signed in 1997 by the U.S. Army, Colorado SHPO, and Advisory Council on Historic Preservation states that the recommendations of the FRRA report are acceptable and that the above-mentioned building and districts are eligible for listing. PDADA concurred with the PA. The PA also states that the unsurveyed structures in Munitions Storage Area A, which house part of the nation's chemical weapons stockpile, are also eligible for the NRHP. The PA further states that documentation of facilities on PCD has been completed and that "no further documentation is required to mitigate the effects of leasing, licensing, and/or disposal of facilities at the Depot" (U.S. Army et al. 1997).

6.18.2 Site-Specific Factors

Factors that need to be considered with regard to significant archaeological sites, traditional cultural properties, and historic structures under the ACWA program include these:

- Destruction or disturbance of cultural resources could occur during construction activities.

- Contamination of cultural resources could occur during an accidental chemical release or spill. This might may lead to the establishment of temporary restrictions on access to the property or possibly to the destruction or disturbance of the resource if soils need to be removed during cleanup.

- Secondary impacts could be associated with the construction or operation of a proposed facility, such as:

  – Increased pedestrian or vehicular traffic in the area could increase the potential for inadvertent or intentional damage to cultural resources by casual passerbys or amateur collectors or

  – Increased erosion potential as a result of construction activities could disturb archaeological sites next to the construction area.

6.18.3 Impacts of the Proposed Action

6.18.3.1 Impacts of Construction

On the basis of previous survey results and the level of ground disturbance in the proposed construction areas, construction of an ACWA pilot facility, including the establishment of a staging area and construction of a power corridor and any additional access routes, would be unlikely to adversely affect eligible cultural resources.

Archaeological Resources. The areas north and east of Munitions Storage Area A, which are potential locations for ACW destruction facilities, were surveyed for archaeological resources (Larson and Penny 1995; FEC 1998). Seven sites and nine isolated finds were recorded within the immediate vicinity of the potential project area (in Sections 2 and 3 of T.20 S and R.22 W and Sections 34 and 35 of T.19 S and R.22 W). None of the sites are eligible for the NRHP; therefore, the use of Area A, east of Munitions Storage Area A, would not affect significant cultural resources. Areas B and C, south and west of Munitions Storage Area A, have not been surveyed. However, they are within the deeply disturbed bunker construction area, where the potential for finding intact archaeological remains that would meet NRHP eligibility criteria is low. Nevertheless, an archaeological survey of these areas might be required if, for some reason, the SHPO would need confirmation that the site is disturbed before concurring on a "no adverse effect" determination for this project. If cultural material is unexpectedly encountered during these ground-disturbing activities, operations should cease immediately, and the SHPO and a qualified archaeologist should be consulted to evaluate the significance of the cultural artifacts.

Traditional Cultural Properties. No traditional cultural properties are known to occur within the construction area for the proposed ACWA facilities. Native American governments have been consulted to determine whether traditional cultural properties are present near the Munitions Storage Area A area. Copies of the consultation letters and any responses received are presented in Appendix F. No impacts on traditional cultural properties are anticipated during construction.

Historic Structures. The structures within Munitions Storage Area A were determined to be eligible as a historic district. However, these facilities were sufficiently documented (mitigated) per the stipulations of the PA, and further review of potential impacts to these structures by the SHPO is not required (U.S. Army et al. 1997). There would be no adverse impacts on the Munitions Storage Area A Historic District from constructing an ACW destruction system at PCD.

6.18.3.2 Impacts of Operations

Archaeological Resources. Routine operation of a pilot facility would not involve ground-disturbing activities or other activities (i.e., transportation of munitions) in locations not previously heavily disturbed. None of the nearby archaeological sites are eligible for the NRHP, so increased pedestrian or vehicular traffic in the area would not cause an adverse impact. Therefore, operations would have no impact on archaeological resources.

Traditional Cultural Properties. No traditional cultural properties are known to occur within the operations area for the proposed ACWA facilities. Native American governments have been consulted to determine whether traditional cultural properties are present near the Munitions Storage Area A area. Copies of the consultation letters and any responses received are presented in Appendix F. No impacts on traditional cultural properties are anticipated during operation.

Historic Structures. The bunkers in the Munitions Storage Area A Historic District were designed and are used to store the weapons stockpile. Munitions would be removed from this stockpile during operation of the proposed ACWA pilot facility. According to the PA, these structures have been mitigated, and removal of ACWs for operation of the pilot test facility would not adversely affect their integrity.

6.18.4 Impacts of No Action

6.18.4.1 Archaeological Resources

Archaeological resources would not be affected by the no action alternative (i.e., continued storage of chemical weapons that might otherwise be destroyed by pilot testing) because ground disturbance is not associated with the current mission.

6.18.4.2 Traditional Cultural Properties

No traditional cultural properties are known to occur within the chemical munitions storage area. Native American governments have been consulted to determine whether traditional cultural properties are present near the Munitions Storage Area A area. Copies of the consultation letters and any responses received are presented in Appendix F. No impacts on traditional cultural properties are anticipated as a result of the no action alternative.

6.18.4.3 Historic Structures

Historic structures at PCD would not be affected by the no action alternative. Chemical munitions that might otherwise be removed and destroyed during pilot testing would continue to be stored in the Munitions Storage Area A Historic District. Such use is compatible with the history and origin of the storage bunkers and is consistent with the requirements of the PA.

6.19 SOCIOECONOMICS

6.19.1 Current Environment

Socioeconomic data for PCD describes a region of influence (ROI) surrounding the site that is composed of only one county: Pueblo County. The ROI is based on the current residential locations of government workers directly connected to PCD activities and captures the area in which these workers spend their wages and salaries. More than 90% of PCD workers currently reside in Pueblo County, with almost 90% of workers living in the city of Pueblo itself (Marrero 2000). The majority of impacts from an ACWA facility would be expected to occur in these locations.

6.19.1.1 Population

The population of Pueblo County was 141,472 in 2000 (U.S. Bureau of the Census 2001b), and it was projected to reach 143,000 in 2001 (Table 6.19-1). In 2000, 102,121 people (72% of the county total) resided in the city of Pueblo itself, with 102,000 people expected to be living in the city in 2001 (U.S. Bureau of the Census 2001b). During the 1980s, both the city and county as a whole had experienced small declines in population, although the state as a whole had experienced a modest growth rate of 1.3% over the same period. In contrast, over the period 1990–1999, the population grew slightly in both the city and county. The growth rate in the city was somewhat less than 0.4%, and the growth rate in the county as a whole was 1.4%. Over the same period, the population in the state grew at a rate of 2.7%. Boone (323 persons in 2000), immediately to the southeast of PCD, is the only other incorporated community in the vicinity of the site (U.S. Bureau of the Census 2001b).

6.19.1.2 Employment

Total employment in Pueblo County in 1999 was 47,994 (U.S. Bureau of the Census 2001a), and it was projected to reach 51,400 in 2001 (Allison 2001). The economy of the county is dominated by the trade and service industries, with employment in these activities currently

TABLE 6.19-1 Population in Pueblo, Pueblo County, and Colorado in Selected Years

Location	1980[a]	1990[a]	Average Annual Growth Rate (%) 1980–1990	2000[b]	Average Annual Growth Rate (%) 1990–2000	2001[c] (Projected)
City of Pueblo	101,686	98,640	–0.3	102,121	0.4	102,000
Pueblo County	125,972	123,051	–0.2	141,472	1.4	143,000
Colorado	2,889,735	3,294,394	1.2	4,301,261	2.7	4,420,000

[a] U.S. Bureau of the Census (1994).

[b] U.S. Bureau of the Census (2001b).

[c] Allison (2001).

contributing to more than 75% of all employment in the county (see Table 6.19-2). Manufacturing, which has traditionally been a strong local source of employment, only contributes a little more than 8% of total county employment. Annual average employment growth in the county was 3.5% during the 1990s (U.S. Bureau of the Census 1992c, 2001a).

Employment at PCD has been stable over the last five years, with 150 government employees working at the site, 78 of whom are employed at PCD (Marrero 2000). In addition, approximately 25 contractors and several military personnel work at the site. Since base realignment in 1993, a number of commercial and industrial tenants have occupied land and buildings formerly used by the military. Tenants employ 30 people (Oburn 2000).

Unemployment in the county declined steadily from the 1980s, when it averaged more than 10%, to a rate averaging 6.5% during the 1990s (Table 6.19-3). Unemployment in the county currently stands at 4.8%, compared with 3.6% for the state (U.S. Bureau of Labor Statistics 2001).

TABLE 6.19-2 Employment in Pueblo County by Industry in 1999

Employment Sector	Number Employed	% of County Total
Agriculture	1,259[a]	2.6
Mining	52	0.1
Construction	3,567	7.4
Manufacturing	4,103	8.5
Transportation and public utilities	850	1.8
Trade	8,608	17.9
Finance, insurance, and real estate	2,066	4.3
Services	27,429	57.2
Total	47,994	

[a] 1997 data.

Sources: U.S. Bureau of the Census (2001a); USDA (1999).

TABLE 6.19-3 Unemployment Rates in Pueblo County and Colorado

Location and Period	Rate (%)
Pueblo County	
1990–2000 average	6.5
2001 (current rate)	4.8
Colorado	
1990–2000 average	4.3
2001 (current rate)	3.6

Source: U.S. Bureau of Labor Statistics (2001).

6.19.1.3 Personal Income

In 1999, total personal income in Pueblo County was $3.0 billion. It was projected to reach $3.4 billion in 2001, based on an annual average rate of growth of 6.2% over the period 1990–1999 (Table 6.19-4). County per capita income also rose in the 1990s and was projected to reach $23,600 in 2001; it was $14,189 at the beginning of the period.

TABLE 6.19-4 Personal Income in Pueblo County

Personal Income	1990[a]	1999[b]	Average Annual Growth Rate (%) 1990–1999	2001[c] (Projected)
Total (millions of $)	1,746	3,003	6.2	3,390
Per capita ($)	14,189	21,525	4.7	23,600

[a] U.S. Bureau of the Census (1994).

[b] U.S. Department of Commerce (2001).

[c] Allison (2001).

6.19.1.4 Housing

Housing stock in the county grew at an annual rate of 1.5% over the period 1990–2000 (Table 6.19-5). The total number of housing units was projected to reach 59,800 in 2001, reflecting the relatively slow annual growth in county population. Growth in the city of Pueblo was slightly lower at 0.5%, with the total number of housing units projected to reach 43,400 in 2001. More than 8,100 new units were added to the existing housing stock in the county during the period 1990–2000, of which more than 2,260 were constructed in the city of Pueblo. Vacancy rates in 2000 were 6.5% in the city and 7.4% in the county as a whole for all types of housing. The annual average growth rate between 1990 and 2000 indicates that there would be 4,400 vacant housing units in the county in 2001, of which almost 1,520 are projected to be rental units available to construction workers at the proposed facility.

6.19.1.5 Community Resources

Community Fiscal Conditions. Construction and operation of the proposed facility might result in increased revenues for local government jurisdictions, including counties, cities, and school districts in the city and county. Revenues would come primarily from state and local sales taxes associated with employee spending during construction and operation. Revenues

TABLE 6.19-5 Housing Characteristics in Pueblo and Pueblo County

Type of Housing	1990[a]	2000[b]	2001[c] (Projected)
City of Pueblo			
Owner-occupied	24,837	26,460	26,600
Rental	13,487	13,847	13,900
Unoccupied	2,538	2,814	2,800
Total units	40,862	43,121	43,400
Pueblo County			
Owner-occupied	31,946	38,449	39,200
Rental	15,111	16,130	16,200
Unoccupied	3,815	4,347	4,400
Total units	50,872	58,926	59,800

[a] U.S. Bureau of the Census (1994).

[a] U.S. Bureau of the Census (2001b).

[a] Allison (2001).

would be used to support additional local community services currently provided by each jurisdiction.

Sales taxes in Pueblo are currently set at 7.5%, and include a city tax of 3.5%, a county tax of 1%, and a state tax of 3%. There is also a 4.3% local tax on lodging and a combined state and federal tax on gasoline and diesel fuel. In 1996, property taxes in the city amounted to 10% of the total assessed value for residential property and 30% of the value for commercial property. State income taxes are currently 4.75% of adjusted gross income (Kornelly and Associates/KPMG Inc. 1999). Tables 6.19-6 and 6.19-7 present data on revenues and expenditures by local government jurisdictions and school districts in Pueblo County.

Community Public Services. Construction and operation of the proposed facility would result in increased demand for community services in the county, cities, and school districts likely to host relocating construction workers and operations employees. Additional demands would also be placed on local medical facilities and physician services. Table 6.19-8 presents data on employment and levels of service (number of employees per 1,000 population) for public safety and general local government services and physicians. Tables 6.19-9 and 6.19-10 provide staffing data for school districts and hospitals. Table 6.19-11 presents data on employment and levels of service for physicians.

6.19.1.6 Traffic

Vehicular access to PCD is afforded from U.S. Highway (US) 50, which links the site with the city of Pueblo and Pueblo Airport to the west and with smaller communities to the east. Other roads used by employees working at PCD include State Route (SR) 96, which intersects with US 50 south of PCD and runs east through North Avondale to the community of Boone. Business Route (BR) 50 intersects with US 50 and runs west through Avondale toward Pueblo. North Avondale Boulevard connects North Avondale with Avondale.

Table 6.19-12 shows average annual daily traffic flows over these road segments, together with congestion level (level of service) designations developed by the Transportation Research Board (1985). The designations range from A to F; A through C represent good traffic conditions with some minor delays experienced by motorists, and F represents jammed roadway conditions.

6.19.2 Site-Specific Factors

The socioeconomic analysis covers the effects on population, employment, income, housing, community resources, and traffic from the proposed action and no action alternatives.

TABLE 6.19-6 Local Government Financial Characteristics in Pueblo and Pueblo County (millions of 1998 $)

Financial Category	City of Pueblo	Pueblo County
Revenues		
Taxes	47.3	24.9
Licenses and permits	0.2	0.1
Intergovernmental	2.3	4.5
Charges for services	0.3	3.1
Fines and forfeits	0.8	0.1
Miscellaneous	0.8	2.5
Total[a]	51.7	35.1
Expenditures		
General government	5.1	14.6
Public safety	20.2	12.7
Highways and streets	2.5	1.2
Health, welfare, and sanitation	3.3	2.8
Culture and recreation	2.8	0.3
Debt service	0.0	0.0
Intergovernmental	2.2	0.3
Other	3.0	1.7
Total[a]	39.1	33.6
Revenues minus expenditures	12.6	1.5

[a] The sum of individual row entries and column totals may not correspond because of independent rounding.

Sources: City of Pueblo (1999); Pueblo County (1999).

6.19.3 Impacts of the Proposed Action

Table 6.19-13 summarizes the socioeconomic impacts from constructing and operating an ACWA pilot test facility. The impacts of no action are provided as well for comparison.

TABLE 6.19-7 School District Financial Characteristics in Pueblo County (millions of 1998 $)

Financial Category	School District 60[a]	School District 70[b]
Revenues		
Local sources	22.0	8.8
State sources	59.1	17.8
Federal sources	0.2	0.1
Other	–3.0[c]	–1.2[d]
Total	78.3	25.5
Expenditures		
Administration and instruction	76.1	14.7
Services	0.0	9.3
Debt service	0.1	0.1
Total	76.2	24.1
Revenues minus expenditures	2.1	1.4

[a] School District 60 serves the city of Pueblo.

[b] School District 70 serves the remainder in Pueblo County.

[c] Includes the reassignment of $3.8 million in revenues to the special revenue fund.

[d] Includes the reassignment of $1.4 million in revenues to the special revenue fund.

Sources: School District 60 (1999); School District 70 (1999).

6.19.3.1 Impacts of Construction

Neutralization/Biotreatment. The potential socioeconomic impacts from constructing and operating a Neut/Bio treatment facility at PCD would be relatively small. Construction activities would create direct employment of about 600 people in the peak construction year and an additional 570 indirect jobs in the ROI. Construction activities would increase the annual average employment growth rate by 0.2% over the duration of construction. A Neut/Bio facility would produce approximately $36 million of income in the peak year of construction.

TABLE 6.19-8 Public Service Employment in Pueblo, Pueblo County, and Colorado

	Pueblo County[a]		City of Pueblo[a]		Colorado[b]
Employment Category	Number Employed	Level of Service[c]	Number Employed	Level of Service[c]	Level of Service[c]
Police protection	187[d]	5.2	236[e]	2.3	2.5
Fire protection[f]	50	1.4	143[e]	1.4	1.0
General local government services	762[g]	21.1	308[e]	3.0[h]	33.4
Total	999	27.6	687	6.7[h]	36.9

[a] Source of population data was U.S. Bureau of the Census (2001b).

[b] U.S. Bureau of the Census (2000).

[c] Level of service represents the number of employees per 1,000 persons in each jurisdiction.

[d] Leach (2000).

[e] Alley (2000).

[f] Does not include volunteers.

[g] Amador (2000).

[h] Judicial and social services for the city of Pueblo are provided by Pueblo County.

TABLE 6.19-9 School District Data for Pueblo, Pueblo County, and Colorado in 1998

	Pueblo County		City of Pueblo		Colorado
Employment Category	Number Employed	Student to Teacher Ratio	Number Employed	Student to Teacher Ratio[a]	Student to Teacher Ratio[a]
Teachers	343	18.8	1,063	16.7	17.7

[a] Student to teacher ratio represents the number of students per teacher in each school district.

Source: Colorado Department of Education (2000).

TABLE 6.19-10 Medical Facility Data for Pueblo County in 1999

Hospital	Number of Staffed Beds	Occupancy Rate (%)[a]
Parkview Medical Center	255[b]	60[b]
St. Mary-Corwin Regional Medical Center	273[b]	47[b]
County total	528	-

[a] Perfect of staffed beds occupied

[b] Data source, by permission: SMG Marketing Group, Inc., © copyright 2001.

TABLE 6.19-11 Employment of Physicians in Pueblo County and Colorado in 1997

Employment Category	Pueblo County		Colorado
	Number Employed	Level of Service[a]	Level of Service[a]
Physicians	358	2.7	2.7

[a] Level of service represents the number of employees per 1,000 persons in each jurisdiction.

Sources for physician numbers and population data: American Medical Association (1999); U.S. Bureau of the Census (2001).

In the peak year of construction, about 1,140 people would in-migrate to the ROI. While in-migration would have a marginal effect on population growth, new residents would require 27% of vacant rental housing in the peak year. No significant impact on public finances would occur as a result of in-migration, and only 22 additional local public service employees would be required to maintain existing levels of service in the four local public service jurisdictions in Pueblo County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding the site.

Neutralization/SCWO. The potential socioeconomic impacts from constructing and operating a Neut/SCWO facility at PCD would be relatively small (Table 6.19.13). Construction activities would create direct employment of approximately 680 people in the peak construction

TABLE 6.19-12 Average Annual Daily Traffic (AADT) in the Vicinity of PCD

Road Segment	Traffic Volume (AADT)	Level of Service[a]
US 50 east of Pueblo Airport	12,800	B
US 50 west of intersection with SR 96	6,300	A
US 50 north of intersection with BR 50	3,600	A
US 50 east of Avondale	4,750	A
BR 50 east of Avondale	1,150	A
SR 96 east of North Avondale	1,500	A
SR 96 west of Boone	1,700	A
North Avondale Boulevard	190[b]	A

[a] Allison (2001).

[b] Smith (2000).

Source: Tinney (2000).

year and an additional 540 indirect jobs in the ROI. Construction activities would increase the annual average employment growth rate by 0.2% over the duration of construction. Direct Neut/SCWO-related employment and related wages and salaries at PCD would also produce about $37 million of income in the peak year of construction.

In the peak year of construction, about 1,200 people would in-migrate to the ROI, both as a result of SCWO employment on post and as a result of the overall growth in the ROI economy through the local procurement of materials and services and through employee spending. While in-migration would have a marginal effect on population growth, new residents would occupy 28% of vacant rental housing during the peak year. No significant impact on public finances would occur as a result of in-migration, and 24 additional local public service employees would be required to maintain existing levels of service in the four local public service jurisdictions in Pueblo County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding the site.

6.19.3.2 Impacts of Operations

Neutralization/Biotreatment. The potential socioeconomic impacts from constructing and operating a Neut/Bio facility at PCD would be relatively small. Operational activities would create about 640 direct jobs annually and an additional 530 indirect jobs in the ROI. A Neut/Bio facility would produce about $44 million annually during operations.

TABLE 6.19-13 Effects of Construction, Operations, and No Action at PCD on Socioeconomics[a,b]

	Neut/Bio		Neut/SCWO		
Impact Category	Construction	Operation	Construction	Operation	No Action
Employment (number of jobs in ROI)					
Direct	600	640	680	640	78
Indirect	570	530	540	580	60
Total	1,170	1,170	1,220	1,220	138
Income (millions of $ in 2000 in ROI)					
Direct	21.3	31.1	23.5	31.1	4.5
Indirect	14.4	12.9	13.4	14.3	1.4
Total	35.7	44.0	36.9	45.4	5.9
Population (number of new residents in ROI)	1,140	750	1,200	790	0
Housing (number of new units in ROI)	420	270	440	290	0
Public finances (% impact on fiscal balance)					
City of Pueblo	1	1	1	1	0
Pueblo County	<1	<1	<1	<1	0
Pueblo County schools[d]	1	1	1	1	0
Public service employment (number of new employees in Pueblo County)[c]					
Police officers	3	2	3	2	0
Firefighters	1	1	2	1	0
General	4	3	4	3	0
Teachers[c]	11	7	12	8	0
Physicians	3	2	3	2	0
Hospitals (number of new staffed hospital beds in Pueblo County)	4	3	5	3	0
Traffic (impact on current levels of service in Pueblo County)	None	None	None	None	None

[a] Impacts are shown for the peak year of construction (2004) and the first year of operations (2009).

[b] The sum of individual row entries and column totals may not correspond because of independent rounding.

[c] Includes impacts that would occur in Pueblo and Pueblo County school districts.

About 750 people would move to the area at the beginning of operations. However, in-migration would have only a marginal effect on population growth and would require less than 32% of vacant owner-occupied housing during facility operations. No significant impact on public finances would occur as a result of in-migration, and 15 additional local public service employees would be required to maintain existing levels of service in the four local public service jurisdictions in Pueblo County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding the site.

Neutralization/SCWO. The potential socioeconomic impacts from constructing and operating a Neut/SCWO facility at PCD would be relatively small (Table 6.18.15). Operational activities would create about 640 direct jobs annually and an additional 580 indirect jobs in the ROI. Direct Neut/SCWO-related employment and related wages and salaries at PCD would also produce about $45 million annually during operations.

About 790 people would move to the area at the beginning of Neut/SCWO facility operation. However, in-migration would have only a marginal effect on population growth and would require about 34% of vacant owner-occupied housing during facility operations. No significant impact on public finances would occur as a result of in-migration, and 16 additional local public service employees would be required to maintain existing levels of service in the four local public service jurisdictions in Pueblo County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding the site.

6.19.4 Impacts of No Action

Current PCD site activities have only moderately significant socioeconomic impacts (Table 6.18-15). PCD currently employs 78 workers. Wage and salary expenditures by PCD employees on goods and services have created an additional 60 indirect jobs in the ROI surrounding the site and increased the annual average employment growth rate in the ROI by 0.01% over the period 1990 to 2000. PCD related wage and salary expenditures have also created an estimated $5.9 million in annual income in the ROI.

6.20 ENVIRONMENTAL JUSTICE

On February 11, 1994, President Clinton issued Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations* (59 FR 7629). This executive order, along with its accompanying cover memo, calls on federal agencies to incorporate environmental justice as part of their missions. It directs them to address, as appropriate, disproportionately high and adverse human health or environmental effects of their actions, programs, or policies on minority and low-income populations. Sections 6.20.1 through 6.20.4 of the EIS address environmental justice issues for the populations defined below.

This EIS used data from the two most recent decennial censuses (1990 and 2000) to evaluate environmental justice in the context of the ACWA at PCD. The 2000 census provides detailed data on race and ethnicity necessary for a systematic definition of minority populations. Although more than a decade old, the 1990 census nevertheless provides the most recent data available on income, which enabled the identification of low-income populations. To remain consistent with these data sources, the EIS employs the following definitions for minority and low-income:

- *Minority* — individuals who classify themselves as belonging to any of the following racial groups: Black (including Black or Negro, African American, Afro-American, Black Puerto Rican, Jamaican, Nigerian, West Indian, or Haitian); American Indian, Eskimo, or Aleut; Asian or Pacific Islander; or "Other Race" (U.S. Bureau of the Census 1991). For present purposes, individuals characterizing themselves as belonging to two or more races also are counted as minorities. This study also includes individuals identifying themselves as Hispanic in origin, technically an ethnic category, under minority. To avoid double-counting, tabulations included only White Hispanics; the above racial groups already account for non-White Hispanics.

- *Low-Income* — individuals falling below the poverty line. For the 1990 census, the poverty line was defined by a statistical threshold based on a weighted-average that considered both family size and the ages of individuals in a family. For example, the 1990 poverty threshold annual income for a family of five with two children younger than 18 years was $15,169, while the poverty threshold for a family of five with three children aged less than 18 years was $14,796 (U.S. Bureau of the Census 1992a). If a family fell below the poverty line for its particular composition, the census considered all individuals in that family to be below the poverty line. Low-income figures in the 1990 census reflect incomes in 1989, the most recent year for which entire annual incomes were known at the time of the census.

For this EIS, an analysis of minority and low-income populations was done by using census data for two demographic units: counties and census block groups. A block group is a geographic unit consisting of a cluster of blocks that is used by the Census Bureau to present data (U.S. Bureau of the Census 1991). Block groups contain enough blocks to encompass about 250–550 housing units, with the ideal one containing about 400 housing units. Because housing density varies over space, the geographic sizes of block groups vary; smaller units tend to occur in denser areas, such as urban areas. This dual focus on counties and block groups enabled the evaluation of environmental justice issues to remain consistent with the geographical focus of analyses in two issue areas where environmental justice is of particular concern: socioeconomics and human health. To maintain consistency with the socioeconomic analysis, the subsections on current conditions and impacts in this section of the EIS consider Pueblo County to be the core county for PCD. To maintain consistency with the human health analysis, the environmental justice analysis considers population characteristics in census block groups within a 30-mi (50-km) radius of PCD. The block groups considered include parts of El Paso, Lincoln, Otero, and Pueblo Counties and all of Crowley County.

To define disproportionate representations of either minority or low-income populations, this EIS uses values for the United States as a whole as reference points, thereby providing an identical comparison for all four installations considered in this EIS. This choice of a reference point, which is central to environmental justice analyses, reflects a desire to remain consistent with Executive Order 12898 and is consistent with the need to select a meaningful reference point for any given impact assessment (Council on Environmental Quality [CEQ] 1997; EPA 1998a). The 2000 census indicates that the United States contains 30.9 % minority persons (U.S. Bureau of the Census 2001c), while the 1990 census indicated that 13.1% of persons for whom poverty status was known were considered low-income population in 1989 (U.S. Bureau of the Census 1992c).

6.20.1 Current Environment

Of the Pueblo County residents recorded in the 2000 census, 42.3% were classified as minority on the basis of the above definition (U.S. Bureau of the Census 2000c). This percentage is slightly higher than the minority percentage in the United States as a whole. The largest percentage of minority persons in Pueblo County (38.0% of the total population) was of Hispanic origin. The 1990 census recorded that 20.2% of the Pueblo County population were below the poverty level (U.S. Bureau of the Census 1992c); this percentage was slightly higher than the percentage in the United States as a whole. Note that the figures for minority and low-income populations did not account for seasonal farm workers, who are present in Pueblo County in large numbers at certain times of the year and include a large proportion of minority and low-income persons (and who are very difficult to track statistically with much reliability). If these seasonal workers would be included, the disproportionality already identified would increase accordingly.

Of the 160 census block groups defined in the 2000 census as being partially or totally within a 30-mi (50-km) radius of PCD, 109 contained minority populations in excess of the minority representation in the United States (Figure 6.20-1). These 109 block groups contained a total of 56,049 minority persons in 2000. Block groups with disproportionately high minority populations included the scattered farming communities of Crowley, Manzanola, and Ordway, as well as nearly all of the city of Pueblo.

Of the 176 census block groups defined in the 1990 census as lying partially or totally within a 30-mi (50-km) radius of PCD, 115 had low-income populations in excess of the 13.1% calculated for the United States as a whole (Figure 6.20-2). These block groups contained a total

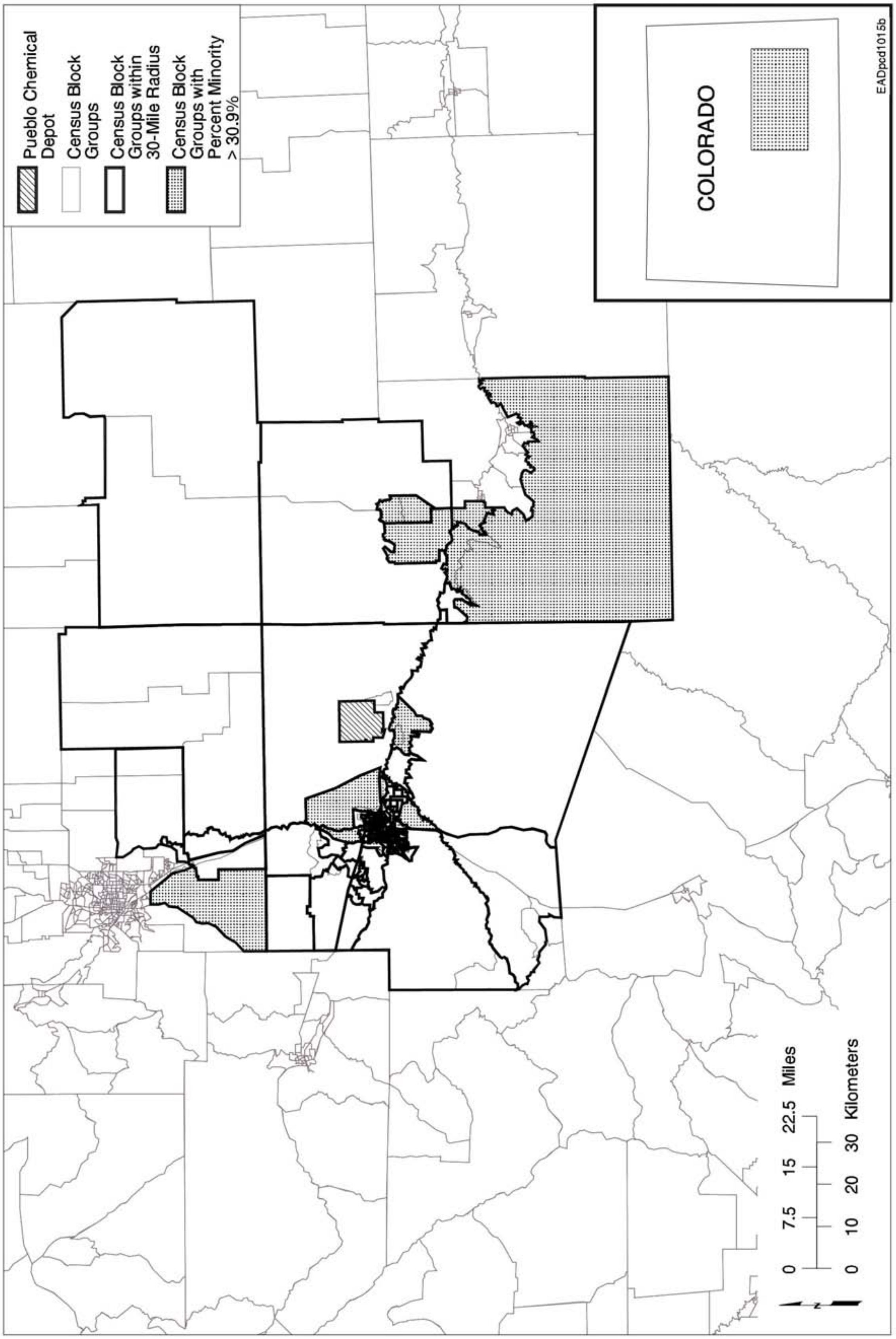

FIGURE 6.20-1 Census Block Groups surrounding PCD with Minority Populations Greater than the National Average in 2000 (Source: U.S. Bureau of the Census 2001d)

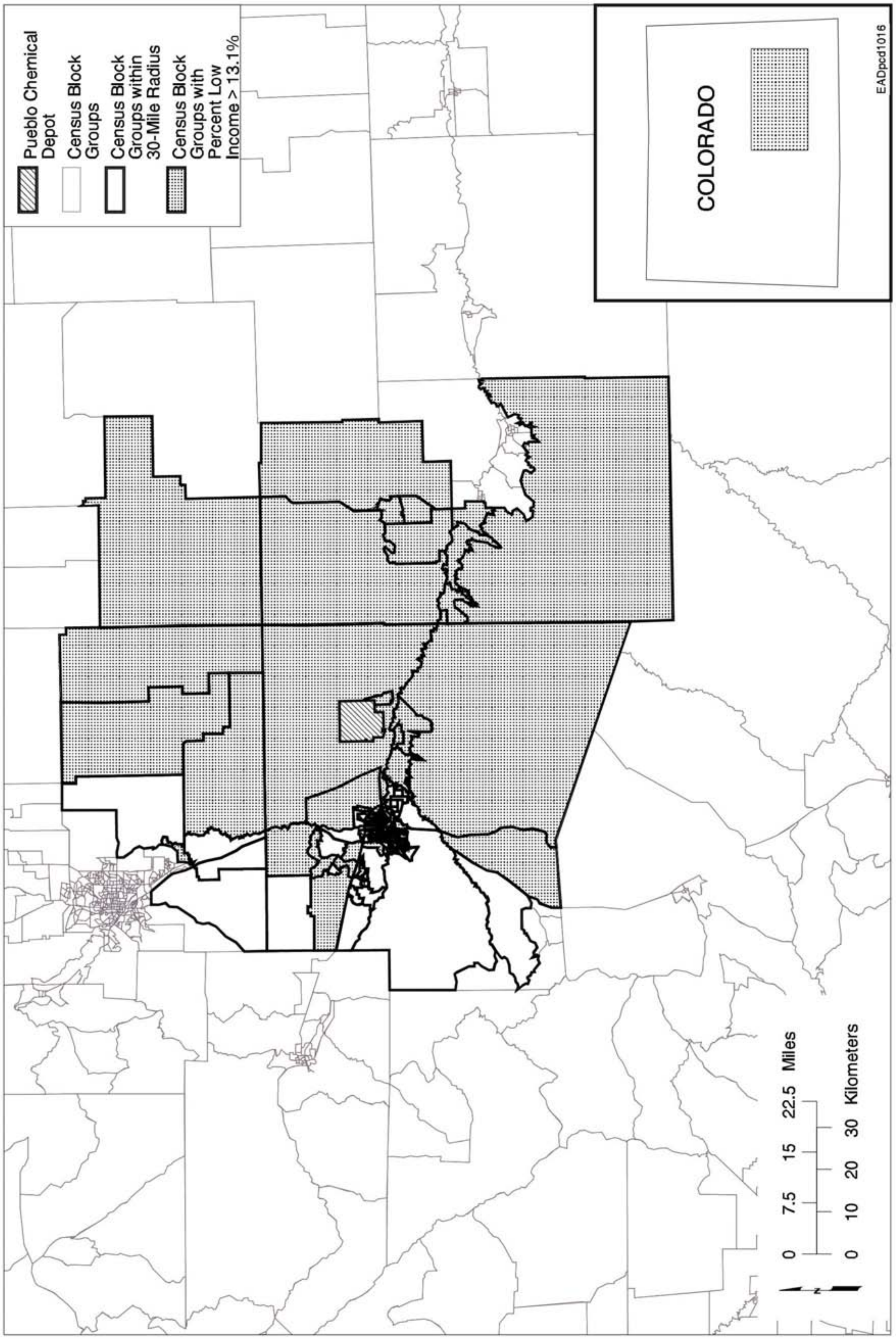

FIGURE 6.20-2 Census Block Groups surrounding PCD with Low-Income Populations Greater than the National Average in 1989 (Source: U.S. Bureau of the Census 1992c)

of 23,310 low-income persons in 1989. Block groups with a disproportionately high representation of low-income populations included the same four communities noted in the preceding paragraph, along with the small communities of Boone, Fowler, Olney Springs to the east of PCD, and Pueblo West to the west of PCD.

6.20.2 Site-Specific Factors

Factors considered in this EIS with potential implications for environmental justice are any activities associated with the ACWA program at PCD. Included are impacts associated with construction, operations, and accidents. The evaluation of environmental justice consequences focuses on socioeconomic and human health impacts, two categories that directly affect all people, including minority and low-income populations.

To address Executive Order 12898, this analysis focuses on impacts that are both high and adverse and that disproportionately affect minority and low-income populations. Although it seems logical that certain characteristics of many environmental justice populations — such as having limited access to health care and reduced or inadequate nutrition — might make such populations disproportionately vulnerable to environmental impacts, there do not appear to be any scientific studies that support this contention for the types of impacts considered in this EIS. The absence of such information precludes any analysis that considers increased sensitivity of minority and low-income populations to impacts. To help compensate for this limitation, the analysis of human health impacts includes conservative assumptions and uncertainty factors to accommodate for potentially sensitive subpopulations (see Section 6.7.2.2). The present analysis considers that a disproportional effect could occur only if the proportion of a population is in excess of the proportion in the United States as a whole, as discussed above under existing conditions. Therefore, significant environmental justice impacts are those that would have a high and adverse impact on the population as a whole and that would affect areas (Pueblo County or census block groups within 30-mi [50-km] of PCD) containing disproportionately high minority or low-income populations.

6.20.3 Impacts of the Proposed Action

6.20.3.1 Impacts of Construction

The primary socioeconomic impacts of construction under either alternative technology, discussed in Section 6.19.5.1, would be an increase in short-term employment and income. They would also include small increases in demand for local housing, schools, and public services. None of these impacts would be high or adverse; local governments and the existing housing stock should be able to accommodate increased demands, and the increased employment and income would be a positive consequence of construction. High and adverse impacts in other areas similarly would not be anticipated during construction of an ACWA facility at PCD (see Section 6.7.2.1). As a result, no environmental justice impacts are anticipated during construction.

6.20.3.2 Impacts of Operations

The primary socioeconomic impacts of operating an ACWA facility, discussed in Section 6.19.5.2 for both technologies, would be increases in employment and income. They would also include small increases in demand for local housing, schools, and public services. Once again, none of these impacts would be high or adverse; local governments and the existing housing stock should be able to accommodate increased demands, and the increased employment and income would be a positive consequence of construction. As a result, no environmental justice impacts are anticipated during operations.

As discussed in Section 6.7.2.2, occupational hazards to workers and releases of agents or other hazardous materials represent the main impacts that could occur during routine operations under both alternative technologies. However, the risk of a noncancer health effect and the risk of cancer from hazardous chemicals released during normal operations would be very low for both workers and the public. These impacts would not be high and adverse, and, as a consequence, no environmental justice impacts are anticipated during normal operation.

6.20.4 Impacts of No Action

As discussed in Section 6.19.6, socioeconomic impacts of continued operations at PCD would be small: primarily a continuation of small, positive economic impacts and a slight increase in demand for housing, schooling, and public services. None of these impacts would be considered high or adverse. Similarly, high and adverse human health impacts on either the workers at PCD or the general public are not anticipated (see Section 6.7.3). As a result, no environmental justice impacts are anticipated under the no action alternative.

6.21 ACCIDENTS INVOLVING ASSEMBLED CHEMICAL WEAPONS

6.21.1 Potential Accidental Releases

This analysis of accidents provides an estimate of the upper range of the potential impacts that might occur as a result of a hypothetical accident related to the proposed action (ACWA pilot testing) or related to the no action alternative (continued storage of the chemical weapons). The accidents selected for analysis were the accidents that were shown to have the highest risk in previous Army analyses (Science Applications International Corporation [SAIC] 1996). The highest-risk accidents are defined as those with the highest combined consequences (in terms of human fatalities) and probability of occurrence. For existing continued storage conditions and for operations, the highest-risk accidents would involve the release of chemical agent; release of other materials would result in lower consequences and risks. In general, the accidents considered in this EIS have a fairly low frequency of occurrence. The accident considered for continued storage (aircraft crash into a storage igloo) has an estimated frequency on the order of 1×10^{-6} per year (i.e., one occurrence in 900,000 years). The accident considered for the pilot facilities (earthquake impacting the unpack area) has a higher estimated frequency of approximately 5×10^{-5} (i.e., one occurrence in 21,000 years).

6.21.1.1 Scenarios

The hypothetical highest-risk accident for ACWA pilot testing assumes that an earthquake would cause the part of the unpack area where munitions are located to fall. The hypothetical highest-risk accident for continued storage assumes an aircraft would crash into a munitions storage igloo with a subsequent fire and the release of agent from all the munitions in the igloo. It is recognized that during operation of an ACWA pilot facility, the risk of a storage accident (as presented under the no action alternative in Section 6.21.3) is also present; however, in Section 6.21.2, the focus is on the consequences of accidents related to pilot testing in order to differentiate between facility risks and storage risks.

Impacts from accidents occurring during transport of agent from the storage igloos to the pilot testing facility were not assessed for this EIS, because the risks from these accidents would be less than those from the accidents included. Accident scenarios and probabilities from on-site transportation are discussed in a PEIS support document (GA Technologies 1987). Potential accidents from handling the munitions inside the igloos were considered, but, at PCD, these accidents are not the highest-risk accidents.

For the pilot facility accident scenario, data given in the PCD Phase I quantitative risk assessment for a baseline incineration facility (SAIC 1996) were used to estimate the maximum amount of agent that could be released during an earthquake. Both ACWA technology providers would use a modified baseline process for ACW access (General Atomics 1999; Parsons and Allied Signal 1999); therefore, it was assumed that the unpack area configuration would not deviate significantly from the baseline. For PCD, it was assumed that the maximum number of munitions in the unpack area would be the contents of four on-site containers (ONCs) containing 155-mm projectiles at the time of the crash. (This assumption results in the largest possible amounts of chemical agent present in the unpack area among the munition types present at PCD.)

ONCs are used to transport munitions at the Tooele Chemical Agent Disposal Facility, but the Army is investigating the feasibility of using modified ammunition vans. A change in the transport system used might also entail changes in the dimensions and capacity of the unpack area or a similarly functioning building or area. Such changes should not invalidate the impact estimates given here, because the assumption on number of munitions present in the unpack area was meant to represent a high-end estimate of the amount of agent that could be released in an earthquake. These accident impact estimates should be representative for either type of transportation system.

For the storage igloo accident scenario, it was assumed that an aircraft crash could release the entire contents of a storage igloo. The probability of such an event occurring is low (on the order of 10^{-6}), but it increases slightly with increasing length of continued storage. For this scenario, the maximum amount of agent at risk was obtained from estimates of the maximum amount of mustard agent stored in any single PCD igloo (DeMers 1999).

6.21.1.2 Methods of Analysis

Potential accidental releases of chemical agent to the atmosphere and the associated consequences of such releases were assessed by using the D2PC[13] Gaussian dispersion model (Whitacre et al. 1987). Two meteorological conditions were assumed in the modeling to assess accident impacts. E-1 conditions consist of a slightly stable atmosphere (stability class E) with light winds (1 m/s). D-3 conditions consist of a neutral atmosphere (stability class D) with moderate winds (3 m/s). E-1 conditions would produce conservative impacts for the assessed accident scenarios. They represent accidents that would occur during the night or during a relatively short period after sunrise. The D-3 conditions would result in more rapid dilution of an accidentally released agent than would E-1 conditions. D-3 conditions represent accidents that would occur during daytime. When D-3 meteorological conditions are assumed, the size of the estimated plume is smaller. In conducting D2PC modeling, it was assumed that no plume depletion by agent deposition would occur. This is a conservative assumption for estimating the area potentially affected by an accidental release, because assuming that more agent remains in the plume allows farther plume travel before concentrations are diluted below the toxicological endpoint levels. The D2PC model default mixing height assumptions were used for modeling. The D2PC model limits its application to accident release scenarios that could produce impacts at distances of less than or equal to about 30 mi (50 km).

For modeling mustard agent instantaneous releases, the “time after functioning” (TAF) parameter was assumed to be 20 hours. (The TAF was applicable only for accident modeling involving mustard agent instantaneous releases; it is defined as the time after detonation required to remove the agent source by decontaminating it or by containing it so it would no longer enter the atmosphere [Whitacre et al. 1987]).

---

[13] The Army has completed the development and validation of a new model (D2Puff). However, the new model is not accredited for use at all installations.

6.21.1.3 Exposures and Deposition

For each of the accident scenarios assessed, the impacts of agent release were modeled by using D2PC-generated plumes with dosages estimated to result in adverse impacts for a certain percentage of the human population exposed (i.e., LCt_{50} = dosage corresponding to 50% lethality; LCt_{01} = dosage corresponding to 1% lethality; no deaths = dosage below which no deaths are expected in the human population exposed; no effects = dosage below which no adverse impacts are expected in the human population exposed). The distances to which these various plumes were predicted to extend were used as the starting point for the analyses of impacts to the various resources of concern under the proposed action and no action alternatives, as detailed in Sections 6.21.2 and 6.21.3 below. These distances are summarized in Table 6.21-1. For reference, the minimum distance from the hypothetical accident locations (i.e., Munitions Storage Area A storage area or the unpack area within the proposed facility locations) to the PCD installation boundary is about 0.7 mi (1.1 km), and the distance to the on-site administrative area is about 4 mi (6.4 km). For all the hypothetical accidents assessed, the no effects plume contour extends into off-post areas and out (i.e., extending from 4 to 30 mi [7 to 50 km]). The extent of the no deaths contour varies from 0.4 to 30 mi (0.6 to 50 km), depending on the meteorological conditions assumed.

6.21.2 Impacts of Accidents during the Proposed Action

6.21.2.1 Land Use

Impacts from an accidental agent release during operation of an ACWA pilot test facility would generate serious negative impacts on land use outside the installation, including the death and quarantine of livestock, interruption of agricultural productivity, and disruption of local industrial activities (see Section 6.21.2.9). Although capable of generating serious negative consequences, the likelihood of such an accident is extremely remote, consequently producing a very low overall risk.

6.21.2.2 Waste Management and Facilities

Hazardous Waste. The highest-risk accident scenario for ACWA pilot testing activities is an earthquake impacting the unpack area. Waste generated under this scenario would be primarily soil and debris contaminated from the dispersion of agent. An undeterminable amount of contaminated wastes could be produced by cleanup of a spill or accident involving dispersion of agent. Spill and emergency response plans and resources would be in place to contain, clean up, decontaminate, and dispose of wastes according to existing standards and regulations.

TABLE 6.21-1 HD Plume Distances Resulting from Accidents at an ACWA Pilot Test Facility (Proposed Action) or in Munitions Storage Area A (No Action) at PCD[a]

Effect	Impact Distance, mi (km)[b]	Exposure Dose (mg-min/m^3)[c]	Impact Area	
			km^2	acres
Proposed action, D-3 (i.e., earthquake impacts; unpack area)				
1% lethality	0.31 (0.50)	150	0.03	7.4
No deaths	0.38 (0.62)	100	0.04	9.9
No effects	4.0 (6.5)	2	2.7	670
Proposed action, E-1 (i.e., earthquake impacts; unpack area)				
1% lethality	1.2 (1.9)	150	0.18	44
No deaths	1.5 (2.4)	100	0.27	67
No effects	>30 (>50)	2	52	13,000
No action, D-3 (aircraft crash into Munitions Storage Area A igloo)				
1% lethality	2.4 (3.9)	150	1.1	270
No deaths	3.1 (5.0)	100	1.7	420
No effects	>30 (>50)	2	200	49,000
No action, E-1 (aircraft crash into Munitions Storage Area A igloo)				
1% lethality	15 (24)	150	13	3,200
No deaths	23 (36)	100	26	6,400
No effects	>30 (>50)	2	140	35,000

[a] Distances and plume areas in table are from D2PC output. Meteorological conditions of either D stability and 3-m/s wind speed or E stability and 1-m/s wind speed and a “time after functioning” of 20 hours (for instantaneous mustard releases) are assumed.

[b] Impact distances downwind of accident that would have 1% lethality, no deaths, or no effects on humans (see Table 6.21-2).

[c] Dosage for duration of accident at specific impact distance. The dosages correspond to default values used in the D2PC code (Whitacre et al. 1997).

Chemical agents are listed in the Colorado hazardous waste regulations (6 CCR 1007-3, Section 261.33(e)). If an accident that would involve a listed hazardous waste were to occur, any contaminated residue, soil, water, or other debris resulting from the cleanup of that agent would also be considered a listed hazardous waste (6 CCR 1007-3, Section 261.3).

Pursuant to Colorado hazardous waste regulations, debris contaminated with a listed hazardous waste may be exempt from regulation as hazardous waste if a demonstration test shows that the waste does not exhibit any hazardous characteristics or if the CDPHE determines, considering the extent of contamination, that the debris is no longer contaminated with hazardous waste (6 CCR 7-1001, Section 261.3(f)). “Debris” is defined as solid material exceeding a 60-mm particle size; it includes manufactured objects, plant or animal matter, and natural geologic material. A mixture of debris and other material is subject to regulation as debris if a visual inspection indicates that the mixture is composed primarily of debris, by volume.

For contaminated soil or water that does not meet the definition of debris, the Army can consider filing a petition to delist the contaminated medium if a demonstration test shows that the waste does not contain the constituent that caused the CDPHE to list the chemical agent or if the hazardous constituent in the medium does not meet the criteria when the factors used by the CDPHE to list the chemical agent (6 CCR 7-1001, Section 206.22) are considered.

Nonhazardous Waste. Considering the particular accident conditions and pursuant to demonstration, the Army might be able to dispose of some or most of the cleanup material as nonhazardous waste in a local landfill.

6.21.2.3 Air Quality

Depending on the amount, an accidental release of HD agent at PCD during operation of an ACWA pilot test facility could have short-term but very significant adverse impacts on air quality, in terms of human injuries and fatalities (see Section 6.21.2.4). However, deposition of agent from air onto the ground surface and/or degradation in the environment would occur within a relatively short period of time. HD decomposes in air relatively quickly; its half-life is about 1.4 days (see Appendix A). Therefore, long-term (e.g., more than a few days after release) adverse air quality impacts would not be expected from an accidental release of HD.

6.21.2.4 Human Health and Safety

For each of the accident scenarios assessed, the impacts of agent release were modeled by using plumes with dosages estimated to result in death for a certain percentage of the population exposed (i.e., LCt_{50} = dosage corresponding to 50% lethality; LCt_{01} = dosage corresponding to 1% lethality; no deaths = dosage corresponding to 0% lethality). The assumption was made that for any accident, the wind would be toward the direction where the largest number of people live. By using site-specific population data, the potential numbers of fatalities for each accident were estimated. Further details on the methods used to estimate number of fatalities are given in Appendix H. This evaluation did not specifically estimate the numbers of nonfatal injuries that would occur for each accident scenario, because there would be great variation in the number and severity of nonfatal injuries, depending on exposure concentration and duration and depending on variations in the populations exposed.

The population at risk at PCD (i.e., persons residing within a 30-mi [50-km] radius of the post) is about 180,000 people. The accident scenario of an earthquake impacting the unpack area would apply to both the Neut/Bio and Neut/SCWO alternatives during processing. This accident scenario would result in a 1% lethality distance of 1.2 mi (1.9 km), when E-1 meteorological conditions are assumed. (Table 6.21-2). The corresponding estimated number of fatalities among the general public would be zero. The estimated number of fatalities for the on-post population would also be zero. In addition, if such an accident occurred under D-3 meteorological conditions, the 1% lethality distance would decrease to 0.31 mi (0.50 km), and the estimated number of fatalities for both the general public and the on-post population would be zero.

Fewer than five individuals occupy the nearest residence just beyond the northern boundary of PCD, a distance of about 1 mi (1.6 km) from the nearest alternative pilot facility location and from the nearest storage igloo. This residence has been an important part of the community and PCD emergency planning efforts. PPE, including suits and gloves, and powered air-purifying respirators (PAPRs) are in place for six individuals to use, if necessary, during safe evacuation or shelter-in-place. These safety precautions should prevent injury to the residents at that location in the event of an accident. However, if an accident were to occur, the individuals might not be able to take protective action quickly enough to prevent injury or death.

The TTC located at the northern boundary of the site employs approximately 230 individuals. The structures on the TTC site are near the central-eastern area, about 5 mi (8 km) from the PCD site boundary. If the wind were blowing toward the TTC at the time of an accident involving an earthquake (proposed action), the no effects plume could extend to 4.0 mi (6.5 km) from the release location under worst-case meteorological conditions (see Table 6.21-1). Therefore, it is unlikely that fatalities or injuries would occur among TTC employees unless some of them were much nearer to the PCD boundary at the time of the earthquake accident.

The plume distance for the earthquake accident scenario does not extend to off-site locations. Therefore, no special consideration of potentially sensitive subpopulation exposures is required for this scenario.

For the human health impacts assessment, an internally initiated accident was also modeled (i.e., an accident caused by equipment failure or human error at the pilot facility). The internally initiated accident that was modeled involved a rupture in the 500-gal (1,900-L) agent holding tank or the connecting piping in the MDB that could result in the release of the tank's entire contents. For such an accident, it was found that the amount of mustard released from the facility stacks via the building's heating, ventilation, and air conditioning (HVAC) system would be negligible, because mustard is relatively nonvolatile and because the room where the leak would occur is relatively small and would contain the agent, providing only a limited surface area for agent evaporation. In addition, the facility's pollution abatement system should capture most or all of the agent that might evaporate from the spill.

TABLE 6.21-2 Fatality Estimates for Potential Accidents Involving HD Release at PCD[a]

Accident Scenario[b]	Distance (mi) To LCt_{50} Dose	Distance (mi) To LCt_{01} Dose	Distance (mi) To No Deaths Dose	On-Post Population at Risk (no. of persons)[c] Source to LCt_{50}	On-Post Population at Risk (no. of persons)[c] LCt_{50} to LCt_{01}	On-Post Population at Risk (no. of persons)[c] LCt_{01} to No Deaths	Maximum Estimated Fatalities for On-Post Population[d]
Continued storage highest-risk accident (applicable to no action and proposed action)							
Aircraft crash into storage area with fire: D-3	1.0	2.4	3.1	0	6	2	2
Aircraft crash into storage area with fire: E-1	4.8	15	23	200	80	0	170
Facility highest-risk accident (applicable for proposed action, Neut/SCWO or Neut/Bio)							
Earthquake impacting unpack area: D-3	0.16	0.31	0.38	0	0	0	0
Earthquake impacting unpack area: E-1	0.54	1.2	1.5	0	0	2	0

Accident Scenario[b]	Off-Post Public Population at Risk (no. of persons)[c] Source to LCt_{50}	Off-Post Public Population at Risk (no. of persons)[c] LCT_{50} to LCt_{01}	Off-Post Public Population at Risk (no. of persons)[c] LCT_{01} to No Deaths	Maximum Estimated Fatalities for Off-Post Population[d]
Continued storage highest-risk accident (applicable to no action and proposed action)				
Aircraft crash into storage area with fire: D-3	0	0	0	0
Aircraft crash into storage area with fire: E-1	1	970	10,871	298
Facility highest-risk accident (applicable for proposed action, Neut/SCWO or Neut/Bio)				
Earthquake impacting unpack area: D-3	0	0	0	0
Earthquake impacting unpack area: E-1	0	0	0	0

[a] Scenarios are highest-risk accidents for pilot facilities and for continued storage (no action).

[b] D-3 corresponds to meteorological conditions of D stability with 3-m/s wind speed, and E-1 corresponds to conditions of E stability with 1-m/s wind speed. All accidents are assumed to occur with the wind blowing toward the location of maximum public or on-post population density.

[c] Population at risk indicates the number of individuals working (for on-post populations) or residing (for off-post populations) within the area encompassed by the plume. LCt_{50} value used was 600, assuming a 25-L/min breathing rate (SAIC 1996; Goodheer 1994; Burton 2001). LCt_{01} and no deaths values were defaults from D2PC code (Whitacre et al. 1987), as given in Table 6.21-1. LCt_{50} value proposed by National Research Council (1997b) of 900 for HD (for 15-L/min breathing rate) was not used in this assessment; this value has not been formally approved for use by the Army.

[d] Total fatalities were calculated by assuming (1) a fatality rate of 75% in the area between the point of agent release and the 50% lethality dosage contour, (2) a fatality rate of 25% in the area between the 50% lethality dosage contour and 1% lethality dosage contour, and (3) a fatality rate of 0.5% in the area between the 1% lethality dosage contour and no deaths dosage contour.

The assessment did not find any difference between the technology systems with respect to accident impacts during pilot facility operations. This finding is attributable to the fact that acute health risks are mainly determined by the quantity of agent released in an accident (the source term). Once neutralization would occur inside the pilot facility, the acute health risks associated with an accidental release of process by-products (e.g., hydrolysate solution) would be negligible in comparison with the risks associated with the release of an agent. Because the alternative technologies would operate at similar throughput rates, with similar total amounts of agent present at the front end of the process (in the unpack area and during munitions disassembly), the assumed source terms from the bounding accidents would be the same.

The main potential differences in accidents involving releases of agent for the different technology systems being tested would be related to the method used to access agent and explosives in the munitions. Cryofracture would be used for separation of energetics in some processes, and the reverse assembly process would be used in others. Assessments of the consequences of accidents involving these separation processes are not presented because the impacts would be substantially smaller than those of the other externally and internally initiated events considered. Also, the currently available vendor design data do not indicate any differences in the two processes that would result in substantially different consequences from those that would result from an accidental release of agent during munitions disassembly.

The Neut/Bio process uses seven process chemicals: sodium hydroxide, sulfuric acid, hydrogen peroxide, ferrous sulfate, liquid nitrogen, aqueous ammonia, and dextrose. The Neut/SCWO process uses five major process chemicals: sodium hydroxide, phosphoric acid, kerosene, liquid oxygen, and liquid nitrogen. Several of the chemicals used in both technologies are flammable or reactive (e.g., sodium hydroxide, sulfuric acid, kerosene), and several exhibit irritant properties through inhalation or dermal contact. However, all are common industrial chemicals with well-established handling procedures and safety standards. According to PMACWA (1999), "the risk from gaseous emissions of these chemicals is minimal, but more work is needed to demonstrate the effectiveness of the containment design in the event of an accidental ignition of energetics during processing." The effectiveness of the containment design is being further addressed by the ACWA technology providers in engineering design studies.

6.21.2.5 Soils

Under the accident scenarios considered for ACWA pilot testing activities at PCD, contamination of surface soils could extend over an area beyond the installation boundaries. Given the nature of the accidents, it is assumed that mustard agent would be widely deposited downwind on surface soils as fine particles or droplets. Fine particles of mustard agent would rapidly degrade (Munro et al. 1999; see Appendix A). In extended cold weather (e.g., freezing temperatures), after about two weeks, the mustard would be present at only negligible levels of less than 0.0001% of the original deposition, and after about 3.5 months (2,215 hours), all of the mustard would be gone.

Near the agent release, pools or larger pieces of mustard (depending on the temperature) might be deposited. However, this mustard, which would degrade more slowly than fine particles, would be removed during cleanup operations and would not have a long-term impact on the surface soils. Contaminated soils excavated during cleanup would be disposed of in accordance with applicable requirements.

6.21.2.6 Water Resources

The mustard deposited on the soil after an earthquake accident would be deposited as fine particles, and no large volumes of mustard would be deposited downwind of the accident site as solid mustard. Near the impact site, pools or pieces of mustard (depending on the temperature) might be present. This mustard would be removed during cleanup operations and would not pose a long-term threat or be a source of water contamination.

The fine mustard particles on the soil surface downwind of the accident would dissipate quickly. Under cold conditions, the mustard might be present for as long as 2,000 hours (3 months). However, even under cold conditions, within two weeks, the amount present would be negligible, less than 0.0001% (Munro et al. 1999) of the original deposition. Under warmer conditions, the mustard would dissipate within a few days of deposition. These estimates are based on tests of mustard droplets on the surface. Because the mustard particles deposited downwind of the accident would be very small, it is expected that the mustard would dissipate in less time than predicted in these estimates.

Transportation of mustard by surface runoff or subsurface flow would be minimal. At 33°F (0.6°C) (30-h half-life), only 0.01% of the mustard would remain after about 16 days (400 hours). At 77°F (25°C) (4- to 8-min half-life), concentrations would be reduced by the same amount in only 80 min (1.3 h) (Munro et al. 1999). Surface runoff might mobilize the fine mustard droplets present on the soil surface, but the turbulent water would hydrolyze this mustard rapidly. To be transported into the subsurface by infiltrating water, the mustard would need to be dissolved, and, once dissolved, it would hydrolyze rapidly. Under cold conditions, which allow for the longest hydrolization half-life of approximately 30 hours, the mustard would be transported less than 100 ft (30 m) in groundwater before decomposing. Saturated hydraulic conductivity ranges from 0.4 to 400 ft/d (0.1 to 120 m/d), so mustard could reach the groundwater under cold conditions. At 77°F (25°C), there would be little chance for any mustard to reach the groundwater table. Estimated groundwater velocity ranges from 0.02 to 3 ft/d (0.006 to 0.9 m/d), with a median value of 0.8 ft/d (0.24 m/d) (Section 6.11.1.1). In 30 days, with the water at 33°F (0.6°C), the concentration of mustard would be only 0.00001% of the initial concentration, and the mustard would travel only 0.6 to 90 ft (0.2 to 27 m) from the source in the groundwater. At 77°F (25°C), it would take only 100 min for the mustard concentration to reach the same reduced level, and the mustard would travel less than 1 ft (30 cm). In addition, initial concentrations reaching the groundwater would be relatively low because of degradation and dilution in the vadose zone.

It is very unlikely that conditions would exist to allow impacts on the water supply wells. If the water were cold and an appropriate rainfall event occurred immediately after the accident, groundwater supply wells within the 1% lethality contour (including those immediately adjacent to Munitions Storage Area A) might conceivably be minimally affected for a short time following an accident, but this result would be unlikely. Impacts on other groundwater resources would be none to negligible. Moreover, groundwater resources off the installation would not be affected.

Impacts on the Spring Fed Pond on Boone Creek would be short-lived. Concentrations would rapidly decrease as a result of degradation and dilution and would be reduced to 0.01% of the initial concentrations within 80 min at 77°F (25°C) and within 16 days at 33°F (0.6°C).

It is unlikely that mustard would reach the Spring Fed Pond because it would be diluted by overland flow, but, if it did, impacts would be minimal and short-lived. Surface runoff might contain some mustard when it reached the pond. But within a few hours to a day, depending on the temperature, these concentrations would be negligible. Dilution from the overland flow and mixing in the pond would also reduce the initial concentration of mustard reaching the pond. In addition, for any appreciable amount of mustard to reach the pond from overland flow, a rainfall event large enough to produce surface runoff, but small enough to not significantly dilute the dissolved mustard, would have to occur within a few hours of the accident.

Impacts on other surface streams and rivers (other than the Spring Fed Pond on Boone Creek) in the area would be none to negligible and short-lived. Degradation times for surface water would be the same as those discussed above for groundwater. Surface water that reached the Arkansas River, which is approximately 5 mi (8 km) away, would have only negligible amounts of mustard remaining because of degradation and significant dilution.

The mustard degradation product TDG, if present at all, would occur at very low concentrations in either surface or groundwater resources. Because of the relatively low toxicity of TDG and its low concentration, impacts of mustard degradation products on all water resources would be none to negligible.

6.21.2.7 Biological Resources

Accident analyses were conducted for a scenario that involved an earthquake causing munitions in part of the unpack area to fall. Ecological impacts from a major accident associated with operation of an ACWA pilot test facility were assessed on the basis of atmospheric concentration estimates made by using the D2PC model (Whitacre et al. 1987). Model output was used to conduct impact analyses for vegetation, wildlife, aquatic habitats and fish, protected species, and wetlands.

Terrestrial Habitats and Vegetation, Wildlife, and Aquatic Habitats and Fish. On the basis of the limited qualitative reports on the phytoxicity studies of mustard, it is not possible to provide an approximate area of impacts for acute exposure of terrestrial plants caused by an accidental release of mustard. In all likelihood, an accidental release of mustard would cause a certain degree of defoliation and retarded germination downwind from the accident location (Opresko et al. 1998). However, hydrolysis of mustard would probably occur quickly after deposition on plant surfaces and soils (see Appendix A). Model runs for an earthquake during mustard processing under D-3 (daytime) meteorological conditions showed an average mustard deposition area of 3 ha (7.4 acres) in the 1% human lethality area that extends to 0.31 mi (0.50 km) downwind of the accident site (see Table 6.21-1).

The deposition plume areas would be elliptical in shape and would occur mostly downwind of an accident. The location and geometry of the plume areas would vary, depending on the atmospheric stability and wind direction at the time of an accident. At PCD, the prevailing winds that would result in the greatest consequences from an accident would be from the north and northeast. A release of HD would thus have a higher probability of affecting ecosystems located south and southwest of the test facility. However, the release could presumably affect ecosystems in any direction, depending on the direction and speed of the wind at the time of the accident. Because of the limitations of the D2PC model, the size of habitat potentially exposed to agent cannot be reasonably approximated.

A screening-level ecological risk assessment was conducted to determine impacts of the bounding accident on three common mammalian species observed in shortgrass prairie and northern sandhill prairie habitats on northern portions of PCD. Species were the pronghorn antelope, Ord’s kangaroo rat, and the black-tailed prairie dog. No benchmark values were found for exposure of birds, reptiles, and amphibians to mustard (HD).

Risks to ecological receptors from the accident were characterized by using the hazard quotient (HQ) approach. The HQ is the ratio between the air concentration of a contaminant (i.e., HD) and a contaminant-specific benchmark concentration representing a no observed effect exposure concentration on the basis of results from laboratory studies. HQs were calculated on the basis of inhalation benchmark values developed for use in ecological risk assessments of wildlife exposed to combustion products at Anniston Army Depot (U.S. Army Center for Health Promotion and Preventive Medicine [USACHPPM] 1999a). The HQ values can vary from zero to infinity. Values greater than one show a potential risk to the ecological receptor from the exposure. It is important to note that HQ values greater than one indicate only the potential for adverse risks (or effects) to individual animals and not actual impacts on them. Actual impacts would depend on many factors, such as the length of exposure to an HD plume, the air concentration, and species sensitivities to various atmospheric concentration levels. HQ values were based on air concentrations estimated by the D2PC model under the air stability expected during typical nighttime conditions (wind speed of 1 m/s) and daytime conditions (wind speed of 3 m/s). Benchmark values were adjusted for differences in inhalation rates on the basis of the body mass of the three species examined. Distances from the source of release due to an earthquake were determined for HQ values of less than one on the basis of D2PC model output for both the “no observed adverse effects level” (NOAEL) and “lowest observed adverse effects level" (LOAEL) exposures (Table 6.21-3). Details of the HQ calculations are provided in Tsao (2001b).

A comparison of the NOAEL for the three mammalian species was made for scenarios involving an earthquake causing munitions in part of the unpack area to fall. HQ values for NOAEL would be less than one for all three species at distances ranging from 6.2 to 6.8 mi (10 to 11 km) from the accident site (see Table 6.21-3). All wildlife species evaluated would be less sensitive than humans on the basis of calculated NOAEL distances in comparison with a no effects distance for humans ranging from 4.0 to >30 mi (6.5 to >50 km) (see Table 6.21-1).

Acute effects from an accidental release would occur quickly after exposure. Exposures of wildlife to HD at a distance of 6.8 mi (11 km) downwind from the accident site would result in mortality, particularly to those species with small home ranges such as small mammals, reptiles, and amphibians that would remain in the HD exposure plume during the accident. Mammals that did survive within this distance would suffer from blistering of the skin, irritation to the respiratory system, eye irritation, and other chronic effects known to occur to humans and laboratory animals (Appendix B in Army 1988).

TABLE 6.21-3 Distance from Accident Site That Would Result in No or Lowest Adverse Effects on Wildlife for Proposed Action at PCD[a]

	Distance (mi) with Hazard Quotient of <1[b]			
	Daytime Conditions		Nighttime Conditions	
Species	LOAEL[c]	NOAEL[d]	LOAEL[c]	NOAEL[d]
Ord's kangaroo rat	1.2	1.2	3.1	4.3
Pronghorn antelope	0.56	1.2	1.9	3.1
Black-tailed prairie dog	1.2	1.9	3.1	4.3

[a] Scenario is an earthquake causing munitions to fall at the unpack area.

[b] Hazard quotient = (dose at a given distance from the source) divided by (benchmark value of HD for receptor species). The concentration is obtained by using the D2PC model and assuming a wind speed of 3 m/s during daytime conditions and 1 m/s during nighttime conditions and a plume exposure duration of 20 min.

[c] LOAEL = lowest observed adverse effects level; the maximum distance from the site at which an adverse effect would be expected to occur.

[d] NOAEL = no observed adverse effects level; the distance from the site beyond which no adverse effects would be expected to occur.

No data were found on the uptake of HD through ingestion under field conditions. Some uptake of HD deposited on vegetation, particularly within a distance of 6.8 mi (11 km) downwind of the release, could occur by herbivores during the first few days after the accident. Hydrolysis of HD would likely occur during the first one to two days after the accident, resulting in various degradation products. No data were found on exposures of wildlife to HD degradation products under field conditions. A recent article that reviews the toxicity of CWA degradation products suggested that TDG could persist in soils following an accidental release (Munro et al. 1999). Laboratory exposures of rats for 90 days to various levels of TDG resulted in a NOAEL of 500 mg/kg/d. Even if all HD degraded to TDG (low likelihood of occurrence) within the deposition area, it would be highly unlikely that a herbivore would receive a dose through the food pathway that would be above the NOAEL reported for laboratory rats (Munro et. al. 1999).

Aquatic organisms inhabiting the Spring Fed Pond on Boone Creek, southeast of Munitions Storage Area A, would likely die from initial exposure to HD. Within a relatively short period, HD would hydrolyze and not persist within the water column. Some impacts on aquatic invertebrates and fish could occur in Lynda Ann Reservoir, AWS Pond, and Chico Creek following the accident. The extent of impacts on aquatic organisms would depend on the sensitivities of individual species, the aerial concentration and deposition of HD, and how quickly breakdown would occur. HD would hydrolyze in water bodies more rapidly during windy conditions, when more turbulence typically occurs at the water surface.

The long-term impacts on terrestrial and aquatic ecosystems from an accident releasing mustard are likely to be minimal. The persistence of HD and HT in soil and on vegetation is estimated to range from one day to about one week (ATSDR 1992). The high reactivity of HD with water suggests that biouptake and biomagnification in local ecosystems would be unlikely. Within a plant’s vascular system, hydrolysis would likely result in the breakdown of HD before it became concentrated in plant tissues (ATSDR 1992).

The area that would be affected by an earthquake that would cause munitions to fall at an unpack area (proposed action alternative) would be smaller than the area that would be affected by a release of HD caused by an aircraft crashing into a storage igloo (i.e., the no action alternative).

Protected Species. The impacts on protected species would be very similar to those on mammalian species as presented in the previous subsection. Because of the scarcity and distant locations of federal and state protected species from the accident location, impacts on this group of species would be less than those on other terrestrial wildlife. The concentration distances projected by the D2PC model used for short-term accident analysis for protected species are the same as those used for wildlife analysis (i.e., plume area is elliptical in shape and would occur mostly downwind of the accident). The location and geometry of the plume areas would vary, depending on the atmospheric stability and wind direction at the time of an accident. Thus, the accident could presumably affect ecosystems in any direction, depending on the wind direction and speed at the time of an accident.

A qualitative discussion of the impacts on the federal and state protected species and the rare plant communities are discussed below. These species included terrestrial vertebrates (Preble's meadow jumping mouse and mountain plover), aquatic biota (plains minnow and a northern leopard frog), and a reptile (massasauga). The risks are characterized qualitatively because the results of a screening-level ecological risk assessment were not available at the time of writing. Information will be updated when available.

Terrestrial Vertebrates: Preble's Meadow Jumping Mouse, Black-Tailed Prairie Dog, Burrowing Owl, Ferruginous Hawk, Mountain Plover, Black Tern, and Loggerhead Shrike. Accidents that occur at night would be more severe than accidents that occur during the day time because of the meteorological influence typical of nighttime conditions. Nevertheless, the short-term impacts on terrestrial vertebrates would be severe, but the long-term impact would be minimal because of the short half-life of mustard.

Aquatic Vertebrates: Southern Red-Belly Dace, Plains Minnow, Plains Leopard Frog, and Northern Leopard Frog. Some short-term impacts on the aquatic species could occur; however, the long-term impacts would be minimal. Mustard would hydrolyze and would not persist in the water column.

Aquatic Invertebrates. No federal and state protected invertebrates have been located on PCD. Therefore, there would be no adverse impacts on this biological category.

Reptiles: Massasauga. No toxicity study of the effects of mustard on reptiles was available. However, impacts on the massasauga could occur. The long-term impact would be minimal because of the short half-life of mustard.

Designated Rare Terrestrial Plant Communities. The rare plant communities near the location of the accident (Table 6.16-1) would be exposed to mustard. However, hydrolysis of mustard would probably occur quickly after deposition on plant surfaces and soils downwind from the accident (see Appendix A).

Wetlands. Wetlands near the site of the accident would be exposed to mustard. Plant species exposed to mustard downwind of the accident would not be likely to become contaminated to a large extent because of the tendency of mustard to break down relatively quickly by hydrolysis.

6.21.2.8 Cultural Resources

The occurrence of an accident, either during the proposed action or no action, could result in impacts on cultural resources within the area exposed to agent. The building materials used in historic structures or the exposed surfaces of archaeological sites could become contaminated during an accident. At a minimum, public access to these historic properties would be temporarily denied until contamination was degraded by exposure to light and moisture or by active decontamination.

For the hypothetical accident assessed here, only temporary impacts (i.e., access restrictions) would be expected on cultural resources located outside the maximum radial distance for no effects of 30 mi (50 km) (see Table 6.21-1). Access restrictions could last for a few days or longer, depending on the degree of contamination and the length of time required to certify that access to these properties could again be permitted. It is expected that low levels of mustard agent contamination would degrade in a few hours under certain conditions, while larger quantities might take several weeks to degrade.

Significant historic properties located within 30 mi (50 km) of the accident (see Appendix H) could be affected by temporary but extended restriction periods until the contaminant was degraded by light and moisture. If the contaminant was deposited as a liquid, the Army might require that the properties of concern undergo various decontamination procedures before they could be released for access by the public. These decontamination procedures could potentially damage the property. However, deposition of liquid agent in quantities that would require decontamination procedures that could damage or destroy cultural resources would most likely be confined to the pilot test facility or storage site where significant cultural properties are already mitigated (i.e., Munitions Storage Area A Historic District) or where none exist. Extended public access restrictions, lasting until the contaminant dissipated, would be the most likely measure for preserving culturally significant properties.

6.21.2.9 Socioeconomics

The accidental release of chemical agent at PCD would have the potential to affect the socioeconomic environment through two means. First, changes might occur in the demand for crops and livestock produced within a 30-mi (50-km) radius around the facility. Second, evacuation of employees from work places might be required. For the bounding case scenarios for both the proposed action (earthquake) and the no action alternative (aircraft crash into a munitions storage igloo), agent release could result in adverse socioeconomic impacts within 30 mi (50 km) of PCD (as indicated by the extent of the no effects plume under E-1 meteorological conditions; see Table 6.21-1).

Agriculture. The most significant impact of an accident on agriculture would be if all crops and livestock produced in a single season were interdicted (either by federal or state authorities) and removed from the marketplace. Although the impacts from losses in agricultural output on the economy of the counties within the 30-mi (50-km) radius surrounding PCD in this scenario would be significant (Table 6.21-4), it is unlikely that the severity of these losses would be any different for the no action and the proposed action alternatives.

TABLE 6.21-4 Socioeconomic Impacts of Accidents at PCD Associated with the Proposed Action and No Action[a]

Parameter	Neut/SCWO	Neut/Bio	No Action
Impacts from a one-year loss of agricultural output			
100% loss of agricultural output			
Employment (no. of jobs)	4,450	4,450	4,450
Income (millions of $)	200	200	200
75% loss of agricultural output			
Employment (no. of jobs)	3,340	3,340	3,340
Income (millions of $)	150	150	150
50% loss of agricultural output			
Employment (no. of jobs)	2,220	2,220	2,220
Income (millions of $)	100	100	100
Impacts from a single-day evacuation of businesses			
100% of economic activity affected			
Sales (millions of $)	22	22	22
Employment (no. of jobs)	63,000	63,000	63,000
Income (millions of $)	15	15	15
75% of economic activity affected			
Sales (millions of $)	16	16	16
Employment (no. of jobs)	47,000	47,000	47,000
Income (millions of $)	11	11	11
50% of economic activity affected			
Sales (millions of $)	11	11	11
Employment (no. of jobs)	31,000	31,000	31,000
Income (millions of $)	8	8	8

[a] Impacts from no action and the proposed action are presented for the first year of operation of an ACWA facility (2009).

Businesses and Housing. The evacuation of businesses as a result of an accident at PCD would probably only be temporary. However, disruption to the economy in the area likely to be evacuated (the CSEPP Protective Action Zone [PAZ] surrounding PCD, consisting of Pueblo County) could be significant. In the worst-case scenario, all business sales and employee income in the PAZ would be lost as a result of the evacuation. An evacuation that might be required after an accident might last many days; since the exact duration of an evacuation could not be determined, the consequent overall effect on local economic activity could not be determined either. The impacts from a temporary, single-day evacuation of businesses in the PAZ are shown in Table 6.21-4. The data in the table may be used to estimate the impacts from an evacuation over a multiple-day period.

Since it is likely that the presence of chemical agent and the risk of accidents at the site are already captured in housing values in the vicinity of the site, an accident would probably not create significant additional impacts on the housing market unless residents were prevented from quickly returning to their homes.

6.21.2.10 Environmental Justice

For a scenario of an earthquake impacting the unpack area, agent release could result in high and adverse impacts within 30 mi (50 km) of PCD (as indicated by the extent of the no effects plume under E-1 meteorological conditions; see Table 6.21-1). The bounding accident maximum distance would be the same under both alternative technologies and the no action alternative. In such a situation, minority and low-income populations could suffer fatalities and serious injuries disproportional to their representation in the United States as a whole, if the wind direction at the time of the accident put the agent plume in the direction of census tracts with high numbers of minority or low-income populations (see Section 6.20.1 for identification of these census tracts). Such severe human health impacts would have similarly high and adverse socioeconomic consequences for Pueblo County, including the removal of some of the work force and the interruption of agricultural activity (see Section 6.21.2.9). However, such accidents have a very low frequency of occurrence, on the order of 5×10^{-5} per year (i.e., one occurrence in 21,000 years), so the risk of the resultant disproportionate impacts would be very low; such impacts are not anticipated.

6.21.3 Impacts of Accidents during No Action (Continued Storage)

6.21.3.1 Land Use

Land use impacts from accidents under the no action alternative would be the same as those discussed under the proposed action (Section 6.21.2.1).

6.21.3.2 Waste Management and Facilities

Waste management impacts from accidents under the no action alternative would be the same as those discussed under the proposed action (Section 6.21.2.2).

6.21.3.3 Air Quality

After an accidental release of mustard agent from a storage igloo at PCD, deposition of agent from air onto the ground surface and/or degradation in the environment would occur within a relatively short period of time (see Section 6.21.2.3). Therefore, long-term (e.g., more than a few days after release) adverse air quality impacts would not be expected from an accidental release of HD.

6.21.3.4 Human Health and Safety

The U.S. Army and Federal Emergency Management Agency (FEMA) routinely conduct CSEPP exercises, in coordination with the communities surrounding PCD and with their participation. These exercises are required under a 1988 memorandum of understanding (MOU) between FEMA and the Army. Because chemical agent is currently stored at the PCD site, some risk from accidents is already present. For example, agent could be released if a pallet were accidentally dropped during daily operations (i.e., maintenance and inspection). The most probable event would be that the pallet would be dropped from 4 feet, the average height that a pallet could be dropped during normal operations. This event would involve three rounds of munitions spilling their contents onto the igloo floor. Emergency response preparation for potential accidents of this type (e.g., maximum credible events for daily operations during normal PCD operations) is routinely evaluated under CSEPP (Freil 1997).

The human health consequences from the hypothetical accident scenario (an aircraft crash into a storage igloo) were estimated in terms of the numbers of fatalities. Under E-1 meteorological conditions, this scenario resulted in a 1% lethality distance of about 15 mi (24 km), 298 fatalities in the general public, and 170 on-post fatalities (see Table 6.21-2). If such an accident would occur under D-3 meteorological conditions, no off-post fatalities and two on-post fatalities would be expected.

Fewer than five individuals occupy the nearest residence just beyond the northern boundary of PCD, a distance of about 1 mi (1.6 km) from the nearest alternative pilot facility location and from the nearest storage igloo. This residence has been an important part of community and PCD emergency planning efforts. PPE, including suits and gloves, and PAPRs are in place for six individuals to use, if necessary, during safe evacuation or shelter-in-place. These safety precautions should prevent injury to the residents at that location in the event of an accident. However, if an accident were to occur, the individuals might not be able to take protective action quickly enough to prevent injury or death.

The TTC located at the northern boundary of the site employs approximately 230 individuals. The structures on the TTC site are near the central-eastern area, about 5 mi (8 km) from the PCD site boundary. On the basis of the assumption that most workers at the TTC site would be present during daytime hours, accident modeling that assumes D-3 meteorological conditions is most applicable for the site. The no deaths distance for the storage igloo accident under D-3 meteorological conditions is about 3.1 mi (5 km) (Table 6.21-2). If one of these accidents would occur at a time when the wind was blowing toward the TTC, some of the employees might experience toxicity from exposure to HD. It is unlikely that any fatalities would occur to these employees (unless some were much nearer to the PCD boundary at the time of the accident). If a bounding accident did occur at night when the wind direction was toward the TTC and during E-1 meteorological conditions, workers present at the TTC at the time would be at risk of injury or death.

If it is assumed that children and/or the elderly are substantially more susceptible to the effects of agent exposure than healthy adult males, then the estimated number of fatalities could increase. When a method is used that assumes there is increased risk to sensitive subpopulations (i.e., that the subpopulations are 10 times more susceptible to fatality from agent exposure than the general public; see U.S. Army 1997b), the number of fatalities among the general public associated with continued storage accident scenarios could increase by a factor 2.6 (details of this assessment are provided in Appendix H). For the worst-case storage accident, if children and the elderly are assumed to be up to 10 times more sensitive to lethal effects than are healthy male adults, and if an aircraft is assumed to crash into a HD storage igloo under E-1 meteorological conditions, up to about 780 fatalities (300×2.6) would be expected in the general population.

6.21.3.5 Soils

Potential impacts on soils associated with the accident scenarios considered under the no action alternative would be the same as those discussed under the proposed action (Section 6.21.2.5).

6.21.3.6 Water Resources

Potential impacts on water resources associated with the accident scenarios under the no action alternative would be the same as those discussed under the proposed action (Section 6.21.2.6).

6.21.3.7 Biological Resources

The impact from an accident involving an aircraft crash into a storage igloo in Munitions Storage Area A, followed by fire, was evaluated for the no action alternative. The methodology used for assessing impacts on biological receptors associated with the no action alternative accident scenario was the same as that used for the proposed action accident evaluation (see Section 6.21.2.7). Table 6.21-1 presents the HD exposures that could result from the bounding accident scenario for the distance intervals representing 1% lethality, no deaths, and no effects for humans. Table 6.21-5 presents the distances from the accident site for HQ values of less than one. The values are based on the D2PC model output for both the NOAEL and LOAEL exposures of the three wildlife species evaluated.

Under E-1 meteorological conditions, some effects on all species would be expected within a distance of 19 mi (31 km) downwind of the accident. During daytime conditions, all species evaluated could be affected by a release of HD at distances much closer to the accident site than distances during a nighttime release. The pronghorn antelope would be least sensitive to HD exposure. No adverse effects on the black-tailed prairie dog would be expected at distances greater than 12 mi (19 km) from the accident during the daytime. These distances are highly

TABLE 6.21-5 Distance from Accident Site That Would Result in No or Lowest Adverse Effects on Wildlife for No Action Alternative at PCD[a]

	Distance (mi) with Hazard Quotient of <1[b]			
	Daytime Conditions		Nighttime Conditions	
Species	LOAEL[c]	NOAEL[d]	LOAEL[c]	NOAEL[d]
Ord’s kangaroo rat	6.2	11	12	18
Pronghorn antelope	4.3	6	10	13
Black-tailed prairie dog	6.8	12	14	19

[b] Scenario is an aircraft crash into a munitions storage igloo.

[b] Hazard quotient = (dose at a given distance from the source) divided by (benchmark value of HD for receptor species). The concentration is obtained by using the D2PC model and assuming a wind speed of 3 m/s during daytime conditions and 1 m/s during nighttime conditions and a plume exposure duration of 20 min.

[c] LOAEL = lowest observed adverse effects level; the maximum distance from the site at which adverse effects would be expected to occur.

[d] NOAEL = no observed adverse effects level; the distance from the site beyond which no adverse effects would be expected to occur.

conservative and are based on several assumptions that might overestimate HD atmospheric releases, dispersal, and species sensitivity under field conditions following an accident.

Impacts on vegetation from mustard deposited due to an aircraft crash would be very similar to those discussed for the proposed action (Section 6.21.2.7). The impacts on protected species from exposure to chemical agents released following an accident during continued storage would be very similar to impacts from an accident under the proposed action (Section 6.21.2.7). The impacts on wetland vegetation from an aircraft crash into a storage igloo during continued storage would be very similar to those from an earthquake affecting the unpack area under the proposed action (Section 6.21.2.7).

6.21.3.8 Cultural Resources

Potential impacts on cultural resources associated with the accident scenarios under the no action alternative would be the same as those discussed under the proposed action (Section 6.21.2.8). See Appendix H for the listing of historic properties that could be affected by the modeled accidents under the no action alternative.

6.21.3.9 Socioeconomics

Potential impacts on socioeconomics associated with the accident scenarios under the no action alternative would be the same as those discussed under the proposed action (Section 6.21.2.9).

6.21.3.10 Environmental Justice

Potential impacts on environmental justice associated with the accident scenarios under the no action alternative would be the same as those discussed under the proposed action (Section 6.21.2.10).

6.22 CUMULATIVE IMPACTS

Cumulative impacts would result from adding the incremental impacts of the proposed action to other past, present, and reasonably foreseeable future actions. “Reasonably foreseeable future actions” are considered to be (1) actions that are covered in an environmental impact document that was either published or in preparation, (2) formal actions such as initiating an application for zoning approval or a permit, or (3) actions for which some funding has already been secured. Cumulative impacts could result from actions occurring at the same time or from actions occurring over a period of time.

An ACWA pilot test facility would take up to 34 months to construct and would operate for up to 36 months. This short operational time frame would reduce the potential for cumulative impacts.

This cumulative impacts analysis does not cover areas in which the proposed action and other reasonably foreseeable future actions would have no impacts or only localized impacts. Thus, the following areas were not analyzed for cumulative impacts:

- Geological resources,
- Cultural resources, and
- Communications infrastructure.

In addition, cumulative impacts were not assessed for accidents. Accidents are low-probability events whose exact nature and time of occurrence cannot reasonably be foreseen. Although their impacts may be large, these impacts cannot be added in a reasonably predictable manner to the impacts of other reasonably foreseeable future actions.

Finally, the analyses in this EIS were based on the assumption that a single, full-scale ACWA pilot test facility would be built. If two or more ACWA pilot facilities were built, they would share common facilities, and each one would be smaller than the full-scale pilot facility. Collectively, they would be similar in size to a full-scale pilot facility, and it is highly unlikely that they would exceed the size of a combined full-scale pilot facility and baseline incinerator. Therefore, on an installation without a baseline incinerator, the impacts of two ACWA pilot facilities and/or an increase in weapons throughput would reasonably be bounded by the impacts of the full-scale pilot facility or the combined full-scale pilot facility and baseline incinerator, and their impacts together would reasonably be bounded by the impacts of the full-scale pilot plant facility. Thus, this cumulative impacts analysis should represent the impacts from either one or two ACWA pilot test facilities.

Government and private organizations were contacted to identify reasonably foreseeable on-post and off-post actions for inclusion in this cumulative impacts analysis. Organizations contacted included the following:

- Pueblo Chemical Depot,
- Pueblo Colorado City Department of Planning and Economic Development,

- Colorado State Air Pollution Control Division,
- El Paso County Planning,
- Pueblo County Planning and Development,
- Transportation Technology Center,
- Pueblo Development Authority,
- Rio Grande Portland Cement Company, and
- West Plains Energy.

6.22.1 Other Reasonably Foreseeable Future Actions

The impacts of past and present actions were considered in previous sections of Chapter 6 under the discussions of the affected environment. They are summarized here, when needed, in the corresponding discussions of cumulative impacts.

6.22.1.1 On-Post Actions

Some on-post actions are already included in the proposed action as defined and analyzed in this EIS. These include building an access road to the ACWA site, building an electrical substation, building a power distribution system, and building wastewater treatment lagoons. Other reasonably foreseeable on-post actions included here in Section 6.22 in this cumulative impacts analysis include:

- Upgrading roads and
- Constructing and operating new facilities, including a Personnel Support Building, parking lot, and waste transfer area.

The impacts of these actions were assessed on the basis of information from discussions with post personnel (Smith 2001; Light 2000).

The only other potential on-post Chem Demil action would be the construction and operation of a baseline incinerator. An EIS for a baseline incinerator at PCD has been prepared

(U.S. Army 2001), but it is not known whether such a facility will be built. To account for this uncertainty, cumulative impacts are assessed in this section of the EIS under two scenarios:

- Impacts from the construction and operation of an ACWA pilot test facility (proposed action) combined with other reasonably foreseeable on-post and off-post actions that do not include a baseline incinerator, and

- Impacts from the construction and operation of an ACWA pilot test facility (proposed action) combined with other reasonably foreseeable on-post and off-post actions, including a baseline incinerator.

6.22.1.2 Off-Post Actions

The reasonably foreseeable off-post actions have been identified broadly as industrial expansion, including the Rio Grande Portland Cement plant; housing growth and development; and some commercial development.

6.22.2 Land Use

Most of the land surrounding PCD is undeveloped ranchland used for grazing. The TTC is adjacent to the northern boundary of PCD. Past and present land use on PCD has been primarily for industrial and related purposes, including administrative, residential, and recreational uses. The reuse plan adopted in 1995 reserved more than 5,200 acres (2,100 ha) for Chem Demil activities and designated about 40% of the land for potential livestock grazing, wildlife management, and open space. Use of land adjacent to Munitions Storage Area A for an ACWA pilot test facility is consistent with current and future land use under the reuse plan and would generate no significant adverse impacts on on-post or off-post land use.

6.22.2.1 Cumulative Impacts with Other Actions

An ACWA pilot test facility as well as other on-post actions would be consistent with proposed installation reuse (Section 6.2.4). The 85 acres (34 ha) disturbed by construction of the ACWA pilot test facility would represent about 0.4% of the total area of PCD. No impacts on land use would be expected from construction or operation of an ACWA pilot test facility (Section 6.2). The Personnel Support Center, its associated parking, and the waste transfer area would disturb about another 7.5 acres (3.0 ha), about 0.03% of the total area of PCD. The city of Pueblo is expanding its housing base. Most residential and commercial development is occurring to the north and south of the city, not eastward toward PCD (Smith 2001). No new large facilities are expected at the Airport Industrial Park or near PCD. Major new facilities are located 12 mi

(20 km) or further from PCD, and any impacts from them would be reduced in accordance with their distance from the installation. These and other anticipated activities in the vicinity of PCD would not contribute to significant adverse impacts on land use when aggregated with impacts from on-post actions.

6.22.2.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

If built, a baseline incinerator would be located in Area A, B, or C, the same general area as that in which the ACWA pilot test facility would be located (U.S. Army 2001). Building a baseline incinerator in one of these locations would be consistent with proposed installation reuse, and the incinerator's impacts on land use would not be expected to vary significantly from those of an ACWA pilot test facility, nor would the combination of two facilities change land uses in the area. Building a baseline incinerator could disturb up to another 85 acres (34 ha) of land in addition to that disturbed by building an ACWA pilot test facility (U.S. Army 2001). The total area disturbed by a baseline incinerator together with an ACWA pilot test facility, the Personnel Support Center, its associated parking, and the waste transfer area, would amount to about 0.8% of PCD's area. The cumulative land use impacts of a baseline incinerator, an ACWA pilot test facility, and other reasonably foreseeable actions should not be significant.

6.22.3 Infrastructure

Table 6.22-1 presents the expected utility demands for a baseline incinerator at PCD.

TABLE 6.22-1 Estimated Annual Utility Demands for a Baseline Incinerator at PCD

Utility	Annual Demand
Electric power (GWh)	29
Natural gas (scf)	460,000,000
Process water (gal)	16,000,000
Potable water (gal)	6,400,000
Sewage produced (gal)	7,500,000

Source: Folga (2001).

6.22.3.1 Electric Power Supply

Cumulative Impacts with Other Actions. The current infrastructure would need to be expanded to meet the electric power needs of an ACWA pilot test facility (Section 6.3.1). With other reasonably foreseeable future on-post actions, the cumulative needs would exceed those of an ACWA pilot test facility alone. Recent electric consumption at PCD has been about 10 to 12 GWh/yr (EDAW et al. 1994). Depending on the ACWA technology chosen, more than 60 GWh/yr of additional electric power might be needed while other on-post uses were still being supplied (Table 6.3-1 and U.S. Army 2001). Discussions with local planners indicated no current or foreseen problems supplying electric power in the Pueblo County area (Smith 2001), and the need for additional power could be met by existing providers.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. Building a baseline incinerator would require an electric infrastructure beyond that needed by an ACWA pilot test facility alone. Recent electric consumption at PCD has been about 10 to 12 GWh/yr (EDAW et al. 1994). Depending on the ACWA technology chosen, more than 89 GWh of additional power would be needed annually for both facilities while other on-post uses were still being supplied (Table 6.3-1 and U.S. Army 2001). Discussions with local planners indicated no current or foreseen problems supplying electric power in the Pueblo County area (Smith 2001), and the need for additional power could be met by existing providers.

6.22.3.2 Natural Gas Supply

Cumulative Impacts with Other Actions. The current infrastructure could not supply the natural gas needs of ACWA pilot test facility (Section 6.3.2). Additional infrastructure might also be needed for other reasonably foreseeable on-post facilities. New pipelines would be required to meet the overall gas supply needs. Depending on the ACWA technology chosen, more than 149 million scf (4,220,000 m^3) of natural gas might be needed annually, while other on-post uses were still being supplied (Table 6.3-1). The main gas line at PCD was sized to meet the requirements of Chem Demil activities, and Excel Energy could supply this amount of natural gas to PCD (Section 6.3.2.). Discussions with local planners indicated no current or foreseen problems supplying natural gas in the Pueblo County area (Smith 2001).

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. If a baseline incinerator were built, additional pipelines and stations would be needed beyond those required for an ACWA pilot test facility alone. Depending on the ACWA technology chosen, an ACWA pilot test facility might require as much as 149 million scf (4,220,000 m^3) of natural gas annually (Table 6.3-1). A baseline incinerator might require an additional 460 million scf (13 million m^3) annually (Table 6.22-1). The main gas line at PCD was sized to meet the requirements of Chem Demil activities, and Excel Energy could supply this amount of natural gas to PCD (Section 6.3.2.). Discussions with local planners indicated no current or foreseen problems supplying natural gas in the Pueblo County area (Smith 2001).

6.22.3.3 Water (Supply and Sewage Treatment)

Cumulative Impacts with Other Actions. New water distribution pipelines would be needed to supply water to an ACWA pilot test facility (Section 6.3.3). Additional pipelines would be needed to supply other possible on-post actions.

Water use during operations of an ACWA pilot test facility would exceed water use during construction. Operational process and potable water use by an ACWA pilot test facility could be up to 24 million gal/yr (92,000 m^3/yr). Water use by other reasonably foreseeable on-post uses would increase these demands but would be smaller. Current use is about 1.4 million gal/yr (5,300 m^3/yr), which would result in a total use of more than 26 million gal/yr (98,000 m^3/yr). This amount is less than historical peak withdrawals.

Constructing and operating an ACWA pilot test facility and other reasonably foreseeable on-post facilities would increase the amount of sanitary wastes requiring disposal. An ACWA pilot test facility would generate as much as 7.5 million gal/yr (28,000 m^3/yr) of sanitary sewage. Other reasonably foreseeable on-post actions would generate additional, but smaller, amounts. The on-post evaporative lagoons might need to be expanded to handle the additional load.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. Additional on-post infrastructure would be needed to supply water to both an ACWA pilot test facility and a baseline incinerator. If a baseline incinerator were built, additional delivery and storage systems beyond those required by an ACWA pilot test facility would be needed.

Water use during operations of an ACWA pilot test facility and a baseline incinerator Would exceed water use during construction. Operational process and potable water use by an ACWA pilot test facility could be up to 24 million gal/yr (92,000 m^3/yr). A baseline incinerator could use up to 22 million gal/yr (85,000 m^3/yr) (U.S. Army 2001). Water use by other reasonably foreseeable on-post uses would increase these demands but would be smaller. Current use is about 1.4 million gal/yr (5,300 m^3/yr), which would result in a total use of more than 46 million gal/yr (180,000 m^3/yr). This amount is less than historical peak withdrawals.

Constructing and operating both an ACWA pilot test facility and a baseline incinerator would about double the amount of sanitary wastes requiring disposal to more than 15 million gal/yr (57,000 m^3/yr). The on-post evaporative lagoons might need to be expanded to handle the additional load.

6.22.4 Waste Management

Cumulative impacts on waste management from the construction and operation of an ACWA pilot test facility, with or without a baseline incinerator and other reasonably foreseeable facilities, should be minimal. Discussions with local planners indicated that current off-post hazardous and nonhazardous waste disposal capacities appear adequate (Smith 2001).

Hazardous wastes are stored at a number of locations around PCD. In 1999, PCD disposed of about 129,000 lb (63,100 kg) of hazardous wastes off post. This quantity included 83,000 lb (38,000 kg) of contaminated soils (Table 6.4-1). Nonhazardous solid wastes are collected and disposed of off post by a licensed solid waste hauler. Sanitary wastewater is treated on post in the East Lagoon System (Section 6.4).

6.22.4.1 Cumulative Impacts with Other Actions

The quantities of construction wastes generated by an ACWA pilot test facility (Table 6.4-2) and other on-post actions would be small and have minimal impacts on waste management systems. Operation of either of the ACWA pilot test facility technologies would increase the amount of hazardous waste shipped off post by about 4,900% over 1999 levels. Both technologies would produce amounts of hazardous and nonhazardous wastes that, while representing a substantial increase in the amount of waste generated by PCD, would be minimal in the PCD vicinity (Tables 6.4-3 and 6.4-4). Even when added to other reasonably foreseeable hazardous wastes, these wastes would have a minimal impact on waste management systems.

Constructing and operating an ACWA pilot test facility and other reasonably foreseeable on-post facilities would increase the amount of sanitary wastes requiring disposal. An ACWA pilot test facility would generate as much as 7.5 million gal/yr (28,400 m^3/yr) of sanitary sewage (Table 6.3-1). Other reasonably foreseeable on-post future actions would generate additional sanitary sewage, but smaller amounts. The on-post evaporative lagoons might need to be expanded to handle the additional load.

6.22.4.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

The quantities of construction and operational wastes generated by a baseline incinerator would represent a substantial increase for PCD but would be minimal in the vicinity of the post (U.S. Army 2001). The total stockpile of munitions to be demilitarized is fixed. If both an ACWA pilot test facility and a baseline incinerator were built and operated, fewer munitions would be demilitarized in each, and fewer wastes would be produced by each than if a single facility was operating alone. Since either facility alone would produce minimal amounts of hazardous wastes, both together would produce wastes that, even when added to other reasonably foreseeable hazardous wastes, would have a minimal impact on waste management systems. A baseline incinerator would also produce brine salts, for which the ultimate disposal requirements are currently unclear (Section 6.4.3).

Constructing and operating both an ACWA pilot test facility and a baseline incinerator would about double the amount of sanitary wastes requiring disposal to more than 15 million gal/yr (57,000 m^3/yr). The on-post evaporative lagoons might need to be expanded to handle this load.

6.22.5 Air Quality

Emissions of toxic and hazardous air and pollutants are of interest primarily because of the impacts they could have on human health and biological resources. Sections 6.22.6 and 6.22.12 discuss potential cumulative impacts for these impact areas. This analysis assumes that an ACWA pilot test facility and a baseline incinerator would be constructed and operated at the same time.

6.22.5.1 Impacts of Construction

PM_{10} and $PM_{2.5}$ from fugitive emissions would be the pollutants of principal concern during construction. Emissions of pollutants from worker and delivery vehicles, construction equipment, fuel storage, and refueling operations would be small, and off-post concentrations would not exceed NAAQS levels (Section 6.5.3).

Cumulative Impacts with Other Actions. Construction of an ACWA pilot test facility would not result in ambient concentrations in excess of particulate NAAQS levels. Table 6.5-6 summarizes the maximum off-post particulate impacts from construction of an ACWA pilot test facility. By itself, construction of the facility would produce, at most, an impact that would be less than 21% of any particulate NAAQS level. Taking current on-post and off-post sources into account (the background levels), the total particulate concentration would be, at most, 55% of the NAAQS level. If construction of a Personnel Support Building, parking area, and waste transfer area along the southern edge of the Chem Demil area would occur at the same time as construction of the ACWA pilot test facility, these particulate levels would increase. These facilities would occupy about 5 acres (2 ha) (Light 2000) in addition to the 25 acres (10 ha) disturbed by construction of an ACWA pilot test facility. Even simultaneous construction of all these facilities would not cause off-post particulate levels to exceed NAAQS levels. Use of best construction practices (such as watering areas where ground-disturbing activities were occurring) would reduce impacts on particulate levels.

The Rio Grande Portland Cement plant currently under construction is located about 20 mi (35 km) southwest of Munitions Storage Area A. It would be a source of particulates.

However, given its distance from PCD, this plant and other reasonably foreseeable off-post future actions would not contribute significantly to PM_{10} or $PM_{2.5}$ levels in the vicinity of PCD.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. Table 6.22-2 presents the particulate air quality impacts from simultaneous construction of an ACWA pilot test facility and a baseline incinerator. These concentrations are overestimates, since they assume that both facilities would be constructed at the same location rather than in different areas; even so, they are still less than 91% of the NAAQS levels. If construction of a Personnel Support Building, parking area, and waste transfer area along the southern edge of the Chem Demil area would occur at the same time as construction of the ACWA pilot test facility, these particulate levels would increase. Given the overestimation involved in the results presented in Table 6.22-2, particulate levels in excess of the NAAQS levels would not be expected. The Rio Grande Portland Cement plant and other reasonably foreseeable on-post and off-post actions would not contribute significantly to PM_{10} or $PM_{2.5}$ levels in the vicinity of PCD.

TABLE 6.22-2 Air Quality Impacts from Construction of an ACWA Pilot Test Facility and a Baseline Incinerator at PCD and Other Nearby Actions[a]

		Concentration (μg/m^3)				
Pollutant	Averaging Time	Maximum Increment[b]	Background	Total	NAAQS	Percentage of NAAQS[c]
PM_{10}	24 hours	67	40	107	150	71 (45)
	Annual	4.7	17	22	50	43 (9.4)
$PM_{2.5}$	24 hours	34	25	59	65	91 (52)
	Annual	2.3	7	9.3	15	62 (15)

[a] See Section 6.5 for details on background and modeling.

[b] Values for ACWA pilot test facility impacts are based on Table 6.5-6. Values for baseline incinerator PM_{10} impacts are based on U.S. Army (2001). Values for baseline incinerator $PM_{2.5}$ impacts are assumed to be 50% of PM_{10} impacts during construction.

[c] Values are based on the total concentration, including the background concentration and maximum increment from simultaneous construction of an ACWA pilot test facility and a baseline incinerator. Values in parentheses are based on the construction of the facilities and ignore background levels.

6.22.5.2 Impacts of Operations

Colorado has an SAAQS for 3-hour SO_2 of 700 μg/m3, which is more stringent than the federal NAAQS. When two standards exist, the more stringent one is the applicable standard.

It is assumed that the construction of a Personnel Support Building, parking area, and waste transfer area would be completed before either the ACWA pilot test facility or baseline incinerator would begin operations.

Cumulative Impacts with Other Actions. As a percentage of the corresponding standard, the largest air quality increment from operating an ACWA pilot test facility by itself would be the 24-hour PM2.5 impact of 1.8 μg/m3, which is about 2.8% of the applicable standard level (Tables 6.5-7 and 6.5-8). When the impacts of other current on-post and off-post sources (the background levels) are taken into account, the largest air quality increment would be the annual PM2.5 impact of 7 μg/m3, about 47% of the applicable standard level. The Rio Grande Portland Cement plant would be located more than 22 mi (35 km) from Munitions Storage Area A. Operation of this facility would produce additional emissions of criteria pollutants, including particulates. However, given its distance from PCD, no significant increases in criteria pollutant concentrations in the vicinity of PCD would be expected. Additional on-post and off-post actions would add to the impacts from an ACWA pilot test facility operating alone, but their cumulative impact would not exceed applicable standard levels.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. Table 6.22-3 presents the air quality impacts from simultaneous operation of an ACWA pilot test facility and a baseline incinerator. These concentrations assume that the facilities are collocated. Except for NO_2, the values rely on baseline incinerator impacts modeled for ANAD and PBA. Although the modeled impacts would be different if done for PCD, these impacts were used because they are the best available indicators of impacts from a baseline incinerator. All impact estimates are under 50% of the applicable standard levels, and both Chem Demil facilities together contribute less than 8% of the applicable standard levels. Other reasonably foreseeable on-post actions would not be expected to contribute to significant atmospheric emissions, and reasonably foreseeable off-post facilities would not produce significant criteria pollutant concentrations in the vicinity of PCD.

TABLE 6.22-3 Air Quality Impacts from Operation of an ACWA Pilot Test Facility and a Baseline Incinerator at PCD and Other Nearby Actions

		Concentration ($\mu g/m^3$)				
Pollutant	Averaging Time	Maximum Increment[a]	Background	Total	Standard[b]	Percentage of Standard[c]
SO_2	3 hours	20	107	127	700	18 (2.8)
	24 hours	5.6	39	45	365	12 (1.5)
	Annual	0.51	8	8.5	80	11 (0.64)
NO_2	Annual	3.2	19	22	100	22 (3.2)
CO	1 hour	89	3,250	3,520	40,000	8.8 (0.22)
	8 hours	14	2,220	2,240	10,000	22 (0.14)
PM_{10}	24 hours	4.8	40	45	150	30 (3.2)
	Annual	0.41	17	17	50	35 (0.82)
$PM_{2.5}$[d]	24 hours	4.8	25	30	65	46 (7.4)
	Annual	0.41	7	7.4	15	49 (2.8)

[a] Sum of the increment for an ACWA pilot test facility and the increment for a baseline incinerator. The ACWA pilot test facility increment is based on larger modeled values for Neut/SCWO and Neut/Bio (Tables 6.5-7 and 6.5-8). The baseline incinerator NO_2 increment was taken from U.S. Army (2001) for PCD. Other baseline incinerator increments were assumed to be the larger of modeled values for ANAD and PBA (U.S. Army 1991, 1997b).

[b] More stringent of the NAAQS level or the SAAQS level.

[c] Values are based on the total concentration, including the background concentration and maximum increment from simultaneous operation of an ACWA pilot test facility and a baseline incinerator. Values in parentheses are based on operation of the facilities and ignore background levels.

[d] Not available in references. Overestimated as being equal to PM_{10}.

6.22.6 Human Health and Safety — Routine Operations

6.22.6.1 Impacts of Construction

PM_{10} and $PM_{2.5}$ from fugitive emissions would be the pollutants of principal concern during construction. Emissions of pollutants from worker and delivery vehicles, construction equipment, fuel storage, and refueling operations would be small, and off-post concentration would not exceed NAAQS levels (Section 6.5.3).

Cumulative Impacts with Other Actions. As noted in Section 6.22.5, the NAAQS levels would not be exceeded during construction of an ACWA pilot test facility alone or with other reasonably foreseeable on-post and off-post facilities. No adverse cumulative impacts on the health of the off-post public would occur.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. If built, a baseline incinerator would add to the particulate impacts of an ACWA pilot test facility. As noted in Section 6.22.5, NAAQS levels would not be exceeded during construction of an ACWA pilot test facility, a baseline incinerator, and other reasonably foreseeable on-post and off-post actions. No adverse cumulative impacts on the health of the off-post public would occur.

6.22.6.2 Impacts of Operations

Cumulative Impacts with Other Actions. On the basis of risks from agent processing and worst-case mustard emissions, the maximum increase in carcinogenic risk to on-post and off-post populations associated with either technology for an ACWA pilot test facility would be 2×10^{-7}, or 20% of the 1×10^{-6} level generally considered representative of negligible risk (Table 6.7-2). Noncarcinogenic risks would be less than 0.1% of the levels considered to present hazards. The maximum estimated concentration of agent from ACWA pilot test facility emissions would be 0.2% of the maximum allowable level recommended by the CDC (Table 6.6-3). Reasonably foreseeable future on-post actions would contribute negligible amounts to the concentrations of air toxics and would not emit agent. Any increases in health risks would be considered negligible.

As noted in Section 6.22.5, applicable standard levels would not be exceeded during operation of an ACWA pilot test facility, either alone or with other reasonably foreseeable on-post and off-post actions. No adverse cumulative impacts on the health of the off-post public would occur.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. The EIS for a baseline incinerator at PCD provides a risk perspective but no quantitative estimates for risks (U.S. Army 2001). The PCD EIS anticipates that the health risk assessment required by RCRA would find no significant health impacts.

This EIS uses the risks for the Johnson Atoll Chemical Agent Disposal System (JACADS) incinerator that were estimated on the basis of measured stack gas concentrations. Risk estimates based on representative conditions at PCD would differ from those derived for JACADS. However, the methodology used in assessing risks from JACADS emissions was very conservative (i.e., it overestimated risks). Thus the JACADS risks can be taken as reasonable indicators of the expected risks from a baseline incinerator at PCD.

The maximum increase in carcinogenic risk from agent processing and worst-case mustard emissions to on-post and off-post populations associated with either technology for an ACWA pilot test facility would be 2×10^{-7}, or 20% of the 1×10^{-6} level generally considered representative of negligible risk (Table 6.7-2). Noncarcinogenic risks would be less than 0.1% of the levels considered to present hazards. As summarized in the PCD EIS (Table 4-21 of U.S. Army 2001), the maximum risk for a baseline incinerator, if built, would be 6.2×10^{-7}, or 62% of the 1×10^{-6} generally considered representative of negligible risk. When additivity for the carcinogens is assumed (a common assumption in risk assessments), a baseline incinerator and an ACWA pilot test facility operating simultaneously would represent an increased carcinogenic risk of approximately 8.2×10^{-7}, or 82% of the benchmark level generally considered representative of negligible risk. The total risk would still generally be considered negligible.

Risks from the maximum possible release of agent from an ACWA pilot test facility were estimated by assuming that agent could be emitted continuously from the filter farm stack at the agent detection limit of the in-stack monitor. (Section 6.6). The detection limit is about 20% of the concentration allowed in the stack. Operations would be shut down if the detection limit were reached. Thus, the estimate of risk is conservative (i.e., it overestimates risk). The maximum estimated risk from ACWA pilot test facility emissions would be 0.2% of maximum allowable level recommended by the CDC (Table 6.6-3). U.S. Army (2001) estimates the maximum risk from the baseline incinerator conservatively and assumes emissions are at the allowable level. This EIS assumes lower emissions are at the detection limit. By adjusting the Army's results for lower emissions to put them at the detection limit, the maximum risk from the baseline incinerator would be 2.4% of the maximum allowable level recommended by the CDC. If an ACWA pilot test facility and a baseline incinerator were operating concurrently, the worst case would have agent levels equal to 2.6% of the allowable level. However, it is highly unlikely that such levels would be reached under routine operating conditions, because the two plants would have separate stacks, which would lead to lower maximum air concentrations than would occur if all emissions were from one stack. Also, the assumption of continuous agent release at the detection limit (Section 6.6.3) is very conservative and results in overestimates of possible agent releases.

If built, a baseline incinerator would add to the air quality impacts of an ACWA pilot test facility. As noted in Section 6.22.5, applicable standard levels would not be exceeded during operation of an ACWA pilot test facility, a baseline incinerator, and other reasonably foreseeable on-post and off-post actions. No adverse cumulative impacts on the health of the off-post public would occur.

6.22.7 Noise

This analysis assumes that an ACWA pilot test facility and a baseline incinerator would be constructed and operated simultaneously.

6.22.7.1 Cumulative Impacts with Other Actions

Construction of an ACWA pilot test facility would result in noise levels of less than 40 to 45 dBA at the nearest residence. Noise levels during operation would be comparable to ambient background, less than 35 dBA at the nearest residence (Section 6.8.3). These levels are less than the EPA's guideline of 55 dBA for protection of the public in typically quiet outdoor and residential areas. Even if the Personnel Support Building, parking lot, and waste transfer area were being built at the same time as the ACWA pilot test facility, the cumulative noise level at the nearest residence would be under the EPA's guideline.

6.22.7.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

Simultaneous construction and operation of an ACWA pilot test facility and a baseline incinerator at the same location would lead to a barely perceptible increase of less than 3 dBA at the nearest residence. The cumulative noise level would still be under the EPA's 55-dBA guideline. Even if the Personnel Support Building, parking lot, and waste transfer area were being built at the same time as these two facilities, the cumulative noise level at the nearest residence would be under EPA's guideline. Other reasonably foreseeable on-post and off-post actions would not contribute significantly to cumulative noise impacts.

6.22.8 Visual Resources

Current (and reasonably foreseeable future) actions on post appear to be in keeping with the existing visual character of PCD and consistent with the reuse plan.

6.22.8.1 Cumulative Impacts with Other Actions

Current (and reasonably foreseeable future) actions appear to be in keeping with the largely industrial nature of PCD (Section 6.9). Traffic and dust during construction of an ACWA pilot test facility and other on-post facilities would affect the visual character of PCD, but the effect would be intermittent and temporary. During operations, an ACWA pilot test facility could produce a small steam plume. Any plumes associated with other reasonably foreseeable facilities would also be small. No adverse visual impacts would result from the construction or operation of an ACWA pilot test facility and other on-post and off-post actions.

6.22.8.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

If built, a baseline incinerator would be located in the Chem Demil area, the same general area in which an ACWA pilot test facility would be located. This location would thus be in keeping with the largely industrial nature of PCD. Construction of a baseline incinerator would add to the visual impacts associated with an ACWA pilot test facility and other on-post actions. Increased traffic and dust during construction of both facilities would increase the effect on the visual character of PCD, but the effect would be intermittent and temporary. During operations, the baseline incinerator would produce a large steam plume that would add to the visual impact of an ACWA pilot test facility's plume. Any plumes associated with other reasonably foreseeable facilities would also be small. No adverse visual impacts would result from the construction or operation of an ACWA pilot test facility, a baseline incinerator, and other on-post and off-post actions.

6.22.9 Soils

With the exception of soil contamination resulting from air emissions during operations, the area that was analyzed with regard to cumulative impacts on soils was limited to the immediate on-post vicinity of the proposed sites. Activities that would disturb soils would have very localized impacts and hence little chance to contribute to cumulative impacts.

About 25 acres (10 ha) of soils would be affected by construction of an ACWA pilot test facility, and up to an additional 60 acres (24 ha) would be affected by development of the associated infrastructure. Area A and Corridors 1, 2, and most of 4 have been previously disturbed. Areas B and C and Corridor 3 are largely undisturbed (Section 6.10).

6.22.9.1 Cumulative Impacts with Other Actions

Construction activities associated with an ACWA pilot test facility, the Personnel Support Building, its parking area, and the waste transfer area in the vicinity of Areas A, B, and C would disturb up to 93 acres (37 ha) of soils and could contribute to soil erosion and accidental spills and releases. These are the same types of impacts associated with construction of an ACWA pilot test facility. These impacts would be temporary and would be minor if the best management practices noted in Section 6.10.3 were followed.

There would be no significant cumulative impacts on surface soils from the routine operation of an ACWA pilot test facility and other on-post and off-post actions. No significant impacts are expected from the ACWA pilot test facility itself (Section 6.10.3). Anticipated facilities near the Chem Demil site would have very low or no emissions associated with their operation. Reasonably foreseeable future off-post sources would have very low emissions and be located far enough away to preclude significant on-post deposition.

6.22.9.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

Construction activities associated with an ACWA pilot test facility, a baseline incinerator, the Personnel Support Building, its parking area, and the waste transfer area could disturb up to 180 acres (77 ha) and could contribute to soil erosion and accidental spills and releases. These are the same types of impacts associated with construction of an ACWA pilot test facility. These impacts would be temporary and would be minor if the best management practices noted in Section 6.10.3 were followed.

There would be no significant cumulative impacts on surface soils from the routine operation of an ACWA pilot test facility and other on-post and off-post actions. No significant impacts are expected from the ACWA pilot test facility itself (Section 6.10.3). A baseline incinerator would have low emissions and no operational impacts on soils (U.S. Army 2001). Anticipated facilities near the Chem Demil site would have very low or no emissions associated with their operation. Reasonably foreseeable off-post sources would have very low emissions and be located far enough away to preclude significant on-post deposition.

6.22.10 Groundwater

This analysis assumes that an ACWA pilot test facility and a baseline incinerator would be constructed and operated at the same time.

All water used at PCD is withdrawn from the terrace alluvial aquifer. PCD has junior water rights to extract 320 million gal/yr (1.2 million m^3/yr) from the aquifer. Past actions at PCD have withdrawn water at a rate of up to 94 million gal/yr (360,000 m^3/yr) from this aquifer (Section 6.3.3) and have caused groundwater contamination in the southern portion of the post (Section 6.11.1). The ICARGS and other ongoing restoration projects are addressing this contamination.

6.22.10.1 Cumulative Impacts with Other Actions

Water use during operations of an ACWA pilot test facility would exceed water use during construction. Operational process and potable water use by an ACWA pilot test facility could be up to 24.4 million gal/yr (92,000 m^3/yr) depending on the technology chosen (Table 6.3-1). Water use by other reasonably foreseeable on-post actions would increase these demands but would be smaller. Current use is about 1.4 million gal/yr (5,300 m^3/yr), which would result in a total use of more than 25.8 million gal/yr (98,000 m^3/yr) for operating an ACWA pilot test facility while still supplying other on-post uses. This use is less than historical peak withdrawals. PCD would need to purchase water rights from more senior water rights holders to withdraw additional water from its wells, potentially diverting water from off-post uses. These withdrawals would cause a cone of depletion in the aquifer during operation of the ACWA pilot test facility. After completion of the chemical demilitarization within 36 months, the withdrawals would cease, and the aquifer would recharge quickly. PCD is hydrologically isolated from off-post actions, so there would be no cumulative impact on groundwater quantity or quality.

During incident-free construction of an ACWA pilot test facility and other reasonably foreseeable on-post facilities, no contamination of groundwater would occur if standard precautions were taken to prevent spills and leaks during refueling and maintenance (Section 6.11.3).

The ACWA pilot test facility would be designed to contain small accidental releases, and the entire facility site would be surrounded by a berm. Water and other substances would not be released to the groundwater during routine operations and accidents or fluctuations during routine operations (Section 6.11.3). Other reasonably foreseeable future on-post facilities would not be expected to release substances to the groundwater during routine operations. Cumulative impacts on groundwater should be negligible.

6.22.10.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

Water use during operations of an ACWA pilot test facility and a baseline incinerator would exceed water use during construction. Operational process and potable water use by an ACWA pilot test facility could be up to 24.4 million gal/yr (92,000 m^3/yr), depending on the technology chosen (Table 6.3-1). A baseline incinerator could use up to 22.4 million gal/yr (85,000 m^3/yr) (U.S. Army 2001). Water use by other reasonably foreseeable on-post actions would increase these demands but would be smaller. Current use is about 1.4 million gal/yr (5,300 m^3/yr), which would result in a total use of more than 48 million gal/yr (180,000 m^3/yr) for operating both facilities while still supplying other on-post uses. This use is less than historical peak withdrawals. PCD would need to purchase water rights from more senior water rights holders to withdraw additional water from its wells, potentially diverting water from off-post uses. These withdrawals would cause a cone of depletion in the aquifer during operation of the ACWA pilot test facility. After completion of the chemical demilitarization, the withdrawals would cease, and the aquifer would recharge quickly. PCD is hydrologically isolated from off-post actions, so there would be no cumulative impact on groundwater quantity or quality.

During incident-free construction of an ACWA pilot test facility, a possible baseline incinerator, and other reasonably foreseeable on-post facilities, no contamination of groundwater would occur if standard precautions were taken to prevent spills and leaks during refueling and maintenance (Section 6.11.3) (U.S. Army 2001).

If built, a baseline incinerator would not be expected to release substances to the groundwater during routine operations (U.S. Army 2001). The ACWA pilot test facility would be designed to contain small accidental releases, and the entire facility site would be surrounded by a berm. Water and other substances would not be released to the groundwater during routine operations and accidents or fluctuations during routine operations (Section 6.11.3). Other reasonably foreseeable future on-post facilities would not be expected to release substances to the groundwater during routine operations. Cumulative impacts on groundwater should be negligible.

6.22.11 Surface Water

This analysis assumes that an ACWA pilot test facility and a baseline incinerator would be constructed and operated at the same time. All water used at PCD is taken from the terrace alluvium aquifer. No withdrawals from or discharges to surface waters are expected for an ACWA pilot test facility, a baseline incinerator, or other reasonably foreseeable on-post actions.

6.22.11.1 Cumulative Impacts with Other Actions

During construction of an ACWA pilot test facility and other on-post facilities, standard construction practices, such as siltation fences, should be used to control erosion. Standard precautions should be followed to prevent spills and leaks during equipment refueling and maintenance of construction equipment. With use of such mitigating practices, the overall cumulative impacts on surface waters from all construction activities would be negligible.

Routine operation of an ACWA pilot test facility would not result in additional releases to surface water. Domestic sewage from the facility would be treated in lined, evaporative lagoons. Cumulatively, these impacts would be small. There would be no cumulative impacts with reasonably foreseeable on- or off-post actions.

6.22.11.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

Standard practices and precautions for preventing spills and leaks should be followed during construction of a baseline incinerator. With use of such mitigating practices, the overall cumulative impact on surface waters from all construction activities would be negligible but would add to the impacts from an ACWA pilot test facility alone.

Routine operation of an ACWA pilot test facility and a baseline incinerator would not result in additional releases to surface water. Domestic sewage from the facilities would be treated in lined, evaporative lagoons. Cumulatively, these impacts would be small. There would be no cumulative impacts with reasonably foreseeable on- or off-post actions.

6.22.12 Biological Resources

Area A, which comprises 180 acres (70 ha), is largely undisturbed and ungrazed. Areas B and C, which comprise about 300 acres (120 ha), have been heavily disturbed (Section 6.13).

6.22.12.1 Terrestrial Habitats and Vegetation

Cumulative Impacts with Other Actions. Section 6.13 describes the impacts on terrestrial habitats and vegetation that might result from disturbing up to 85 acres (34 ha) of land, a small fraction of the 4,900 acres (2,000 ha) designated for wildlife management under the reuse plan, while constructing an ACWA pilot test facility and its associated infrastructure. Construction of other on-post facilities would increase vegetation loss as sites would be cleared; the acreage involved would be smaller than the acreage disturbed for an ACWA pilot test facility alone but is not known exactly. Using standard erosion and runoff controls could mitigate impacts on vegetation that would result from sedimentation and erosion. If possible, several areas should not be used as facility sites. Construction in the southern portions of Area A would avoid the sensitive northern sandhill prairie community in the northern portion of Area A. Construction in Area B would disturb greasewood scrub vegetation. Avoiding the most concentrated stands in the central and eastern portions of Area B would reduce impacts. Construction in the center of Area C would avoid impacts on the shortgrass prairie habitat that supports a colony of black-tailed prairie dogs, a candidate species for federal listing as threatened or endangered.

A screening-level ecological risk assessment for soils found that air emissions from routine operations of an ACWA pilot test facility would have negligible impacts on ecological receptors (Section 6.13). Given the small emissions potential of other reasonably foreseeable on-post actions, cumulative impacts on terrestrial habitats and vegetation would be negligible.

Impacts on terrestrial habitats and vegetation associated with off-post facilities would be related to the size of the developments and the land area occupied. Reasonably foreseeable off-post actions would have localized impacts that would add to the impacts of actions at PCD. The impacts of off-post actions could not be quantified but are expected to be minor.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. The PCD EIS (U.S. Army 2001) indicates that construction of a baseline incinerator would disturb 85 acres (34 ha) of land. The total disturbance with an ACWA pilot test facility would be 170 acres (77 ha), still a small fraction of the 4,900 acres (2,000 ha) designated for wildlife management under the reuse plan. This increased disturbance would result in increased vegetation loss. Using standard erosion and runoff controls could mitigate the additional impacts on vegetation due to sedimentation and erosion. As noted above, several areas should be avoided as facility sites if possible.

A screening-level ecological risk assessment for soils found that air emissions from routine operations of an ACWA pilot test facility would have negligible impacts on ecological receptors (Section 6.13). U.S. Army (2001) found deposition during routine operation of a baseline incinerator to be below levels known to affect terrestrial habitats and vegetation. In addition, the total stockpile quantity is fixed; if a baseline incinerator were built and operated, fewer munitions would be demilitarized in the ACWA pilot test facility, reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions, cumulative impacts on terrestrial habitats and vegetation from an ACWA pilot test facility, a baseline incinerator, and other potential facilities during routine operations should be negligible.

Impacts on terrestrial habitats and vegetation associated with off-post facilities are related to the size of the developments and the land area occupied. Reasonably foreseeable off-post actions would have localized impacts that would add to the impacts of actions at PCD. The impacts of off-post actions could not be quantified but are expected to be minor.

6.22.12.2 Wildlife

Area A, which comprises 180 acres (70 ha), is largely undisturbed and ungrazed. Areas B and C, which comprise about 300 acres (120 ha), have been heavily disturbed (Section 6.13).

Cumulative Impacts with Other Actions. Section 6.14 describes the impacts on wildlife that might result from disturbing up to 85 acres (34 ha) of land, a small fraction of the 4,900 acres (2,000 ha) designated for wildlife management under the reuse plan, while constructing an ACWA pilot test facility and its associated infrastructure. Each new, on-post construction activity would affect wildlife by increasing the loss of habitat and increasing human activity and construction traffic. Cumulatively, these increases would cause additional deaths among less mobile species, such as small mammals and lizards, and displace additional wildlife during the construction period. Increased noise would cumulatively displace additional small mammals and potentially lead to increased habitat abandonment by songbirds.

Additional operations on post would increase the number of workers and deliveries. The number of roadkills would increase with the consequent increase in traffic. The Personnel Support Center would increase traffic noise, but even with other on-post actions, there would be no appreciable cumulative increase in noise levels.

A screening-level ecological risk assessment of soils found that air emissions from routine operations of an ACWA pilot test facility would have negligible impacts on ecological receptors (Section 6.13). Other reasonably foreseeable on-post actions would have small amounts of emissions and would not have adverse impacts on wildlife. Reasonably foreseeable off-post actions would have localized impacts that would be expected to be minor. Cumulative impacts on wildlife would be negligible.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. Construction of an ACWA pilot test facility and a baseline incinerator would disturb up to 170 acres (77 ha) of land, a small fraction of the 4,900 acres (2,000 ha) designated for wildlife management under the reuse plan. Construction of a baseline incinerator would increase the loss of habitat and amount of human activity and construction traffic over the levels associated with an ACWA pilot test facility, cause additional deaths among less mobile species, and displace additional wildlife during the construction period. Noise levels and the area affected by noise would increase minimally, leading to displacement of additional small mammals and potential increases in habitat abandonment by songbirds.

A screening-level ecological risk assessment for soils found that air emissions from routine operations of an ACWA pilot test facility would have negligible impacts on ecological receptors (Section 6.13). The U.S. Army (2001) found deposition during routine operation of a baseline incinerator to be below levels known to affect wildlife. In addition, the total stockpile to be demilitarized is fixed; if a baseline incinerator were built and operated, fewer munitions would be demilitarized in the ACWA pilot test facility, reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions, cumulative impacts on wildlife from an ACWA pilot test facility, a baseline incinerator, and other potential facilities during routine operations should be negligible.

During facility operations, additional activities would cumulatively increase the number of roadkills, as worker and delivery traffic would increase.

Adding a baseline incinerator near an ACWA pilot test facility would result in an increase of less than 3 dBA in the noise levels associated with an ACWA pilot test facility alone. This and other new facilities would not make appreciable contributions to noise levels.

Impacts on wildlife associated with off-post facilities would be related to the size of the developments and the land area occupied. Reasonably foreseeable off-post actions would have localized impacts that would add to the impacts of actions at PCD. The wildlife impacts of off-post actions on wildlife could not be quantified but are expected to be minor.

6.22.12.3 Aquatic Habitats and Fish

Cumulative Impacts with Other Actions. No aquatic resources occur in the areas proposed for the ACWA pilot test facility or other reasonably foreseeable future on-post actions. There should be no impacts associated with construction.

Operation of the ACWA pilot test facility would not result in any adverse impacts on aquatic ecosystems (Section 6.15). Other reasonably foreseeable future on-post and off-post actions would either have small emissions or be far enough away from the ACWA pilot test facility to contribute negligible amounts to overall deposition. Cumulative impacts on aquatic habitats and fish during operations should be negligible.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. No aquatic resources occur in the areas proposed for the ACWA pilot test facility, the baseline incinerator, or other reasonably foreseeable future on-post actions. There should be no impacts associated with their construction.

A baseline incinerator would be unlikely to cause sufficient deposition to affect aquatic species adversely (U.S. Army 2001). The total stockpile to be demilitarized is fixed; if a baseline incinerator would be built and operated, fewer munitions would be demilitarized in the ACWA pilot test facility, reducing its overall emissions and deposition. Given the small emissions potential or their distance from the ACWA sites, cumulative impacts on aquatic habitats and fish from other reasonably foreseeable actions, an ACWA pilot test facility, and a baseline incinerator should be negligible.

6.22.12.4 Protected Species

Adverse impacts on protected species, if any, would result from construction and not operational activities and would depend on the location of the facility.

Cumulative Impacts with Other Actions. Construction in the southern portion of Area C would affect the shortgrass prairie habitat that supports a colony of black-tailed prairie dogs (candidate for federal listing). Mountain plovers are likely, but not confirmed, breeding residents of the grazed shortgrass prairie adjacent to the southern portion of Area C. Loss of shrubland habitat in Areas A and B could affect the loggerhead shrike (federally listed as a sensitive species). Avoiding these areas would avoid the potential for adverse impacts. Each additional facility in these areas would increase the potential for adverse impacts. Avoiding work in areas where standing water accumulates during rainy periods would reduce the potential for impacts on northern leopard frogs (federally listed as sensitive species) if infrastructure construction would occur along Corridor 3 (Section 6.16.3).

Operation of an ACWA pilot test facility would result in no adverse impacts to protected species (Section 6.16). Other reasonably foreseeable action would either have small amounts of emissions or be far enough away from the ACWA pilot test facility to contribute negligible amounts to overall deposition. Cumulative impacts on protected species from normal operation of an ACWA pilot test facility and other reasonably foreseeable actions would be negligible.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. Construction of the baseline incinerator in the areas noted above would increase the potential for adverse impacts on protected species beyond those associated with construction of an ACWA pilot test facility alone. Avoiding these areas, if possible, would avoid the potential for adverse impacts.

Routine operation of an ACWA pilot test facility would have negligible impacts on protected species (Section 6.16). The U.S. Army (2001) found that routine operation of a baseline incinerator would have negligible impacts on protected species. The total stockpile to be demilitarized is fixed; if a baseline incinerator would be built and operated, fewer munitions would be demilitarized in the ACWA pilot test facility, reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions, cumulative impacts on protected species from an ACWA pilot test facility, a baseline incinerator, and other potential facilities during routine operations should be negligible. Reasonably foreseeable future off-post actions could affect the same overall populations as those that are affected by other actions at PCD. These impacts could not be quantified but are expected to be minor.

6.22.12.5 Wetlands

Cumulative Impacts with Other Actions. There are no wetlands in the areas proposed for the ACWA pilot test facility (Section 6.17). Other reasonably foreseeable future actions would also avoid wetlands. If runoff from construction activities were contained by using standard erosion control measures, cumulative impacts from on-post actions would be negligible.

Routine operation of an ACWA pilot test facility would have negligible impacts on wetlands (Section 6.17). Given the small emissions potential of other reasonably foreseeable actions, or given their distance from the ACWA areas, cumulative impacts on wetlands from an ACWA pilot test facility and other potential actions should be negligible.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. There are no wetlands in the areas proposed for the baseline incinerator. Other reasonably foreseeable future actions would also avoid wetlands. If runoff from construction activities were contained by using standard erosion control measures, no cumulative impacts from on-post actions would occur.

Routine operation of an ACWA pilot test facility would have negligible impacts on wetlands (Section 6.17). A baseline incinerator would be unlikely to cause sufficient deposition to affect wetlands adversely (U.S. Army 2001). The total stockpile to be demilitarized is fixed; if a baseline incinerator is built and operated, fewer munitions would be demilitarized in the ACWA pilot test facility, reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions, adverse cumulative impacts on wetlands from an ACWA pilot test facility, a baseline incinerator, and other potential facilities during routine operations should be negligible.

6.22.13 Socioeconomics

Construction and operation of ACWA technologies might result in cumulative impacts if construction and operations activities would occur concurrently with other existing or future activities on-post at PCD or in the ROI (see Section 6.19) surrounding the post.

6.22.13.1 Cumulative Impacts with Other Actions

The on-post development of alternate uses for PCD facilities could create additional demands on post utility and transportation infrastructures if reuse activities would occur concurrently with the construction or operation of an ACWA pilot test facility. However, other reasonably foreseeable on-post actions would probably employ far fewer people than would an ACWA pilot test facility using either technology. In the area surrounding the post, industrial, commercial, and residential development that could occur might also lead to cumulative impacts on local socioeconomic resources if impacts were not adequately planned for.

The cumulative socioeconomic impacts from the construction and operation of an ACWA pilot test facility together with existing or reasonably foreseeable economic development activities would be relatively small. In the next few years, a small number of local road extension projects, the Rio Grande Portland Cement plant, and a number of small commercial and industrial facilities in Airport Industrial Park are expected to be built. Except for the cement plant, which is expected to employ 100 workers once construction is finished by the end of 2002 (Smith 2001), more specific information on the size and precise timing of any of these projects was not available. However, judging from the impact of similar activities on other smaller communities elsewhere in the country, even if all of these projects were to occur during construction and operation of an ACWA pilot test facility, the potential cumulative impact on the economy of Pueblo County, local labor markets, local public and community services, and the local traffic network would be minor.

6.22.13.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

More significant cumulative socioeconomic impacts would occur if a baseline incinerator was constructed concurrently with an ACWA pilot test facility and other reasonably foreseeable off-post actions. Construction of both on-post projects would generate approximately 3,100 direct and indirect jobs in the peak year in the ROI, with employment during the operation of both facilities likely to be roughly 2,400. Construction and operations jobs for both facilities would be filled partially by workers moving into the ROI, which would have a moderate effect on the local housing market. Demand for housing would require approximately 40% of the vacant rental stock during the peak year of construction, and roughly 51% of vacant owner-occupied housing would be filled annually during operations. If current vacancy rates and housing developments already underway in the county continue, adverse cumulative impacts on housing should not occur.

Local labor markets would probably not be adversely affected by the concurrent construction and operation of an ACWA pilot test facility, a baseline incinerator, and reasonably foreseeable off-post activities. Unemployed workers in Pueblo County and adjacent El Paso County work in a variety of occupations and are sufficient in number to meet the demand for local labor that would be created by both projects.

Concurrent construction and operation of the two facilities and projected off-post activities might produce moderate impacts on the local transportation network near the post. Taken together, construction of both facilities would result in an additional 1,800 daily trips on US 50 West, the local road segment most heavily used by existing post employees; this would represent a 14% increase in annual average daily traffic. Concurrent operation of both facilities would result in an additional 1,400 daily trips, or an increase of 11% in annual average daily traffic on US 50 West. Changes in traffic levels over this road segment during construction and operation would not significantly affect the current level of service.

While additional local public service employees, medical services, and teachers would be needed if activities associated with a baseline incinerator, an ACWA pilot test facility, and other reasonably foreseeable off-post activities would occur concurrently, the increased demand would be moderate and concentrated in the peak year of construction. Given sufficient planning, local public service providers should be able cope with the additional demands by associated increases in city, county, and school district revenue collections.

6.22.14 Environmental Justice

Environmental justice impacts would be related to socioeconomic and human health impacts. No environmental justice impacts are anticipated from construction and routine operation of an ACWA pilot test facility (Section 6.20).

6.22.14.1 Cumulative Impacts with Other Actions

During construction and routine operations of either ACWA technology at PCD, high and adverse impacts on human health or socioeconomic activities are not anticipated (Sections 6.7 and 6.19). Moreover, the cumulative impacts associated with an ACWA pilot test facility and other reasonably foreseeable actions would probably not contribute to high and adverse impacts on populations (Sections 6.22.6 and 6.22.13). As a result, significant cumulative environmental justice impacts from construction and routine operations are not anticipated.

6.22.14.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

If built, a baseline incinerator would add to the human health and socioeconomic impacts from an ACWA pilot test facility alone. These impacts would not be considered high and adverse (Sections 6.22.6 and 6.22.13). As a result, significant cumulative impacts on environmental justice from the construction and routine operation of an ACWA pilot test facility, a baseline incinerator, and other reasonably foreseeable actions are not anticipated.

6.23 AGRICULTURE

This section was prepared in response to public comment on the draft of this EIS (see Volume 2, Section 2, Part DD of this final EIS). This assessment describes agriculture near PCD and evaluates whether toxic air pollutants from pilot facility operations would impact crops and livestock. It also assesses potential agricultural losses from an accident involving release of chemical agent.

6.23.1 Current Environment

6.23.1.1 Land Use

The region of influence (ROI) used to assess impacts on agriculture consists of five counties located entirely or partly within an area 30 mi (50 km) around the site. This agricultural ROI contains 5.9 million acres (2.4 million ha) of land, of which 4.3 million acres (1.7 million ha) (73%) were farmland in 1997 (USDA 1999). In the ROI, there were approximately 2,700 farms in 1997, more than half of which were operated by full-time farmers (Table 6.23-1). Average farm size in the ROI counties ranged from 1,019 to 3,530 acres (412 to 1,429 ha).

6.23.1.2 Employment

Agriculture was historically only a moderately significant local source of employment in the five-county ROI, and its importance declined during the 1990s. In 1999, with 4,785 employees in farms and agricultural services, agriculture contributed 2% to total

TABLE 6.23-1 Farms and Crop Acreage in the Agricultural Region of Influence around PCD in 1997[a]

	Land (acres) and Farms (no.)	
Farms and Land	ROI	State
Land in farms (acres)	4,307,231	32,634,221
Number of farms	2,697	28,268
Full-time farms	1,425	15,399
Average farm size (acres)	1,019–3,530	1,154
Total cropland (acres)	674,545	10,509,384
Harvested cropland (acres)	350,297	5,896,984

[a] The agricultural ROI is composed of the following counties: Crowley, El Paso, Lincoln, Otero, and Pueblo.

Source: USDA (1999).

employment in the region. Within Pueblo County, there were 1,300 agricultural workers in 1999, about 3% of total county employment (U.S. Bureau of the Census 2001a). Information on numbers of migrant and seasonal farm workers was unavailable. Within the West Census Region in 1998, such farm workers were predominantly Hispanic (69%). Whites accounted for 29% of the total (Runyan 2000).

6.23.1.3 Production and Sales

Wheat, hay, corn, and sorghum are the primary crops harvested (Table 6.23-2). In Pueblo County, there are also more than 4,000 acres (1,600 ha) in vegetable production. Onions, peppers, and watermelons make up the largest portions of this acreage (Rhoades 2000). Cattle

TABLE 6.23-2 Agricultural Production in the Agricultural Region of Influence around PCD in 1997[a]

	Crops (acres) and Livestock (no.)	
Crops and Livestock	ROI	State
Selected crops harvested		
Wheat	159,045	2,515,100
Hay	109,125	1,607,991
Corn	37,480	1,016,128
Sorghum	11,294	148,004
Beans	3,645	116,544
Livestock inventory		
Cattle and calves	317,234	3,307,301
Hogs and pigs	8,331[b]	787,440
Sheep and lambs	9,442[b]	593,755
Layers and pullets	2,115[b]	3,793,457
Broilers sold	0[b]	11,933

[a] The agricultural ROI is composed of the following counties: Crowley, El Paso, Lincoln, Otero, and Pueblo.

[b] ROI inventory is an underestimate due to data unavailability for some counties.

Source: USDA (1999).

are the most important type of livestock produced. Farms in the agricultural ROI generated $282 million in agricultural sales in 1997, representing 6% of total agricultural sales in the state as a whole. The majority of sales (76%) consisted of livestock, with a smaller contribution made by crops (Table 6.23-3) (USDA 1999).

6.23.2 Site-Specific Factors

The only aspect of pilot facility operations that could have an impact on agriculture is the release of substances that could cause toxic effects on crops or livestock. Routine or fluctuating operations of a pilot facility or an accident could release organic or inorganic compounds, including agent or processing by-products, to the environment (see Sections 6.5 and 6.6). Atmospheric releases could result in the widespread dispersal and deposition of contaminants. Exposures might result in lethal effects, reduced growth or other limiting effects, or no observable effect.

6.23.3 Impacts of the Proposed Action

Impacts from construction and operations are discussed below. This analysis considers effects on agricultural production, employment, and sales. The impacts of no action are provided for comparison.

TABLE 6.23-3 Sales by Farms in the Agricultural Region of Influence around PCD in 1992 and 1997[a]

	Sales (millions of $)	
Product	1992	1997
Livestock	259,855	214,676
Harvested crops	53,014	67,769
Agricultural ROI total	312,869	282,445
State total	4,115,552	4,534,213

[a] The agricultural ROI consists of the following counties: Crowley, El Paso, Lincoln, Otero, and Pueblo.

Sources: USDA (1994, 1999).

6.23.3.1 Impacts of Construction

Construction impacts would be confined to the installation; therefore, no significant impacts on agriculture would be likely from facility construction activities.

6.23.3.2 Impacts of Routine Operations

During routine operations, crops and livestock in the vicinity of the pilot test facility would be exposed to atmospheric emissions from the boiler stack and process stack. All such facility emissions, including emissions of criteria pollutants, organic compounds, and trace elements, would be within applicable air quality standards (see Sections 6.5 and 6.6).

A screening-level ecological/agricultural risk assessment was conducted to assess the risk to agriculture resources from deposition of air emissions during routine operations of both of the pilot test technologies. For this evaluation, it was assumed that all emissions were deposited on the soils within a circle defined by the distance from the proposed pilot test site to the nearest PCD installation boundary. This assumption provides an upper limit on possible deposition at off-site locations. Actual deposition of pollutants would be less than this value and would tend to decline with distance from PCD. Within this area, the deposited emissions were assumed to be completely mixed into the top 1 cm (0.5 in.) of soil. The resulting pollutant concentration was compared with the lowest soil benchmark value available from the EPA and state sources. These benchmark concentrations for soil are based on conservative ecological endpoints and sensitive toxicological effects on plants, wildlife, and soil invertebrates. Soil chemical concentrations that fall below the benchmark are considered to have negligible risk. Those chemicals that exceed the benchmark values are considered to be contaminants of concern and would be evaluated in further detail. None of the chemicals emitted by a pilot test facility, when deposited on soils, would exceed the soil benchmark values, indicating that the risks of impacts on agriculture from maximum concentrations would be negligible (Tsao 2001a). Off-site concentrations would be substantially lower due to the effect of emission dilution over a larger area.

Most of the toxic air pollutants emitted by a pilot test facility (Section 6.6) would be from the boiler stack, a source type commonly found in any combustion facility that requires fuel to heat up the system. Boiler emissions would be followed in quantity by the emissions from the emergency diesel generator, which would operate only in case of power failure. The technology-specific emissions would contribute very little to the overall deposition of metals and organics onto soil. There is no evidence that deposited residuals from agent emitted due to fluctuating operations would bioaccumulate through the food chain (USACHPPM 1999b).

6.23.3.3 Impacts of Accidents

Section 6.21 describes potential accidents for both the proposed action and no action, including a catastrophic event that would release agent to surrounding land areas. Although extremely unlikely, release of agent might affect a major portion of the ROI. The largest impact of an accident on agriculture would result if all of the crops and livestock produced in a single season in the ROI were interdicted (either by federal or state authorities) and removed from the marketplace. The impacts from such losses in agricultural output on the economy of the counties within the 30-mi (50-km) radius surrounding BGAD would be significant. Table 6.23-4 presents three scenarios of regional losses of employment and income associated with 50, 75, or 100% loss of agricultural production (see Appendix G). These scenarios are presented for each of the pilot test technologies and for no action. The estimated losses do not include the losses that would occur in the case of death of breeding stocks of animals. Because scenarios involving widespread agent release were identified for both the proposed action and no action, the magnitude of such losses is unlikely to differ between the proposed action and no action.

TABLE 6.23-4 Agricultural Impacts of Accidents at PCD Associated with the Proposed Action and No Action[a]

Parameter	Neut/SCWO	Neut/Bio	No Action
Impacts to the regional economy from a one-year loss of agricultural output			
100% loss of agricultural output			
Employment (no. of jobs)	4,450	4,450	4,450
Income (millions of $)	200	200	200
75% loss of agricultural output			
Employment (no. of jobs)	3,340	3,340	3,340
Income (millions of $)	150	150	150
50% loss of agricultural output			
Employment (no. of jobs)	1,220	1,220	1,220
Income (millions of $)	100	100	100

[a] Impacts from no action and the proposed action are presented for the first year of operation of an ACWA facility (2009).

6.23.4 Impacts of No Action

6.23.4.1 Impacts of Routine Operations

The agricultural impacts of continuing routine operations at PCD would be negligible and as included in baseline conditions for the PCD region.

6.23.4.2 Impacts of Accidents

Potential impacts on agriculture associated with the accident scenarios under the no action alternative would be the same as those discussed under the proposed action alternatives (Section 6.23.3.3).

6.24 OTHER IMPACTS

6.24.1 Unavoidable Adverse Impacts

Most potential adverse impacts identified in this EIS would either be negligible or could be avoided through careful facility siting and adherence to best management practices during the construction and operation of industrial facilities. However, some minor unavoidable adverse impacts could result from implementation of an ACWA technology. These are described in this section.

ACWA facility construction activities, including land clearing and moving of personnel and equipment in the construction staging area(s), would require disturbance of as much as 25 acres (10 ha) and could result in unavoidable adverse impacts comparable to those that would occur at any construction site of similar size. An additional 60 acres could be disturbed by utility construction.

- As much as 85 acres (34 ha) of vegetative and terrestrial habitats could be disturbed. Most disturbances would be short-term (about 34 months) and would be mitigated through revegetation.

- Wildlife would be affected by loss of habitat, increased human activity in the construction area, increased traffic on local roads, and noise. Less mobile and burrowing species (such as amphibians, some reptiles, and small mammals) could be killed during vegetation clearing and other site preparation activities.

- The loggerhead shrike, a federal sensitive species, could be affected by loss of habitat.

- Although no cultural resources are known to exist in the construction areas, it is possible that archaeological resources could be encountered and destroyed during construction. However, since there was past disturbance in the construction areas, the likelihood of finding important cultural resources there is remote.

- Air quality would be affected during construction and operations as a result of increased fugitive dust and stack exhaust emissions. However, the concentration levels of these pollutants, when added to background air concentrations, would be below the applicable air quality standards.

- An estimated 44 (Neut/Bio) and 48 (Neut/SCWO) worker injuries could occur during ACWA facility construction. When workers follow established safety precautions, however, the risk of worker fatalities is very low.

The normal operations of an ACWA facility would have minor unavoidable adverse impacts. Facility workers would be subject to some risks from operations; consequently, an estimated 97 injuries are expected from occupational hazards. There would also be minor increases in emissions of air pollutants, but these emissions would be well below allowable levels and would not significantly affect human health, ecological resources, or wetlands. Impacts related to fluctuating operations are also expected to be minimal, given the safety features that would be built into the design of any of the ACWA facilities, which would prevent migration of contaminants to the environment in the event of a spill or other operational accident. While there would be significant unavoidable adverse impacts related to a catastrophic accident, the probability of this scenario is extremely low.

6.24.2 Irreversible and Irretrievable Commitment of Resources

Irreversible commitments are those that cannot be reversed (i.e., the resource is permanently lost or consumed). Irreversible commitments that would result from the construction and operation of a proposed ACWA pilot test facility would include the consumption of electricity and natural gas, as described in Section 6.3. Materials such as the concrete and steel used to construct the pilot test facility would also generally be irreversible commitments, since they would probably not be recyclable because of potential agent contamination. Data on the quantities of construction materials that would be required for an ACWA pilot facility are provided in Kimmell et al. (2001).

Irretrievable commitments are those that are lost for a period of time. Irretrievable commitments that would result from the construction and operation of a proposed ACWA pilot test facility would include water and habitat. Implementation of an ACWA technology would consume both process and potable water for the period of construction and operations (i.e., less than seven years total). (Amounts of water consumed are discussed in Section 6.3.) When operations would cease, water used by the ACWA technology would be available for other uses. Habitat lost because of the construction of an ACWA pilot test facility would also represent an irretrievable commitment. Habitat in the footprint of an ACWA pilot facility would be lost during the period of construction and operations (i.e., less than six years total). After decontamination and decommissioning, the land could be revegetated, and habitat could be restored. Depending on the methods chosen for decommissioning, habitat losses could also be considered irreversible.

6.24.3 Short-Term Uses of the Environment and Enhancement of Long-Term Productivity

Constructing and operating one or more pilot test facilities would be an action of limited duration — less than six years. Construction would disturb soils, wildlife, and other biota, and it would produce temporary air emissions. Operations would produce air emissions, liquid effluents, and liquid and solid wastes. Air emissions and liquid effluent releases would be temporary, ceasing at the end of project life. Disposal of wastes on post and off post would be a long-term commitment of land with restricted use. Construction and operation of one or more pilot test facilities would have short-term socioeconomic impacts for the duration of pilot testing by creating jobs, increasing tax revenues, and increasing demand for housing and public services.

After pilot testing, the ACWA facility might be used to destroy the remaining ACW stockpile. At the end of stockpile destruction, the facilities would be decontaminated and demolished, and the land would be returned to long-term productivity.

The pilot testing of an ACWA technology system would not substantially reduce or increase the risks to the general public from accidents involving chemical agents. This situation would occur because the accidents with the greatest consequences, although highly unlikely, are associated with ACW storage, and ACW storage would continue during pilot testing. The consequences from highly unlikely accidents involving agents at a pilot test facility would be less than the consequences from similar highly unlikely accidents involving ACW storage.

6.25 MITIGATION

For environmental resource areas where adverse impacts have been identified, mitigation measures have been developed to minimize or avoid potential impacts from constructing and operating an ACWA pilot facility. The mitigation measures are outlined below. Because no adverse impacts on land use, infrastructure, noise, visual resources, aquatic resources, socioeconomics, or environmental justice were identified, no mitigation would be required for these resource areas.

6.25.1 Waste Management

Adequate facilities exist to handle the hazardous and nonhazardous wastes that would be generated by construction activities. Large potentially hazardous waste streams would be produced from operating either of the neutralization pilot test facilities. The Army will work with regulators to develop procedures for handling potentially hazardous wastes resulting from ACW destruction. These procedures might include conducting tests to determine the toxicity of wastes, developing a process to stabilize salt wastes, sending wastes to a permitted hazardous waste disposal facility, or others.

6.25.2 Air Quality — Criteria Pollutants

Fugitive dust emissions would be generated during construction and operation of either ACWA pilot facility. To minimize dust emissions, access roads would be paved with asphaltic concrete, and standard dust suppression measures (i.e., watering) would be employed at the construction sites.

6.25.3 Air Quality — Toxic Air Pollutants

No significant emissions of hazardous air pollutants are expected during construction of either ACWA pilot facility. During operations, exhaust air released through filter farm stacks for both ACWA technologies would be purified through multiple carbon filter banks, and agent monitoring devices between filter banks would ensure that, in the unlikely event that some agent was not destroyed in the neutralization process and subsequent treatment, it would be detected, and the causes would be remedied immediately.

6.25.4 Human Health

Some risk to workers would be present as a result of constructing and operating either ACWA pilot facility. Workers would adhere to safety standards and use protective equipment as necessary to reduce these risks. Also, the ACWA facility would be designed and operated to contain potential agent emissions to air, water, or soils. Design components (e.g., recycling process effluents, surrounding the facility with a berm, installing automated agent detection devices) would be incorporated to minimize operational and accidental emissions. Emergency response procedures are in place to protect human health and safety, both on post and off post, in the unlikely event of a significant release to the environment from a catastrophic accident (see Section 6.7.1.4).

6.25.5 Geology and Soils

Best management practices (e.g., use of soil fences, berms, and liners; revegetation of disturbed land following construction) would be employed to minimize the potential for soil erosion that might be caused by construction of an ACWA pilot facility. A berm would surround the facilities to contain any potential releases from spills or fluctuating operations. In addition, the facilities would be designed to incorporate many safety features (e.g., detection devices, automatic shutoff) that would prevent migration of spills from an operational accident.

6.25.6 Groundwater, Surface Water, and Wetlands

Runoff created by construction would be contained or minimized by using standard erosion control measures. A berm would surround the facilities to contain any potential releases from spills or fluctuating operations. The facilities would be designed to incorporate many safety features (e.g., detection devices, automatic shutoff) that would prevent migration of spills from an operational accident.

6.25.7 Vegetation, Wildlife, and Protected Species

Construction could affect as much as 85 acres (34 ha) of vegetative and terrestrial habitat. The following mitigation measures would be implemented to reduce adverse impacts on ecological resources during construction.

- Facilities would be sited on previously disturbed vegetative areas, where possible.
- Disturbed areas along infrastructure rights-of-way and the construction site would be revegetated with native seed/shrub mixes recommended by the Natural Resources Conservation Service.
- Vehicle speed along site access roads would be low to reduce the incidence of roadkills.
- Periodic openings would be provided in all nonsecurity fencing being built to allow pronghorn antelope to pass.
- Before construction of either ACWA facility, the Army would conduct clearance surveys of construction areas for protected species.

- Construction activities would avoid protected species' habitats.

- Construction workers would be briefed on sensitive ecological resources and mitigation measures.

6.25.8 Cultural Resources

The Army would consult with the Colorado SHPO to confirm that an archaeological survey of the construction area was not warranted. Unexpected discoveries of archaeological artifacts in the construction area would be evaluated and reported in accordance with cultural resource laws and regulations.

6.26 REFERENCES FOR CHAPTER 6

Acoustical Society of America, 1983, *American National Standard Specification for Sound Level Meters, ANSI S1.4-1983*, New York, N.Y., Feb.

Acoustical Society of America, 1985, *American National Standard Specification for Sound Level Meters, ANSI S1.4A-1985, Amendment to ANSI S1.4-1983*, New York, N.Y., June.

Agency for Toxic Substances and Disease Registry, 1992, *Toxicological Profile for Mustard "Gas*," TP-91/92, prepared by Clement International Corp., for U.S. Department of Health and Human Services, Public Health Service, Washington, D.C., Sept.

Alley, P., 2000, record of telephone conversation on FTE employees between Alley (City of Pueblo, Pueblo, Colo.) and L. Nieves (Argonne National Laboratory, Argonne, Ill.), Oct.

Allison, T.A., 2001, *Forecasted Data for ACWA Socioeconomic Analyses*, intralaboratory memorandum from Allison to M. Goldberg (Argonne National Laboratory, Argonne, Ill.), Oct. 22.

Amador, S., 2000, record of telephone conversation on FTE employees between Amador (Pueblo County, Pueblo, Colo.) and L. Nieves (Argonne National Laboratory, Argonne, Ill.), Oct.

American Medical Association, 1999, *Physician Characteristics and Distribution in the U.S.*, Chicago, Ill.

Anderson, P., 2000, e-mail on noise associated with Tooele incinerator from Anderson (EG&G Inc., Tooele, Utah) to Y.-S. Chang (Argonne National Laboratory, Argonne, Ill.), Oct. 4.

ATSDR: see Agency for Toxic Substances and Disease Registry.

Avian Power Line Interaction Committee, 1996, *Suggested Practices for Raptor Protection on Power Lines: The State of the Art in 1996*, Edison Electric Institute/Raptor Research Foundation, Washington, D.C.

Benjamin and Geomatrix, 1996, *Probabilistic Seismic Hazard Assessment for the U.S. Army Chemical Disposal Facility, Pueblo Depot Activity, Colorado*, JBA 148-130-PU-002, Rev. 0, prepared by Jack R. Benjamin and Associates, Inc., Mountain View, Calif., and Geomatrix Consultants, Mountain View, Calif., March.

Brattstrom, B.H., and M.C. Bondello, 1983, "Effects of Off-Road Vehicles on Desert Vertebrates," pp. 167–206 in R.H. Webb and H.G. Wilshore (editors), *Environmental Effects of Off-Road Vehicles: Impacts and Management of Arid Regions*, Springer Verlag, New York, N.Y.

Burton, T.M., 2001, *Breathing Rates for Toxicity Data*, memorandum from Burton (U.S. Army Nuclear and Chemical Agency, Springfield, Va.) to Commander (Soldier and Biological Chemical Command, Aberdeen Proving Ground, Md.), May 24.

Cain, K., 1999, *Re-application for the National Pollutant Discharge Elimination Permit Number CO-0034673 for Pueblo Chemical Depot*, EPA ID FCO8213820725, U.S. Environmental Protection Agency, Region VIII, March 30.

Canestorp, K.M., 1999, notes from PCD site visit and meeting with Canestorp (U.S. Fish and Wildlife Service, Pueblo, Colo.) by E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), Dec. 7.

Canestorp, K.M., 2000, letter from Canestorp (U.S. Fish and Wildlife Service, Pueblo Chemical Depot, Pueblo, Colo.) to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), May 1.

Carlson, L.W., 2000, letter on federal threatened and endangered species from Carlson (Colorado Ecological Field Services Office, U.S. Fish and Wildlife Service, Lakewood, Colo.) to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), May 9.

CBDCOM, 1997, *Solicitation No. DAAM01-97-R-0031*, U.S. Army, Chemical and Biological Defense Command, Aberdeen Proving Ground, Md., Aug.

CDC: see Centers for Disease Control and Prevention.

CDPHE: see Colorado Department of Public Health and Environment.

Centers for Disease Control and Prevention, 1988, “Final Recommendations for Protecting the Health and Safety against Potential Adverse Effects of Long-Term Exposure to Low Doses of Agents: GA, GB, VX, Mustard Agent (H, HD, T) and Lewisite (L),” U.S. Department of Health and Human Services, *Federal Register* 53(50)8504–8507, March 15.

CEQ: see Council on Environmental Quality.

Chafin, D.T., 1996, *Hydrogeology of the Alluvial Aquifers at the Pueblo Depot Activity Near Pueblo, Colorado*, Water-Resources Investigations Report 95-4137, U.S. Geological Survey, Denver, Colo.

Chick, N., 2001, fax on background concentrations from Chick (Colorado Department of Public Health and Environment, Denver, Colo.) to A. Smith (Argonne National Laboratory, Argonne, Ill.), March 1.

City of Pueblo, 1999, *1997–1998 City of Pueblo Comprehensive Annual Financial Report*, Pueblo, Colo.

CNHP: See Colorado Natural Heritage Program.

COE: see U.S. Army Corps of Engineers.

Colorado Department of Education, 2000, http://www.cde.state.co.us, accessed in 2000.

Colorado Department of Public Health and Environment, 1999, *Colorado Air Quality Commission Report to the Public, 1998–1999*, Air Pollution Control Division, Denver, Colo.

Colorado Department of Public Health and Environment, 2001, *Ambient Air Quality Standards: Colorado Air Quality Control Commission*, http://www.cdphe.state.co.us/op/airregs.asp.

Colorado Natural Heritage Program, 1999, *Conservation Status Handbook, Colorado’s Animals, Plants, and Plant Communities of Special Concern*, Vol. 3, No. 2., Colorado State University, Fort Collins, Colo., and The Nature Conservancy.

Corbitt, R.A., 1990, *Standard Handbook of Environmental Engineering*, McGraw-Hill, Inc.

Council on Environmental Quality, 1997, *Environmental Justice Guidance under the National Environmental Policy Act*, CEQ, Executive Office of the President, Washington, D.C., Dec.

Dawson, S.V., and G.V. Alexeeff, 2001, "Multi-Stage Model Estimates of Lung Cancer Risk from Exposure to Diesel Exhaust, Based on a U.S. Railroad Worker Cohort," *Risk Analysis* 21(1):1–18.

DeMers, G. 1999, fax on munitions from DeMers (Pueblo Chemical Depot, Pueblo, Colo.) to H. Hartmann (Argonne National Laboratory, Argonne, Ill.), Dec. 14.

DOC: see U.S. Department of Commerce.

DOI: see U.S. Department of the Interior.

Ebasco Environmental, 1990, *Enhanced Preliminary Assessment Report: Pueblo Depot Activity Pueblo, Colorado*, prepared by Ebasco Environmental, Lakewood, Colo., under the supervision of Argonne National Laboratory, Argonne, Ill., for U.S. Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, Md., March.

EDAW et al., 1994, *Pueblo Depot Activity Reuse Development Plan*, prepared by EDAW, Inc., San Francisco, Calif., and Hammer, Siler, George Wilson & Co., Silver Spring, Md., for Pueblo Area Council of Governments and U.S. Department of Defense, Office of Economic Adjustment, Dec.

Emlen, J.T., 1971, "Population Densities of Birds Derived from Transect Counts," *The Auk* 88:323–342.

EPA: See U.S. Environmental Protection Agency.

Executive Order 13045, 1997, "Protection of Children from Environmental Health Risks and Safety Risks," *Federal Register* 62(78):19885-19888, Apr. 23.

FEC: See Foothill Engineering Consultants, Inc.

Folga, S.M., 2001, *Incinerator Utility Usage*, intraoffice e-mail from Folga to A.E. Smith and L.A. Nieves (Argonne National Laboratory, Argonne, Ill.), May 25.

Foothill Engineering Consultants, Inc., 1998, *Cultural Resources Survey of the Pueblo Chemical Depot, Pueblo County, Colorado,* Vols. I–III, prepared by T. Hoeffer et al., FEC, Golden, Colo., submitted to Rust Environmetnal and Infrastructure, Englewood, Colo., for U.S. Army Corps of Engineers, Omaha District, Omaha, Neb., May 26.

Freil, G.E., 1997, *Maximum Credible Events (MCE) for Daily Chemical Operations,* memorandum and attachments from Freil (U.S. Army Materiel Command, Alexandria, Va.) to various Army staff, AMCCB (385-61), Apr. 30.

GA Technologies, 1987, *Risk Analysis of the Continued Storage of Chemical Munitions, Chemical Stockpile Disposal Program,* SAPEO-CDE-IS-87009, prepared by GA Technologies, San Diego, Calif., for Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Aug.

General Atomics, 1999, *Assembled Chemical Weapons Assessment (ACWA) Draft Test,* Technical Report DAAM01-98-D-003 129300/0, San Diego, Calif., June 30.

Goodheer, I., 1994, *Dose Response Data for the Tooele Chemical Agent Disposal Facility Quantitative Risk Assessment (TOCDF QRA)*, memorandum from Goodheer (U.S. Army Nuclear and Chemical Agency, Springfield, Va.) to Commander (U.S. Army Chemical Material Destruction Agency, Aberdeen Proving Ground, Md.), June 13.

Hammerson, G.A., 1999, *Amphibians and Reptiles in Colorado*, Colorado Department of Natural Resources, Division of Wildlife, Denver, Colo.

Holland, M., 2000, *PCD Population Distribution*, e-mail from Holland (U.S. Army Corps of Engineers, Pueblo, Colo.) to H. Hartmann (Argonne National Laboratory, Argonne, Ill.), Apr. 26.

Kaczmarek, K., 2000, letter from Kaczmarek (Colorado Department of Natural Resources, Division of Wildlife, Pueblo, Colo.) to E. Pentecost (Argonne National Laboratory, Argonne, Ill.), May 26.

Kimmell, T., et al., 2001, *Technology Resource Document for the Assembled Chemical Weapons Assessment Environmental Impact Statement*, ANL/EAD/TM-101, Vols. 1–5 and errata, Argonne National Laboratory, Argonne, Ill.

Kingery, H.E. (editor), 1998, *Colorado Breeding Bird Atlas*, Colorado Bird Atlas Partnership and Colorado Division of Wildlife, Denver, Colo.

Kirkham, R.M., and W.P. Rogers, 1981, *Earthquake Potential in Colorado, A Preliminary Evaluation*, Bulletin 43, Colorado Geological Survey, Department of Natural Resources, Denver, Colo.

Knopf, F.L., 1996, "Perspectives on Grazing Non-Game Bird Habitats," in *Rangeland Wildlife*, R.R. Krausman (editor), Society for Range Management, Denver, Colo.

Kornelly and Associates and KPMG Inc., 1999, *Economic Impact Study for the Pueblo Chemical Depot Chemical Demilitarization Facility*, Pueblo, Colo., Oct.

Larson, T.K., and D.M. Penny (editors), 1995, *Results of a Class III Pedestrian Survey on Portions of the Pueblo Depot Activity Area, Pueblo County, Colorado*, Vol. I and II, prepared by Gulf Engineers & Consultants, Inc., Baton Rouge, La., and Larson-Tibesar Associates, Inc., Laramie, Wyo., for U.S. Army Corps of Engineers, Omaha District, Omaha, Neb., Jan.

Leach, B., 2000, record of telephone conversation between Leach (Pueblo County, Pueblo, Colo.) and L. Nieves (Argonne National Laboratory, Argonne, Ill.), Sept.

Liebich, R.E., and M.P. Cristoforo, 1988, "The Use of Audibility Analysis to Minimize Community Noise Impact of Today's Smaller Generation Facilities Located near Residential Areas," presented at American Power Conference 50th Annual Meeting, Chicago, Ill., Apr.

Light, S., 2000, *Draft Chemical Stockpile Demilitarization Program, Pueblo Pre-RCRA Construction*, Briefing, Pueblo Chemical Depot, U.S. Army Corps of Engineers, Engineering and Support Center, Pueblo, Colo., June 21.

Luz, G.A., and J.B. Smith, 1976, "Reactions of Pronghorn Antelope to Helicopter Overflight," *Journal of the Acoustical Society of America* 59:1514–1515.

MacDonald and Mack Partnership, 1984, *Historic Properties Report, Pueblo Depot Activity, Pueblo, Colorado,* Minneapolis, Minn., Aug.

Manci, K.M., et al., 1988, *Effects of Aircraft Noise and Sonic Booms on Domestic Animals and Wildlife*, AFESC TR 88-14, NERC-88/29, U.S. Air Force, Engineering and Service Center, and U.S. Fish and Wildlife Service, Fort Collins, Colo.

Marrero, P., 2000, record of telephone conversation between Marrero (Pueblo Chemical Depot, Pueblo, Colo.) and T. Allison (Argonne National Laboratory, Argonne, Ill.), Jan.

Mitretek, 2001a, *Estimates of Environmental Releases Associated with the Destruction of Assembled Chemical Weapons during Pilot Plant Testing of the Parsons Honeywell Neutralization/Biotreatment Process*, Mitretek Systems, Inc., McLean, Va., May.

Mitretek, 2001b, *Estimates of Environmental Releases Associated with the Destruction of Assembled Chemical Weapons during Pilot Plant Testing of the General Atomics Neutralization/Supercritical Water Oxidation Process*, Mitretek Systems, Inc., McLean, Va., May.

Munro, N.B., et al., 1999, "The Sources, Fate, and Toxicity of Chemical Warfare Agent Degradation Products," *Environmental Health Perspectives* 107(12):933–974, Dec.

National Oceanic and Atmospheric Administration, 1999, *Local Climatological Data: Annual Summary with Comparative Data for Pueblo, Colorado*, National Climatic Data Center, Asheville, N.C.

National Research Council, 1997a, *Risk Assessment and Management at Deseret Chemical Depot and the Tooele Chemical Agent Disposal Facility*, prepared by National Research Council, Washington, D.C., published by National Academy Press, Washington, D.C.

National Research Council, 1997b, *Review of Acute Human-Toxicity Estimates for Selected Chemical-Warfare Agents*, prepared by Subcommittee on Toxicity Values for Selected Nerve and Vesicant Agents, National Research Council, Washington, D.C., published by National Academy Press, Washington, D.C.

National Safety Council, 1999, *Injury Facts, 1999 Edition*, Itasca, Ill.

NOAA: see National Oceanic and Atmospheric Administration.

Oburn, D., 2000, record of telephone conversation between Oburn (Pueblo Chemical Depot, Pueblo, Colo.) and T. Allison (Argonne National Laboratory, Argonne, Ill.), Jan.

Opresko, D.M., et al., 1998, "Chemical Warfare Agents: Estimating Oral Reference Doses," in Ware, G.W. (editor), *Reviews of Environmental Contamination and Toxicology*, Vol. 156, Springer-Verlag, New York, N.Y.

Parker, P.L., 1995, *Guidelines for Evaluating and Documenting Traditional Cultural Properties*, National Register Bulletin 38, U.S. Department of the Interior, National Park Service., Washington, D.C.

Parsons and Allied Signal, 1999, *Assessment of Technologies for Assembled Chemical Weapon Demilitarization*, draft demonstration test final report, prepared by Parsons Infrastructure & Technology Group, Inc., and Allied Signal for U.S. Army Chemical and Biological Command, July.

PCD: see Pueblo Chemical Depot.

PDA: see Pueblo Depot Activity.

PDADA: see Pueblo Depot Activity Development Authority.

PMACWA, 1999, *Assembled Chemical Weapons Program: Supplemental Report to Congress*, U.S. Department of Defense, Program Manager Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md., Sept. 30.

Pueblo Chemical Depot, 1997, *Pueblo Chemical Depot Chemical Accident/Incident Response and Assistance Plan (PCD-CAIRAP)*, U.S. Army, Pueblo, Colo.

Pueblo Chemical Depot, 1999, *Hazardous Waste Management Plan*, prepared by Harza Engineering Company, Chicago, Ill., for Pueblo Chemical Depot, Directorate of Environmental Management, Pueblo, Colo., and U.S. Army Corps of Engineers, Omaha District, Omaha, Neb., Dec.

Pueblo Chemical Depot, 2000a, *Pueblo Chemical Depot Recycling Plan*, U.S. Army, Pueblo, Colo., June.

Pueblo Chemical Depot, 2000b, *Installation Spill Contingency Plan*, draft final, U.S. Army, Pueblo, Colo.

Pueblo Chemical Depot, 2000c, *Oil and Hazardous Substance Spill Prevention, Control, and Countermeasures Plan*, draft final, U.S. Army, Pueblo, Colo.

Pueblo Chemical Depot, 2001, *Chemical Accident/Incident Response and Assistance Plan (PCD-CAIRAP)*, Apr.

Pueblo County, 1999, *1997–1998 Pueblo County Comprehensive Annual Financial Report*, Pueblo, Colo.

Pueblo Depot Activity, 1995, *Final Synthetic Minor Permit Application for Pueblo Depot Activity, Pueblo, Colorado*, prepared for L.M. Olson (Colorado Department of Public Health and Environment, Denver, Colo.), Oct.

Pueblo Depot Activity Development Authority, 1996, *Master Lease Interim Lease No. DACA45-1-96-6001 with Supplemental Agreements*, Pueblo, Colo., Feb.

Pueblo Depot Activity Development Authority, 2000, *Pueblo Chemical Depot Reuse Development Plan Update*, Pueblo, Colo., June.

Raytheon, 1996, *Johnston Atoll Chemical Agent Disposal System (JACADS) Human Health & Ecological Risk Assessment,* prepared by Raytheon Engineers & Constructors, Inc., Philadelphia, Penn., for U.S. Army Chemical Demilitarization and Remediation Activity, Aberdeen Proving Ground, Md., Dec. 30.

Rhoades, R., 2000, letter from Rhoades (Pueblo Field Office, Natural Resources Conservation Service, U.S. Department of Agriculture) to T. Allison (Argonne National Laboratory, Argonne, Ill.), July 26.

Rhodes, M., 2000, *Meteorological Data for PCD,* e-mail from Rhodes (University of Illinois, Urbana, Ill.) to Y.-S. Chang (Argonne National Laboratory, Argonne, Ill.), Jan. 5.

Rice, R.C., et al., 1989, "Ionic Composition of Vadose Zone Water in an Arid Region," *Groundwater* 27(6):813–822.

Rink, B., 2000, *Pueblo Data,* e-mail from Rink (Colorado Department of Public Health and Environment, Denver, Colo.) to Y.-S. Chang (Argonne National Laboratory, Argonne, Ill.), Feb. 3.

Robbins, C.S., et al., 1966, *Birds of North America,* Golden Press, New York, N.Y.

Ross, T., 2001, record of telephone conversation between Ross (Pueblo Chemical Depot, Pueblo, Colo.) and H. Hartmann (Argonne National Laboratory, Argonne, Ill.), Oct.

Runyan, J.L., 2000, *Profile of Hired Farmworkers, 1998 Annual Averages,* U.S. Department of Agriculture, Economic Research Service, Washington, D.C., http://www.ers.usda.gov/Publications/AER790/.

Rust, 1997, *Draft Final Preliminary Site-Wide Groundwater Evaluation Report, Pueblo Chemical Depot, Pueblo, Colorado,* prepared by Rust Environment & Infrastructure Inc., Englewood, Colo., for U.S. Army Corps of Engineers, Omaha District, Neb., Dec.

Rust and E-E Management, 1999, *Ecological Surveys at Pueblo Chemical Depot, Pueblo, Colorado,* prepared by Rust Environmental and Infrastructure Inc., Englewood, Colo., and Engineering-Environmental Management, Inc., Lakewood, Colo., for U.S. Army Corps of Engineers, Omaha District, Omaha, Neb., June.

SAIC: see Science Applications International Corporation.

School District 60, 1999, *FY 1997–1998 Annual Report for the Colorado Department of Education,* Pueblo, Colo.

School District 70, 1999, *FY 1997–1998 Annual Report for the Colorado Department of Education*, Pueblo, Colo.

Science Applications International Corporation, 1996, *Pueblo Chemical Agent Disposal Facility Phase 1 Quantitative Risk Assessment*, Report SAIC-96/2602, prepared by SAIC, Abingdon, Md., for U.S. Army Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md, Nov.

Scott, G.R., et al., 1978, *Geologic Map of the Pueblo 1° × 2° Quadrangle, South-Central Colorado*, Miscellaneous Investigations Map I-1022, U.S. Geological Survey, Denver, Colo.

Shah, H.H., and J.W. Reed, 1996, *Seismic Fragilities of Structures and Equipment, U.S. Army Pueblo Chemical Agent Disposal Facility Pueblo, Colorado*, prepared by Jack R. Benjamin and Associates, Inc., Mountain View, Calif., for Science Applications International Corporation, March.

Simmons, T.H., and R.L. Simmons, 1998, *Historic Structures Survey, Pueblo Chemical Depot, Pueblo County, Colorado*, prepared by Front Range Research Associates, Inc., Denver, Colo., for Foothill Engineering Consultants, Inc., Golden, Colo.

SMG Marketing Group, Inc., 2001, data from Hospital Select web site, Chicago, Ill., http://www/hospitalselect.com.

Smith, A.E., 2001, record of telephone conversations on actions in Pueblo County in the vicinity of Pueblo Chemical Depot between Smith (Argonne National Laboratory, Argonne, Ill.) and various sources, Feb. 27.

Smith, K., 2000a, *Information about Stockpile Generated Wastes at Pueblo Chemical Depot*, record of telephone conversation between Smith (Argonne National Laboratory, Argonne, Ill.) and T. Ross (Pueblo Chemical Depot, Pueblo, Colo.), Oct. 24.

Smith, K., 2000b, record of telephone conversation between Smith (Pueblo County Department of Transportation, Pueblo, Colo.) and T. Allison (Argonne National Laboratory, Argonne, Ill.), Jan. 24.

Storm Prediction Center, 2000, *Historical Tornado Data Archive*, http://www.spc.noaa.gov/archive/tornadoes/index.html.

Tinney, R., 2000, record of telephone conversation between Tinney (Colorado Department of Transportation, Denver, Colo.) and T. Allison (Argonne National Laboratory, Argonne, Ill.), Jan. 24.

Transportation Research Board, 1985, *Highway Capacity Manual,* National Research Council, Washington, D.C.

Tsao, C.L., 2001a, *Ecological Risk Assessment of Chemical Emissions from an ACWA Pilot Facility during Normal Operation for Pueblo Chemical Depot (PCD)*, intraoffice memorandum from Tsao to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), Nov. 30.

Tsao, C.L., 2001b, *Calculation of Inhalation HQ of HD (Mustard Gas) for Terrestrial Wildlife Ecological Risk Assessment at Pueblo Chemical Depot (PCD)*, intraoffice memorandum from Tsao to E.D. Pentecost (Argonne National Laboratory, Ill.).

USACHPPM: see U.S. Army Center for Health Promotion and Preventive Medicine.

USAEHA: see U.S. Army Environmental Hygiene Agency.

U.S. Army, 1982, *Installation Environmental Assessment*, draft, Headquarters, U.S. Army Depot System Command, Tooele, Utah, Dec.

U.S. Army, 1984, *Installation Environmental Assessment, Pueblo Depot Activity, Pueblo, Colorado,* Nov. 1984 revision of Dec. 1982 draft, Headquarters, U.S. Army Depot System Command, Tooele, Utah.

U.S. Army, 1988, *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement,* Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Jan.

U.S. Army, 1991, *Final Environmental Impact Statement for Disposal of Chemical Agents and Munitions Stored at Anniston Army Depot, Anniston, Alabama,* Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., May.

U.S. Army, 1997a, *Environmental Assessment: Reuse of a Portion of Pueblo Chemical Depot, Colorado,* U.S. Army Materiel Command, Alexandria, Va.

U.S. Army, 1997b, *Revised Final Environmental Impact Statement for Disposal of Chemical Agents and Munitions Stored at Pine Bluff Arsenal, Arkansas*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Apr.

U.S. Army, 2000, *1999 Biennial Hazardous Waste Report for the Pueblo Chemical Depot (PCD),* attachment to letter from K. Cain (Department of the Army, Pueblo Chemical Depot, Pueblo, Colo.) to M. Neumiller (Colorado Department of Public Health and Environment, Hazardous Materials and Waste Management Division, Denver, Colo.), Feb. 22.

U.S. Army, 2001, *Draft Environmental Impact Statement for Destruction of Chemical Munitions at Pueblo Chemical Depot, Colorado*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., May.

U.S. Army Center for Health Promotion and Preventive Medicine, 1999a, *Development and Derivation of Inhalation Benchmark Values for Wildlife: An Application to Identify Ecological Risk to Airborne Contaminants*, Study 87-1299-99, Health Effects Research Program, Toxicology Directorate, Aberdeen Proving Ground, Md., Dec.

U.S. Army Center for Health Promotion and Preventive Medicine, 1999b, *Derivation of Health-Based Environmental Screening Levels for Chemical Warfare Agents,* Aberdeen Proving Ground, Md.

U.S. Army Corps of Engineers, 1987, *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1, Waterways Experiment Station, Vicksburg, Miss.

U.S. Army Environmental Hygiene Agency, 1990, *Environmental Noise Study No. 52-34-0490-90, Pueblo Army Depot Activity, Pueblo, Colorado, 11-15 September 1989*, Aberdeen Proving Ground, Md.

U.S. Army et al., 1987, *Geological-Seismological Investigation of Earthquake Hazards for a Chemical Stockpile Disposal Facility at the Pueblo Depot Activity, Colorado*, prepared by the U.S. Army Engineer Division, Huntsville, Ala.; Jacobs Engineering Group, Inc.; and URS/John A. Blume & Associates, Engineers, for the Office of the Program Manager for Chemical Munitions.

U.S. Army et al., 1992, *Seismic Design for Buildings*, Army Technical Memorandum 5-80-10, Headquarters, Departments of the Army, Navy, and Air Force, Washington, D.C.

U.S. Army et al., 1997, *Programmatic Agreement among United States Army, Colorado State Historic Preservation Officer, and Advisory Council on Historic Preservation for the Utilization and Eventual Disposal of Above Ground Facilities at Pueblo Chemical Depot, Colorado*.

U.S. Bureau of Labor Statistics, 2001, *Local Area Unemployment Statistics*, Washington, D.C., ftp://ftp.bls.gov/pub/time.series/la/, accessed in Feb. 2001.

U.S. Bureau of the Census, 1991, *1990 Census of Population and Housing, Summary of Population and Housing Characteristics, Colorado*, Washington, D.C.

U.S. Bureau of the Census, 1992a, *1990 Census of Population and Housing, Summary of Social, Economic, and Housing Characteristics, Colorado*, Washington, D.C.

U.S. Bureau of the Census, 1992b, *County Business Patterns, 1990*, Washington, D.C., http://www.census.gov/ftp/pub/epcd/cbp/view/cbpview.html, accessed in Sept. 2000.

U.S. Bureau of the Census, 1992c, *1990 Census of Population and Housing*, data including STF 1 and STF 3a, Washington, D.C., http://factfinder.census.gov., accessed in Feb. 2000.

U.S. Bureau of the Census, 1994, *City and County Data Book*, *1994,* Washington, D.C.

U.S. Bureau of the Census, 2000, *1997 Census of Governments*, Compendium of Public Employment, Washington, D.C., http://www.census.gov/ftp/pub/govs/www/cog.html.

U.S. Bureau of the Census, 2001a, *County Business Patterns*, *1999*, Washington, D.C., http://www.census.gov/ftp/pub/epcd/cbp/view/cbpview.html.

U.S. Bureau of the Census, 2001b, *American FactFinder,* Washington, D.C., http://factfinder.census.gov.

U.S. Bureau of the Census, 2001c, *State and County Quickfacts*, Washington, D.C., http://quickfacts.census.gov/qfd/states/08000.html, accessed in Sept. 2001.

U.S. Bureau of the Census, 2001d, *Census 2000 Redistricting Data (Public Law 94-171) Summary File*, Washington, D.C., http://www.census.gov/clo/www/redistricting.html, accessed in Aug. 2001.

USDA: see U.S. Department of Agriculture.

U.S. Department of Agriculture, 1979, *Soil Survey of Pueblo Area, Colorado, Parts of Pueblo and Custer Counties*, Soil Conservation Service in cooperation with Colorado Agricultural Experiment Station, June.

U.S. Department of Agriculture, 1994, *Census of Agriculture 1992*, National Agricultural Statistics Service, Washington, D.C., http://www.nass.usda.gov/census/census92/agrimenu.htm.

U.S. Department of Agriculture, 1999, *Census of Agriculture 1997*, National Agricultural Statistics Service, Washington, D.C., http://www.nass.usda.gov/census/census97/volume1/vol1pubs.htm, accessed in Feb. 2000.

U.S. Department of Commerce, 2001, *Local Area Personal Income,* Bureau of Economic Analysis, Washington, D.C., http://www.bea.doc.gov/bea/regional/reis/.

U.S. Department of the Interior, 1986a, *Visual Resource Inventory*, BLM Manual Handbook H-8410-1, Bureau of Land Management, Washington, D.C., Jan.

U.S. Department of the Interior, 1986b, *Visual Resource Contrast Rating*, BLM Manual Handbook H-8431-1, Bureau of Land Management, Washington, D.C., Jan.

U.S. Department of the Interior, 1999, *National Wetlands Inventory Map, North Avondale, Colorado Quadrangle*, U.S. Fish and Wildlife Service.

U.S. Environmental Protection Agency, 1974, *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety,* EPA-550/9-74-004, Washington, D.C.

U.S. Environmental Protection Agency, 1979, "Protective Noise Levels" (condensed version of *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety,* EPA/ONAC 550/9-74-004, March 1974), http://www.nonoise.org/library/levels/levels.htm.

U.S. Environmental Protection Agency, 1989, *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A),* EPA/540/1-89/002, Interim Final, Office of Emergency and Remedial Response, Washington, D.C., Dec.

U.S. Environmental Protection Agency, 1994, *Exposure Assessment Guidance for RCRA Hazardous Waste Combustion Facilities (Draft)*, EPA 530/R-94/021, Office of Solid Waste, Washington, D.C.

U.S. Environmental Protection Agency, 1995, *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models,* EPA-454/B-95-003a and updated model (Version 00101), Office of Air Quality Planning and Standards, Research Triangle Park, N.C., Sept.

U.S. Environmental Protection Agency, 1997, *Exposure Factors Handbook*, EPA/600/P-95/002Fa, Office of Health and Environmental Assessment, Washington, D.C., Aug.

U.S. Environmental Protection Agency, 1998a, *Final Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses*, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency, 1998b, *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Peer Review Draft,* EPA/530/D-98/001A, July.

U.S. Environmental Protection Agency, 2000a, *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources*, Office of Air Quality Planning and Standards, Research Triangle Park, N.C., Clearinghouse for Inventories and Emission Factors (CHIEF), TTNWeb, http://www.epa.gov/ttn/chief/ap42/index.html.

U.S. Environmental Protection Agency, 2000b, *Documentation for the 1996 Base Year National Toxics Inventory for Nonroad Vehicle and Equipment Mobile Sources*, prepared by Eastern Research Group, Inc., Morrisville, N.C., for EPA, Emissions Monitoring and Analysis Division, Research Triangle Park, N.C., June 2.

U.S. Environmental Protection Agency, 2000c, *Technical Support Document: Control of Emissions of Hazardous Air Pollutants from Motor Vehicles and Motor Vehicle Fuels*, EPA-420-R-00-023, Office of Air and Radiation, Dec.

U.S. Environmental Protection Agency, 2001a, *National Emission Trends Inventory (NET 1996), County and Plant Emission Summaries*, Office of Air Quality Planning and Standards, Research Triangle Park, N.C., Regional Transport Office (RTO), TTNWeb, http://www.epa.gov/ttn/rto/areas/net.htm, accessed in March 2001.

U.S. Environmental Protection Agency, 2001b, *AIRSData, Monitor Values Report*, Office of Air Quality Planning and Standards, Research Triangle Park, N.C., http://www.epa.gov/air/data/monvals/html, accessed in Feb. 2001.

Watts, K.R., and R.F. Ortiz, 1990, *Geohydrology and Ground-Water Quality at the Pueblo Depot Activity Landfill near Pueblo, Colorado*, Water-Resources Investigations Report 89-4143, U.S. Geological Survey, Denver, Colo.

Whitacre, C.G., et al., 1987, *Personal Computer Program for Chemical Hazard Prediction (D2PC)*, CRDEC-TR-87021, U.S. Army, Armament Munitions Chemical Command, Chemical Research, Development, and Engineering Center, Aberdeen Proving Ground, Md., Jan.

White, M.A., 2000, *Background Noise Levels at the Transportation Technology Center for Pueblo Chemical Depot Environmental Study*, letter from White (Transportation Technology Center, Inc., Pueblo, Colo.) to K. Smith (Argonne National Laboratory, Argonne, Ill.), Feb. 28.

Whorton, M., 2000a, record of telephone conversation on synthetic minor permit for PCD between Whorton (Argonne National Laboratory, Argonne, Ill.) and T. Ross (Pueblo Chemical Depot, Pueblo, Colo.), Nov.

Whorton, M., 2000b, personal communication on PCD civilian personnel from Wharry (Pueblo Chemical Depot, Pueblo, Colo.) to Whorton (Argonne National Laboratory, Argonne, Ill.), Oct. 18.

7 BLUE GRASS ARMY DEPOT (BGAD), KENTUCKY

7.1 INTRODUCTION

BGAD is located in east central Kentucky, just southeast of the City of Richmond (Figure 7.1-1) and approximately 30 mi (50 km) southeast of the City of Lexington. The facility encompasses approximately 14,600 acres (5,900 ha), composed mainly of open fields and wooded areas. The installation is used for the storage of chemical defense equipment and conventional explosive munitions as well as assembled chemical weapons (ACWs).

7.1.1 Potential Sites and Facility Locations

An assembled chemical weapons assessment (ACWA) pilot test facility would require about 25 acres (10 ha) of land (Kimmell et al. 2001). In addition, during construction, land would be required for a construction lay-down area, temporary offices, parking, holding basins for surface water, and temporary utility installations. This additional land area could total 70 acres (28 ha). The facility and other land requirements together could total 95 acres (38 ha).

For this *National Environmental Policy Act* (NEPA) assessment, it is assumed that any ACWA pilot test facility would be located close to the Chemical Limited Area (current ACW storage location) (Figure 7.1-2, Proposed Areas A and B). A close location would be required to minimize risks associated with on-post transport of agent-containing munitions and to avoid interfering with other ongoing on-post operations (e.g., to avoid having to halt operations during the transport of munitions). Areas north of the Chemical Limited Area are close to the installation boundary and thus not very suitable for an ACWA pilot test facility. Areas south of the Chemical Limited Area include a major access road, rail line, and wetland areas, so they too are not very suitable for a pilot test facility. Two areas would be suitable locations (Figure 7.1-2). Proposed Area A, directly adjacent to the eastern boundary of the Chemical Limited Area, is slightly larger than 100 acres (40 ha) in size. Use of Proposed Area A could interfere with several other activities. Proposed Area B, directly adjacent to the western boundary of the current storage area, is also close to 100 acres (40 ha) in size. The Army has identified potential routes for constructing supply lines for electric power, water, natural gas, and communication. Any of these routes could serve either Proposed Area A or Proposed Area B.

7.1.2 Munitions Inventory

ACWs stored at BGAD contain either nerve or blister agents (Table 7.1-1). More than 100,000 ACWs with a total of 523 tons (1,046,840 lb) of chemical agent are stored at the depot

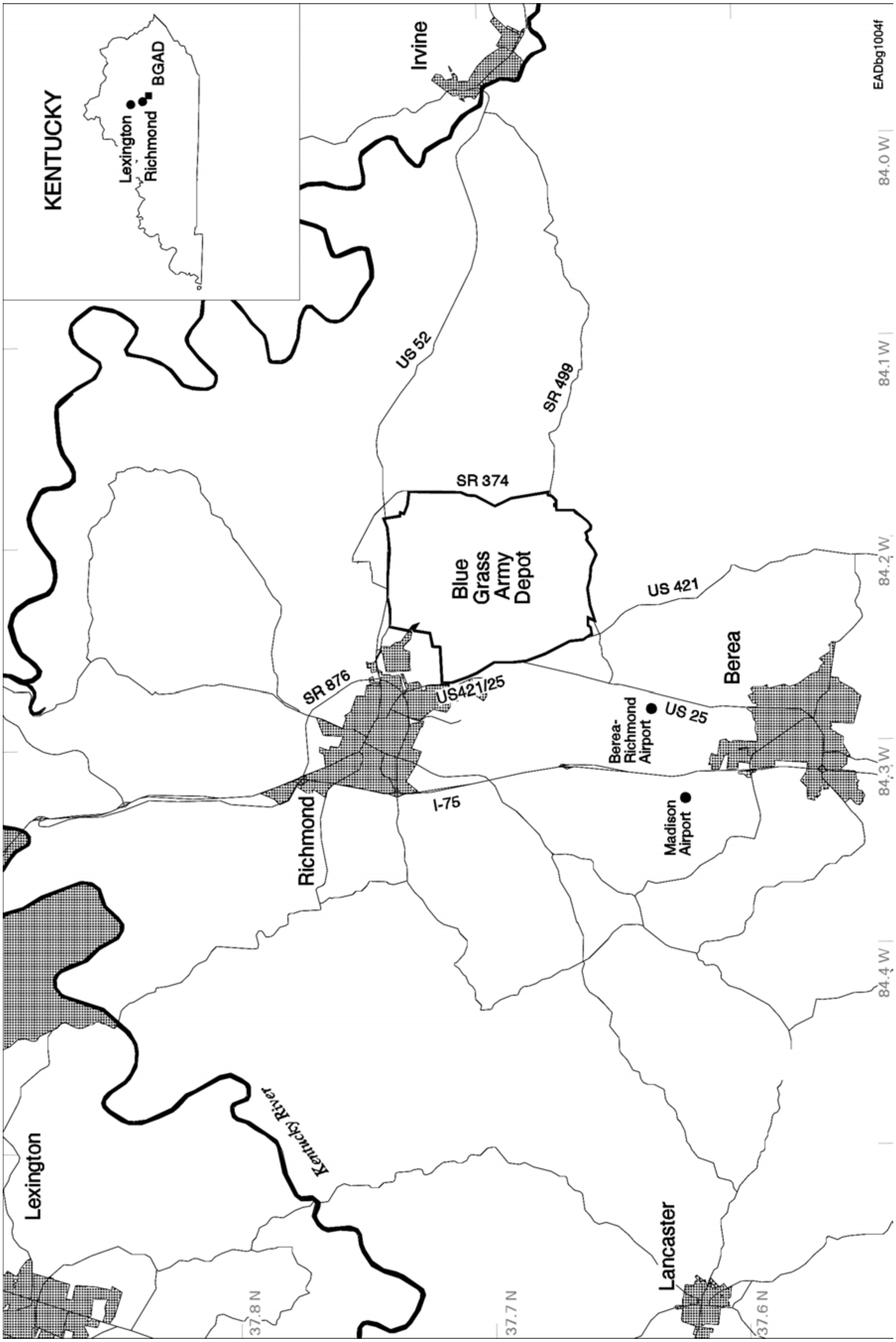

FIGURE 7.1-1 Location of BGAD

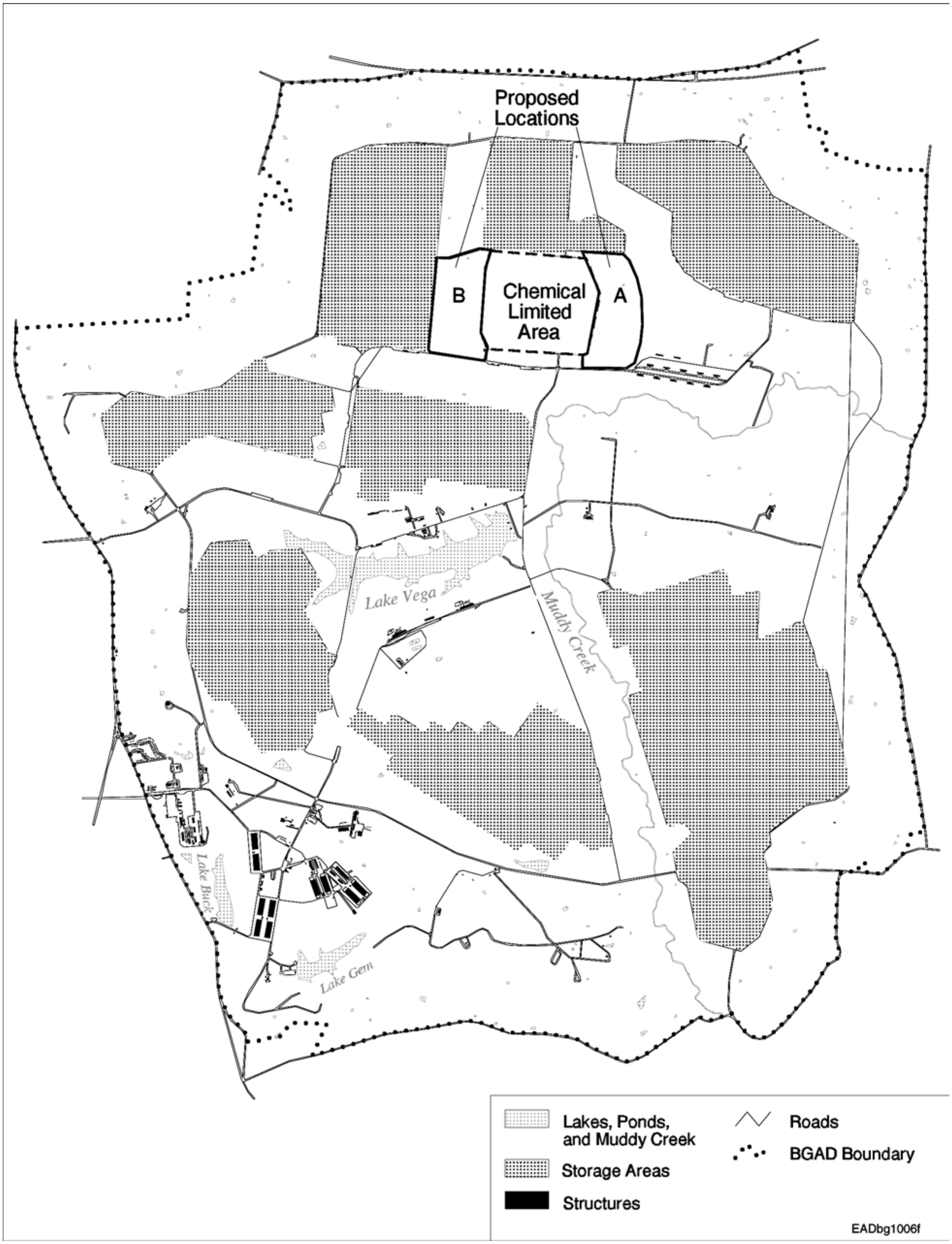

FIGURE 7.1-2 Facilities at BGAD

TABLE 7.1-1 Assembled Chemical Weapons Inventory at BGAD

Type of Munition[a]	Agent	Number in Inventory	Total Weight of Agent (lb)[b]
115-mm rocket, M55	GB	51,716	553,360
115-mm rocket warhead, M56	GB	24	260
115-mm rocket, M55	VX	17,733	177,340
115-mm rocket warhead, M56	VX	6	60
155-mm projectile, M121/A1	VX	12,816	76,900
155-mm projectile, M110	H	15,492	181,260
8-inch projectile, M426	GB	3,977	57,660
Total		101,764	1,046,840

[a] Basic configurations are shown. Some of the munitions have been modified through maintenance activities.

[b] Numbers may vary because of rounding off. The agent numbers shown are those reported under Chemical Weapons Convention (CWC) requirements (Chemical and Biological Defense Command [CBDCOM] 1997).

(Kimmell et al. 2001). The chemical agents are encapsulated in three types of munitions: 155-mm projectiles, 8-in. projectiles, and 115-mm rockets. The nerve agent GB (Sarin) is contained in 8-in. projectiles and 115-mm rockets and warheads; the nerve agent VX is contained in 155-mm projectiles and 115-mm rockets and warheads. Blister agent H (mustard) is contained in 155-mm projectiles. Rockets are fuzed and contain propellants and explosives in addition to chemical agent. Projectiles are not fuzed and may or may not contain explosives in addition to chemical agent. All ACW munitions at BGAD are stored inside 45 earthen-covered, concrete magazines (referred to throughout this document as igloos). In addition to the ACWs listed in Table 7.1-1, BGAD stores nonstockpile items consisting of a 1-ton container and three U.S. Department of Transportation (DOT) bottles in the Chemical Limited Area. However, these are not ACWs and are not part of the ACWA Program. Access is restricted by redundant security systems.

Chemical munitions undergo routine inspection and inventory in accordance with applicable Army regulations and guidelines. Igloos, in addition to undergoing the Army-regulated inspection and maintenance, are regularly monitored in accordance with applicable Kentucky Department of Environmental Protection (KDEP) regulations. Monitoring may occur quarterly, monthly, or weekly, depending on the item stored.

Because of the increasing age of the stockpile at BGAD, about 68 GB-containing rockets and 45 mustard-containing projectiles have leaked (BGAD 2000c). When a leaking munition is detected during routine inspection of an igloo, it is identified and removed from the surrounding munitions. The surrounding munitions and area are decontaminated. The leaking munition is placed into a munition-specific steel overpack. This procedure provides a high degree of assurance that the agent will be contained, even if the munition continues to leak. The leaking munitions are segregated into separate storage igloos and regulated as hazardous waste (see Section 7.4.1.1).

7.2 LAND USE

7.2.1 Installation History and Uses

The U.S. Army opened Blue Grass Ordnance Depot in 1942 (Geo-Marine, Inc. 1996). The depot's main mission was to store ammunition, although it also served as a general supply site and included utilities and administration facilities. The U.S. Government operated the installation from when it opened in April 1942 until October 1943. From October 1943 to October 1945, the facility was operated by the Blue Grass Ordnance Depot, Inc., a subsidiary of Firestone Tire and Rubber Company. The U.S. Government resumed operation of the installation in October 1945 and has continued to operate it to the present time.

In 1964, the Blue Grass Ordnance Depot (located in Richmond, Kentucky) merged with the Lexington Signal Depot (located in Lexington, Kentucky) to form Lexington-Blue Grass Army Depot. Lexington-Blue Grass Army Depot operated until 1992, providing ammunition and general supply support and maintaining communications and electronics equipment. In response to a Base Realignment and Closure (BRAC) Commission decision in 1988, the federal government directed that the Lexington facility close by 1995. In 1992, the general supply and maintenance mission that the Lexington facility had undertaken ended. Final closure was completed in 1994. The federal government is in the process of transferring ownership of the Lexington facility to the Commonwealth of Kentucky. The remaining Blue Grass facility was reorganized and renamed Blue Grass Army Depot in 1992.

In addition to conventional munitions, the Army began to store chemical weapons at its Blue Grass installation in 1944. Chemical weapons storage at the installation was interrupted in 1949 after the chemical weapons inventory was shifted to Rocky Mountain Arsenal. Blue Grass began to receive shipments of more modern chemical agents and weapons in 1952, and this activity continued until the mid-1960s. Since that time, one of the roles of BGAD has been the safe storage of existing chemical weapons (Geo-Marine, Inc. 1996).

In 1996, the Army established the Blue Grass Chemical Activity (BGCA) as a special unit focused on the management and storage of chemical weapons on BGAD. The BGCA is a tenant organization of BGAD, reporting to the U.S. Army Soldier and Biological Chemical Command (SBCCOM). The primary mission of BGCA is the safe storage and monitoring of the chemical weapons stockpile that is located within the Chemical Limited Area, a highly secured 250-acre (100-ha) site in the northern part of BGAD.

Currently BGAD is an Operations Support Command (OSC) depot whose core business is providing munitions, chemical defense equipment, and support to the U.S. Department of Defense (DOD). As a Tier I facility, BGAD is staffed to store conventional munitions for training and major force deployment. BGAD is the Army's major storage site for chemical defense equipment. The conventional munition operations at BGAD include shipping and receiving, storage, maintenance, inspection, and demilitarization. The OSC and SBCCOM are major subordinate commands of the Army Materiel Command (AMC).

7.2.2 Current and Planned On-Post Land Use

Current land use on BGAD primarily involves industrial and related activities associated with the storage and maintenance of conventional and chemical munitions. There is also a contractor-operated helicopter maintenance facility located at BGAD. A total of 1,152 structures are located on BGAD. Most of these are steel-reinforced, earthen-covered concrete magazines (igloos) used to store munitions. Of these munitions storage igloos, a small portion are used specifically by the BGCA; most of these BGCA igloos contain chemical munitions and agents, and a few contain materials, supplies, metal parts, equipment, and hazardous waste. In addition, BGAD includes warehouses; aboveground magazines; maintenance buildings; operations, administrative, and medical buildings; and military family housing structures.

The most dominant features of the 14,600-acre (5,900-ha) facility are large tracts of undeveloped woodland and more than 7,000 acres (2,800 ha) of land currently leased to local farmers for hay production and pasture (BGAD 2000b). BGAD can be divided into major areas on the basis of the arrangement of the structures discussed above, as follows (Figure 7.2-1):

- Administrative area, containing the installation headquarters and several other permanent features;

- Housing area, containing two family housing units (one not currently in use);

- Conventional munitions storage area, containing the igloos used for munitions storage; and

- Chemical agent storage area (Chemical Limited Area) containing the igloos used for ACW storage.

Anticipated future use of BGAD would remain broadly consistent with current use, focusing primarily on conventional munitions storage. One main modification would be the

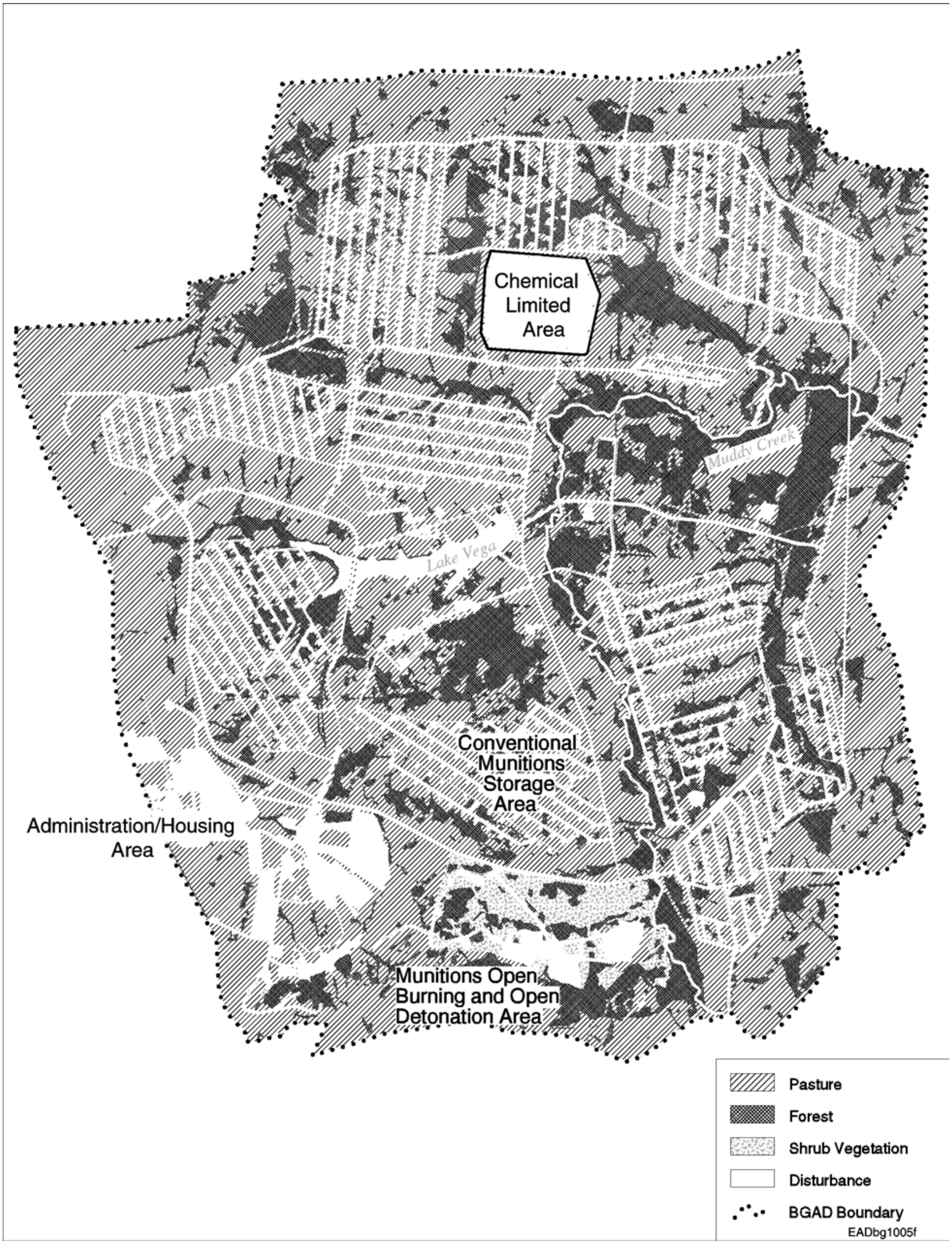

FIGURE 7.2-1 Land Use at BGAD

eventual removal of chemical weapons from BGCA, which would allow that portion of BGAD to be converted back for conventional munitions or other storage use.

7.2.3 Current and Planned Off-Post Land Use

BGAD lies near the geographic center of rural Madison County, Kentucky, roughly 30 mi (50 km) southeast of Lexington and adjacent to the southeastern portion of Richmond, Kentucky. Communities in the vicinity of the installation consist primarily of small towns, including Berea, Brodhead, Crab Orchard, Ford, Irvine, Kirksville, Lancaster, Mount Vernon, Nicholasville, Paint Lick, Waco, Wilmore, and Winchester.

BGAD lies on a plain roughly 10 mi (16 km) south of the Kentucky River. The installation features gently rolling open fields and woodlots. Land use in the vicinity of BGAD is mixed and includes agricultural, industrial, low-density residential (within communities and isolated residences), and commercial uses. A large recreational facility, the Lake Reba Recreational Complex, occupies 350 acres (140 ha) on the northwestern border of the facility. It includes a golf course, several ball fields, and a children's play area. Parcels of agricultural land have been rezoned for industrial uses, including the 175-acre (70-ha) Richmond Industrial Park along the western boundary of BGAD.

More distant from BGAD, agriculture remains an important land use in Madison County. In 1997, the county contained more than 1,400 farms covering more than 220,000 acres (89,000 ha) (U.S. Department of Agriculture [USDA] 1999). Cropland on these farms totaled more than 140,000 acres (57,000 ha); the remaining area (roughly one-third) was used for grazing.

Land use in the vicinity of BGAD likely will remain fairly constant in the foreseeable future. The main trend emerging in the area near the installation is the conversion of small blocks of farmland to residential and light industrial use. Depending on economic conditions and the success of local industrial parks located near BGAD, this trend, coupled with increasing residential development and use, will probably continue in coming years.

7.2.4 Impacts on Land Use

7.2.4.1 Impacts of the Proposed Action

Proposed testing activities at BGAD would be conducted within the portion of the installation that has been reserved for chemical demilitarization (Chem Demil) activities. Impacts on land use designations at BGAD are expected to be negligible. However, use of Proposed

Area A could interfere with other site activities. The locations and activities proposed for an ACWA pilot test facility are consistent with current installation use in the areas reserved for Chem Demil activities and with the historic and planned use of the installation.

Impacts on land use outside BGAD due to normal construction and operation are anticipated to be negligible. Normal construction and operation of an ACWA pilot test facility at BGAD would not interfere with activities in other areas of the installation or the surrounding communities. Any discharges as a result of occasional fluctuations in routine operations would be extremely small and would not affect off-post activities (see Section 7.6).

7.2.4.2 Impacts of No Action

Under the no action alternative, storage of chemical stockpile components at BGAD would continue. Land use in the immediate storage area (already identified for activities associated with chemical weapons), in other areas of BGAD, and in surrounding areas outside the installation would continue as described for the existing environment.

7.3 INFRASTRUCTURE

Table 7.3-1 lists the annual utility requirements for an ACWA pilot test facility at BGAD, and Table 7.3-2 lists the approximate acreage needed for construction of an ACWA facility and associated utilities infrastructure. The following sections describe the requirements for an ACWA pilot test facility, current installation utility and infrastructure demands, and the impacts of construction and operation of an ACWA pilot test facility on utilities and infrastructure.

TABLE 7.3-1 Approximate Annual Utility Demands for Operation of an ACWA Pilot Test Facility at BGAD[a]

	Annual Demand			
Utility	Neut/Bio	Neut/SCWO	Neut/GPCR/ TW-SCWO	Elchem Ox
Electric power (GWh)	2	60	26	122
Natural gas (scf)	9,000,000	52,000,000	133,000,000	52,000,000
Process water (gal)	1,300,000	6,300,000	18,000,000	1,000,000
Potable water (gal)	300,000	6,400,000	6,400,000	6,400,000
Sewage (produced) (gal)	400,000	7,500,000	7,500,000	7,500,000

[a] Unit conversions: 1 scf (standard cubic foot) = 0.28 Nm^3. 1 gal = 3.8 L.

Source: Kimmell et al. (2001)

TABLE 7.3-2 Estimated Land Area Disturbed for Construction of an ACWA Pilot Test Facility and Associated Infrastructure at BGAD[a]

Construction Activity	Area Disturbed (acres) Proposed Area A	Area Disturbed (acres) Proposed Area B
Pilot facilities (includes all construction disturbance except the following)	25	25
Wastewater treatment plant	1	1
Transmission lines (69-kV)[b]		
Towers and conductor stringing	<1	<1
Right-of-way clearing	20	18
Communication cables[c]	4	2
Gas pipeline[d]	10	11
Water pipeline[d]	5	7
Parking lots	4	4
Access road[e]		
Option 1	28	22
Option 2	25	19
Option 3	18	7
Maximum possible area disturbed[f]	95	88

[a] Unit conversion: 1 acre = 0.4 ha.

[b] Transmission line would be on wooden single pole structures spaced about 320 ft (98 m) apart; each tower and conductor stringing site would disturb 900 ft^2 (84 m^2). A 100-ft (30-m) corridor would be cleared of trees and shrubs for a right-of-way.

[c] Communication cables would require a maximum right-of-way width of 15 ft (5 m).

[d] Gas and water pipeline construction would require a 60-ft-wide (18-m-wide) right-of-way. Entire right-of-way would be disturbed.

[e] Amount of disturbance does not take into account the use of existing roads in case widening and upgrading would be required. The access road would require a 60-ft-wide (18-m-wide) right-of-way. Three options for location of an access road were assumed. Option 1 = access road from west entrance along existing roadways. Option 2 = new access road from west BGAD entrance, going north to Route 2. Option 3 = access road from north boundary of BGAD.

[f] Total disturbance assuming Option 2 is selected.

7.3.1 Electric Power

7.3.1.1 Current Supply and Use

Electricity is currently provided to BGAD by Kentucky Utilities Company. The current capacity of the depot is just less than 31,000 MWh/yr of electric power, and the installation consumed approximately 7,800 MWh in 2000. Kentucky Utilities Company distributes power to BGAD via 69-kV transmission lines.

7.3.1.2 ACWA Pilot Test Facility Requirements

Table 7.3-1 lists the amounts of electricity that each of the technologies being considered for the proposed ACWA pilot test facility would use during normal operations. Electricity use would be highest for Elchem Ox (122 GWh/yr) and lowest for Neut/Bio (2 GWh/yr). The current electrical distribution system is limited in extent and would not be able to support the proposed ACWA pilot test facility. Figure 7.3-1 identifies the potential locations of 69-kV transmission line corridors to the two proposed locations for an ACWA facility. Table 7.3-2 lists the estimated acreage that would be disturbed by this construction.

7.3.1.3 Impacts of the Proposed Action

The current infrastructure would not be able to meet the electric power supply needs of the ACWA pilot test facility. New service connections would have to be added, and two new substations would need to be constructed. The new power supply would supply the pilot facility and associated areas and would be independent of the other BGAD power supply infrastructure. Therefore, no impact from operations on the existing electric power supply at BGAD is anticipated.

7.3.1.4 Impacts of No Action

There would be no impacts on the electric power supply infrastructure from the no action alternative. The electrical upgrades required by the ACWA Program would not be undertaken. The electric power supply for the installation would remain as described for the existing environment.

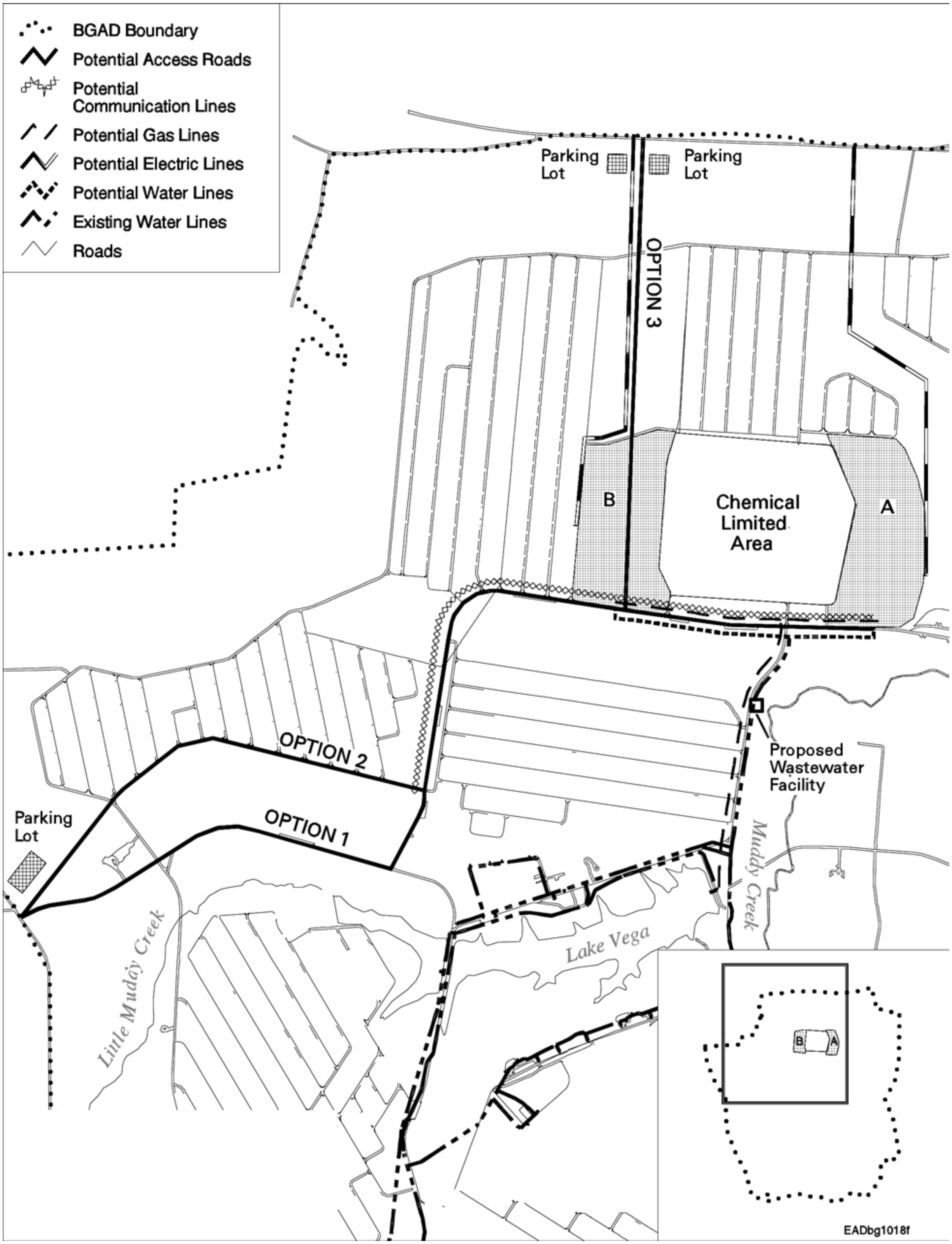

FIGURE 7.3-1 Proposed Utility and Road Access Corridors for the Proposed ACWA Pilot Test Facility at BGAD

7.3.2 Natural Gas

7.3.2.1 Current Supply and Use

Natural gas is provided to BGAD by Delta Natural Gas Company. The main gas line at BGAD does not extend to the Chemical Limited Area; a new pipeline could connect to the existing main south of the Chemical Limited Area (Figure 7.3-1). An off-post natural gas pipeline also runs outside the eastern boundary of BGAD. In fiscal year (FY) 2000, the installation used slightly more than 45,000 ft^3 of natural gas. Several buildings at BGAD have recently been converted to use natural gas, and more are scheduled for conversion over the next several years.

7.3.2.2 ACWA Pilot Test Facility Requirements

Table 7.3-1 lists the amounts of natural gas that the technologies being considered for the proposed ACWA pilot test facility would use during normal operations. Natural gas use would be highest for the Neut/GPCR/TW-SCWO technology at 138 million scf. Natural gas use would be the same for the Neut/SCWO and Elchem Ox technologies, at roughly 37% of the Neut/GPCR/TW-SCWO usage (i.e., 52 million scf). The Neut/Bio technology uses the smallest amount of natural gas, at 9 million scf. Construction of new gas pipelines would be required to provide gas to the proposed sites. Figure 7.3-1 identifies the assumed gas line corridor for Proposed Areas A and B, and Table 7.3-2 lists the estimated acreages that would be disturbed by this construction.

7.3.2.3 Impacts of the Proposed Action

The current infrastructure would not be able to meet the needs for natural gas of the ACWA pilot test facility. New pipelines would have to be added to an existing main, and a new metering station would need to be constructed. The new natural gas supply for the pilot facility and associated areas would be independent of the existing natural gas infrastructure at BGAD. Therefore, no impact from operations on the existing natural gas supply at BGAD is anticipated.

7.3.2.4 Impacts of No Action

There would be no impacts on the natural gas supply infrastructure from the no action alternative. The natural gas pipeline required by the ACWA Program would not be built. The natural gas infrastructure would remain as described for the existing environment.

7.3.3 Water

7.3.3.1 Current Supply and Use

Lake Vega, a human-made, 135-acre (55-ha) impoundment with an estimated capacity of 600 million gal (23 million m^3), supplies the water at BGAD. It is located in the central portion of BGAD and collects water from Little Muddy Creek (Figure 7.3-1). The existing water treatment plant used to process the water from Lake Vega has a capacity of 720,000 gal/d (2,700 m^3/d) (U.S. Army 1988). In FY 1999, the depot produced approximately 51 million gal (193,000 m^3) of water, and it produced approximately 39 million gal (148,000 m^3) in FY 2000.

7.3.3.2 ACWA Pilot Test Facility Requirements

Annual process water use for the ACWA technologies would range from 1 million gal/yr of process water for Elchem Ox to 18 million gal/yr of process water for Neut/GPCR/TW-SCWO. In addition, approximately 6.4 million gal/yr of potable water would be required for each of the technologies except Neut/Bio. Neut/Bio would require the least amount of water, at only 1.3 million gal/yr of process water and 300,000 gal/yr of potable water. The current water supply infrastructure at BGAD would be sufficient to meet those needs if the existing water supply lines were extended.

Potable water for the ACWA facility would be available to both Proposed Area A and Proposed Area B from an existing water main near the Chemical Limited Area. Construction of pipelines from the water main would be required to provide water to the proposed areas. Figure 7.3-1 shows the assumed utility corridors for Proposed Areas A and B, and Table 7.3-2 lists the estimated acreages that would be disturbed by this construction.

BGAD currently operates two wastewater treatment plants (WWTPs). WWTP #1 is located in the southwest corner of BGAD and discharges into an unnamed tributary to Hays Fork of Silver Creek. It treats more than 26 million gal (98,400 m^3) annually. WWTP #1 would not be a likely candidate to receive wastewater from an ACWA pilot test facility because of its distance from the proposed locations for the pilot facility. WWTP #2 is located closer to the proposed locations and discharges to Muddy Creek. WWTP #2 does not have sufficient capacity to support a pilot plant, since the average design flow is 16,000 gal/d (61 m^3/d) and the average amount of water treated is 10,500 gal/d (40 m^3/d). A new wastewater treatment plant for sewage would need to be constructed (Figure 7.3-1). The most likely location would be near the ACWA pilot test facility site. Treated wastewater would be discharged to the Muddy Creek drainage. Alternatively, the Army could connect to WWTP #1 or to the existing infrastructure in the city of Richmond. A later decision on wastewater treatment would be made if BGAD were selected for ACWA pilot tests. Further environmental and permitting review would be conducted after such a decision.

7.3.3.3 Impacts of the Proposed Action

The existing water supply systems would be sufficient to supply the needs of the proposed ACWA pilot facility. Impacts on the installation or off post from any of the ACWA technologies would be negligible.

Construction of the ACWA pilot test facility would require water for numerous uses, including washing, dust control, preparation of concrete, and fire control. These needs have not been estimated quantitatively; however, the total estimated use would be small when compared with existing capacity, and the existing water supply system would be adequate to meet these needs. Impacts on the water-supply and sewage-treatment infrastructure from construction activities would be negligible. Minor local disruptions in supply might occur when the ACWA facility was connected to the existing infrastructure, but these common types of disruption would be short-lived.

The existing water supply system would not be sufficient to provide enough water for fire fighting and other potential emergency response needs. The ACWA facility would need a storage tank of sufficient capacity to meet projected emergency requirements.

A new sewage treatment facility may need to be constructed to meet the needs of the proposed ACWA pilot facility. The sewage treatment plant would operate in accordance with all applicable regulations and permits. Construction of the ACWA facility and sewage treatment facility would have a negligible impact on water supply and the existing sewage treatment infrastructure.

If a new sewage treatment facility were constructed, the proposed action would have no off-post impacts on the water supply or sewage treatment infrastructure. The BGAD water and sewage infrastructure is self-contained, and impacts would be limited to the installation.

7.3.3.4 Impacts of No Action

There would be no impacts on the water use and supply infrastructure from the no action alternative. Water supply, treatment, and use would continue as described for the existing environment.

7.3.4 Communications

7.3.4.1 Current System

BGAD uses an Avaya Definity ECSG3R switch with a 24-strand fiber-optic cable and 600-pair copper cable.

7.3.4.2 ACWA Pilot Test Facility Requirements

Additional fiber-optic and/or copper cables would have to be provided. Communications lines to support the chemical mission of the Chemical Limited Area do not currently exist. A communications system would need to be installed to support an ACWA pilot test facility. Activities would include tapping into an existing communications hut, building a second hut as the termination point, and installing approximately 1–2 mi (1.6–3.2 km) of cable (Figure 7.3-1, Table 7.3-1). Radio communications would be handled by a new Motorola digital 800-MHz radio system. The ACWA facility would need to have a radio system compatible with the new BGAD 800-MHz radio system.

7.3.4.3 Impacts of the Proposed Action

Construction of new communication lines would not affect existing service. The proposed communication lines would follow existing rights-of-way, and the environmental impacts from ground disturbance during construction would be minimal.

7.3.4.4 Impacts of No Action

There would be no impacts on the communication infrastructure from the no action alternative. The installation of new communication lines required by the ACWA Program would not occur.

7.4 WASTE MANAGEMENT

7.4.1 Current Waste Generation and Management

The amounts and types of waste generated at BGAD during 2000 (Williams 2001) are summarized in Table 7.4-1.

7.4.1.1 Hazardous Wastes

BGAD generates hazardous wastes from maintenance of conventional munitions, demilitarization of obsolete conventional munitions, and operations related to the storage of chemical munitions. Kentucky hazardous waste regulations designate chemical agents, at the point of becoming a solid waste, as listed hazardous wastes. The Army has declared M55 rockets containing chemical agent as hazardous waste. Therefore, any waste derived from the treatment of these wastes, any solid waste mixed with these wastes, any waste that contains these wastes, and any residue from the cleanup of a spill of these wastes may also be a listed hazardous waste. Activities that are sources of hazardous wastes at BGAD include the following:

- Facility maintenance (paints, solvents, water conditioners, etc.);

- Vehicle maintenance (used oil, batteries, coolant, etc.);

TABLE 7.4-1 Wastes Generated at BGAD in 2000[a]

Type of Waste	Amount Generated	Shipped Off Post?
Hazardous liquids	26,000 lb	Yes
Hazardous solids	1,300,000 lb	Yes
Hazardous solids treated on post[b]	160,000 lb	No
Nonhazardous solids	725,000 lb	Yes
Sanitary wastes	28 million gal	No

[a] Unit conversions: 1 lb = 0.45 kg. 1 gal = 3.8 L.

[b] Typically, these are materials containing explosive or reactive residues.

Source: Williams (2001).

- Chemical agent decontamination (field test materials, toxic chemical analysis agents, personal protective equipment [PPE], etc.)

- Conventional munitions washout facilities (explosive-contaminated activated charcoal, explosive-sludge-contaminated filters, etc.)

- Other items related to the storage, maintenance, and demilitarization of conventional munitions.

There are two types of hazardous waste storage facilities at BGAD:

1. Facilities to store hazardous solids obtained from the washout of conventional ammunitions, explosive-contaminated charcoal, and explosive-sludge-contaminated filters; solids from demilitarization operations and maintenance; explosives; sandblast media; and baghouse dusts.

2. Facilities to store obsolete and/or leaking chemical munitions and associated wastes generated during the monitoring, filtration, and decontamination of tools, PPE, and equipment stored in the Chemical Limited Area.

7.4.1.2 Nonhazardous Wastes

Solid Wastes. BGAD routinely generates about 350 tons/yr of nonhazardous solid wastes. These wastes are disposed of off post at a local landfill.

Sanitary Wastes. Two wastewater treatment plants with a total capacity of about 115,000 gal/d (435 m^3/d) and several septic systems exist on BGAD (see Section 7.12). Average usage is about 80,000 gal/d (242 m^3/d).

7.4.2 ACWA Pilot Test Facility Waste Generation and Treatment Requirements

The construction and operation of an ACWA pilot test facility would generate an array of solid and liquid wastes, both hazardous and nonhazardous. Estimates of waste generated during construction are based on waste generation from construction of comparable buildings, scaled by building size and number of construction workers (full-time equivalents or FTEs). The types and amounts of waste generation expected from the operation of an ACWA test facility have been estimated by using the techniques of stoichiometric mass balance[1] for each unit process coupled with the analytical results obtained from initial demonstration tests for each technology. This technique relies on a number of assumptions that have not yet been fully verified (Kimmell et al. 2001). How sensitive these estimated results are to the various assumptions used in this procedure has not been determined.

All of the proposed ACWA technologies would produce brine salts as solid waste. These salts could contain significant amounts of toxic heavy metals (e.g., lead). Such solid waste would probably fail the *Resource Conservation and Recovery Act* (RCRA) Toxicity Characteristic Leaching Procedure (TCLP). If so, the hazardous salt waste would need to be stabilized by a procedure that would reduce leaching of the heavy metal to a level that would allow it to be approved for land disposal as a hazardous solid waste. Salt wastes have proven somewhat difficult to stabilize, so additional studies might be required to identify an effective stabilization technology. If stabilization of the solid salt waste was required, either a waste management process for stabilizing the waste would be needed on post or the waste would need to be shipped off post to an appropriately permitted waste treatment facility. Commercial facilities exist for managing this type of waste.

If a generator produces waste streams that are listed hazardous waste under federal or state law, that generator may choose to conduct a demonstration to show that the waste is nonhazardous (referred to as "delisting"; see *Code of Federal Regulations*, Title 40, Part 260, Section 22 [40 CFR 260.22]). If the delisting is granted, the waste can then be disposed of as a nonhazardous solid waste, resulting in an important cost savings. Delisting a waste depends on the types and amounts of minor constituents in the waste. The composition of a waste may vary strongly in accordance with a variation of the operating parameters. In the case of BGAD, it is known that the residuals from treating mustard (blister) and nerve agent would be defined and listed as hazardous wastes by Kentucky hazardous waste regulations. However, information on the waste streams that could result from the ACWA technologies is not sufficient to determine if a delisting could be obtained.

It is assumed that most wastes generated by the proposed action would be collected and disposed of off post in accordance with U.S. Army, state, and federal regulations. Any wastes determined to be hazardous under the RCRA regulations would be stored and disposed of as prescribed by the EPA and applicable state and local regulations.

---

[1] Calculations are based on the principle of the conservation of mass in chemical reactions (i.e., the total mass in is equal to the total mass out).

7.4.3 Impacts of the Proposed Action

7.4.3.1 Impacts of Construction

Construction activities associated with the building of the ACWA pilot test facility would generate both solid and liquid nonhazardous wastes. The solid nonhazardous wastes would be primarily in the form of building material debris and excavation spoils. Liquid nonhazardous wastes would include wastewater from washdowns and sanitary wastes. Construction would also generate small amounts of both solid and liquid hazardous wastes such as solvents, paints, cleaning solutions, waste oils, contaminated rags, and pesticides. No changes in BGAD waste management systems would be expected to be needed for the management and disposal of solid and liquid construction wastes.

Estimates of the amounts of waste that would be generated during the construction of an ACWA pilot test facility at BGAD are shown in Table 7.4-2. Data in this table cover the four technologies being considered: Neut/Bio, Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox. These estimates were based on the proposed building size and an estimated total construction work force representing about 1,100 full-time-equivalent-years (FTE-yr) (Volume 1 of Kimmell et al. 2001). Sanitary wastes and wastewater would be the only significant liquid effluent that would be generated during construction. All of the construction wastes could be treated by existing systems, and no additional environmental impacts from managing these wastes are expected.

TABLE 7.4-2 Wastes Generated during Construction of an ACWA Pilot Test Facility at BGAD

Waste	Neut/Bio	Neut/SCWO	Neut/GPCR/ TW-SCWO	Elchem Ox
Hazardous wastes				
Solid (yd^3)	80	90	100	100
Liquid (gal)	31,000	37,000	34,000	39,000
Nonhazardous wastes				
Solids				
Concrete (yd^3)	210	210	230	220
Steel (tons)	32	36	29	33
Other (yd^3)	1,700	1,700	1,800	1,800
Liquids				
Wastewater (gal)	2,000,000	2,400,000	2,200,000	2,500,000
Sanitary (gal)	4,500,000	5,300,000	4,800,000	5,600,000

Source: Kimmell et al. (2001).

7.4.3.2 Impacts of Operations

Munitions are not generally considered wastes while they are in storage. However, in the case of M55 rockets stored at BGAD, the Army has reclassified these munitions as waste due to obsolescence of the rocket. Typically, munitions are reclassified as wastes upon their removal from storage for treatment and disposal or if they are no longer usable. Upon disassembly and destruction of an ACW, the remaining residuals become wastes. Wastes resulting from the normal operation of an ACWA pilot test facility would include components from the treatment of metal parts and dunnage as well as process residues (e.g., contaminated salts generated from treating chemical agents and energetics). An ACWA pilot test facility would also generate a number of nonprocess wastes (e.g., office trash, PPE, decontamination solution, spent carbon filters). The ACWA pilot test facility would recycle all process liquids obtained in the operation phase back through the reaction vessel. Such recycling would eliminate these liquids from the waste streams. If stabilization of the hazardous solid salt waste obtained in the normal processing of ACWs was required, either a waste management process for stabilizing the waste would be needed at BGAD, or the waste would need to be shipped off post to an appropriately permitted treatment facility. Depending on the technology chosen for stabilization of the salt waste, a new treatment unit might be required.

BGAD has primarily nerve agent and relatively little mustard agent in its ACW inventory. The Neut/Bio technology has proven effective at treating only mustard agent, whereas the Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox technologies can treat both types of agent. Considering the designed agent throughput of the ACWA pilot test facility, 16 days of actual operation (for all technologies) for mustard processing would deplete the entire BGAD inventory of mustard agent. The number of operating days per year used to process GB and VX nerve agents was 276 days for processing either agent by Neut/SCWO and 232 days and 87 days for processing GB and VX, respectively, by Neut/GPCR/TW-SCWO or Elchem Ox (Table 7.4-3).

Polychlorinated biphenyls (PCBs) have been identified as a constituent in the firing tubes of M55 rockets held in the chemical munitions inventory at BGAD. The concentrations of PCBs in these munitions can range from less than 50 to more than 2,000 parts per million (ppm). Therefore, treatment of these munitions with ACWA technologies would involve the treatment of PCB wastes. In addition, the treatment process could generate brine wastes containing more than 50 ppm of PCBs or unacceptable amounts of toxic PCB intermediate by-products, such as dioxins or furans. PCB concentrations in wastes generated during the pilot-scale testing of ACWA technologies would need to be evaluated. Wastes containing PCBs in excess of 50 ppm are subject to regulation under the *Toxic Substances Control Act* (TSCA).

Hazardous Wastes. Wastes that would be generated from the operation of an ACWA pilot test facility are summarized in Table 7.4-3. The numbers in Table 7.4-3 account for only the

TABLE 7.4-3 Hazardous Wastes Generated Annually from the Operation of an ACWA Pilot Test Facility at BGAD[a]

Waste	Amount of Waste Generated (tons/yr) per Technology, Agent Being Processed, and No. of Operating Days (d)								
	Neut/Bio	Neut/SCWO		Neut/GPCR/TW-SCWO			Elchem Ox		
	Mustard (16 d)	Mustard (16 d)	Nerve[b] (276 d)	Mustard (16 d)	GB (232 d)	VX (87 d)	Mustard (16 d)	GB (232 d)	VX 87(d)
Brine salts (total)	214	220	2,900	220	2,600	960	18	103	41
Sodium phosphate	-	3.1	2,300	2.2	2,100	700	-	-	-
Sodium fluoride	-	-	76	-	87	-	-	-	-
Sodium sulfate	38	140	57	136	-	65	-	-	-
Sodium chloride	54	54	-	54	-	-	-	-	-
Sodium bisulfate	65	-	-	-	-	-	-	-	-
Other salts	9	1.3	54	2.8	90	82	18	103	41
Water in salt cake	25	29	360	29	340	110	-	-	-
Aluminum oxide	-	-	1,200	-	590	204	-	-	-
Anolyte-catholyte waste	-	-	-	-	-	-	125	199	284
Biomass (total)	104	-	-	-	-	-	-	-	-
Biomass solids	66	-	-	-	-	-	-	-	-
Water in biomass	36	-	-	-	-	-	-	-	-
Other solids	2	-	-	-	-	-	-	-	-
Process liquids	-	-	-	-	-	-	1	8.5	3.5

[a] A hyphen means that the waste stream is not generated by the specific technology.

[b] The value for nerve agent includes GB and VX. Separate values were not provided for this technology from the demonstration results.

Sources: Mitretek (2001a–d); Kimmell et al. (2001).

waste streams that would be produced during the processing of mustard and nerve agents. They do not account for the wastes that would be produced during storage; these would include primarily contaminated solids, such as PPE and pallets, and small quantities of contaminated liquids obtained from cleanup procedures. BGAD would continue to generate wastes associated with storage at decreasing rates during ACWA facility operation until the stockpile was completely destroyed.

Neutralization/Biotreatment. This technology would result in a number of process-related waste streams. Salts and biomass would be extracted from the bioreactor effluents, treated further, and dried to be disposed of as solid hazardous waste (Table 7.4-3). The liquids obtained from the further treatment of the bioreactor effluents would be recycled back through the bioreactor, thus eliminating the release of any process liquid wastes.

Various types of nonprocess wastes would be generated from the operation of this technology. These would include dunnage, PPE, spent carbon filters, pallets, and decontamination solution. All of these nonprocess operation wastes have the potential to be contaminated by an agent, and such contamination would require treatment. Under the Neut/Bio technology, nonprocess wastes would be treated by the metal parts treater (MPT). Treatment of nonprocess wastes would result in approximately 130 tons of residual brine waste; this amount is included in the overall brine waste numbers shown in Table 7.4-3. Nonprocess waste would also generate about 60 tons of metal wastes; this total is included in Table 7.4-4.

No significant impacts are expected from the generation of hazardous waste during operation of an ACWA facility. It is assumed that most wastes generated during operations would be collected and disposed of off post in accordance with U.S. Army, state, and federal regulations. Any wastes determined to be hazardous in the RCRA regulations would be stored and disposed of as prescribed by the EPA and applicable state and local regulations.

If the salts and biomass wastes failed the RCRA TCLP tests, some type of stabilization of these wastes would be necessary. Depending on the technology chosen and the amount of loading of the wastes in the stabilization matrix, the amount of stabilized waste could easily exceed the hazardous waste estimates given in Table 7.4-3 by a factor of 2.5. If stabilization of

TABLE 7.4-4 Nonhazardous Wastes Generated Annually from the Operation of an ACWA Pilot Test Facility at BGAD

	Amounts of Waste Generated Annually per Technology and Agent Being Processed							
	Neut/Bio	Neut/SCWO	Neut/GPCR/TW-SCWO			Elchem Ox		
Nonhazardous Waste	Mustard	Mustard/ Nerve[a]	Mustard	GB	VX	Mustard	GB	VX
Sanitary wastes (gal)	400,000	7,500,000	400,000	5,200,000	1,900,000	400,000	5,200,000	1,900,000
Other solid wastes (yd^3)[b]	123	1,800	123	1,500	570	123	1,500	570
Recyclable wastes (yd^3)[c]	49	720	49	600	225	49	600	225
Metal and solid (5X) wastes (tons)	640	1,300	1,280	3,000	1,900	640	1,740	1,040

[a] The value for nerve agent includes GB and VX. Separate values were not provided for this technology from the demonstration results.

[b] Domestic trash and office waste.

[c] Recyclable wastes include paper and aluminum.

Source: Mitretek (2001a–d); Kimmell et al. (2001).

the solid salt waste was required, either a waste management process for stabilizing the waste would be needed, or, alternatively, the waste would need to be shipped off post to an appropriately permitted treatment facility. Depending on the treatment chosen, a new facility might need to be constructed or an existing off-post commercial facility might need to handle the off-post shipment of solid salt waste.

Neutralization/SCWO. Process effluents from the SCWO units would be combined, and brine salts (mostly sodium sulfate, sodium chloride, and sodium phosphate, see Table 7.4-3) would be extracted and dried for disposal as solid hazardous waste. Only small quantities of liquid wastes would be released from the process, since process liquids would be recycled back into the SCWO units.

Nonprocess operational wastes (e.g., PPE, spent carbon filters, pallets, decontamination solution) were estimated by the vendor (General Atomics 1999). All these wastes could potentially be contaminated by an agent. Such contamination would require treatment. Current operating plans include recycling all nonprocess liquids obtained in the operation phase back through the reaction vessel. Such recycling would eliminate these liquids from the waste streams. Recycling of nonprocess wastes would result in approximately 190 tons of brine waste; this amount is included in the overall brine waste numbers shown in Table 7.4-3.

No significant impacts are expected from the generation of hazardous wastes during the operation of an ACWA facility. It is assumed that most wastes generated during operations would be collected and disposed of off post in accordance with U.S. Army, state, and federal regulations. Any wastes determined to be hazardous under the RCRA regulations would be stored and disposed of off post as prescribed by the U.S. Environmental Protection Agency (EPA) and applicable state and local regulations.

If the brine salts failed the RCRA TCLP tests, some type of stabilization of the salt would be necessary. Depending on the technology chosen and the amount of loading of the salt wastes in the stabilization matrix, the amount of stabilized salt waste could easily exceed the salt waste estimate given in Table 7.4-3 by a factor of approximately 2.5. If stabilization of the solid salt waste was required, either a waste management process for stabilizing the waste would be needed, or, alternatively, the waste would need to be shipped off post to an appropriately permitted treatment facility. Depending on the treatment chosen, a new facility might need to be constructed or an existing off-post commercial facility might need to handle the off-post shipment of solid salt waste.

Neutralization/GPCR/TW-SCWO. The operation of this technology would involve several sources of waste. Hydrolysates for both agent and energetics would be combined and sent to the TW-SCWO unit. This unit, which operates at supercritical conditions, would rapidly oxidize all input materials. Upon completion of oxidation, the liquid effluents from this unit would contain soluble and unsoluble salts and metal oxides. These effluents would be sent to the evaporator/crystallizer unit. The resulting dried hazardous brine salts would be disposed of as hazardous wastes (primarily sodium fluoride, sodium sulfate, and sodium chloride; see Table 7.4-3). The liquid effluent would be recycled back to the neutralizer unit as make-up water.

The GPCR unit consists of a thermal reduction batch processor (TRBP) and the reactor (GPCR) itself. In the TRBP, contaminated materials, such as dunnage and metal parts contaminated with agent and energetics, would be placed in a heated oven. The resulting volatile organics would be swept by heated hydrogen gas into the reactor, where they would be reduced to simple hydrocarbons (HCs) and acid gases. The gaseous effluent would pass through a caustic scrubber that would generate brine salts from the acid gases. These hazardous salts would be combined with the brine salts obtained from the TW-SCWO unit, listed in Table 7.4-3. All liquids would be recycled.

Nonprocess operational wastes (e.g., PPE, spent carbon filters, pallets, decontamination solution) could potentially be contaminated by agent. Such contamination would require treatment. Current operating plans include recycling all nonprocess liquids obtained in the operations phase back through the reaction vessel. Such recycling would eliminate these liquids from the waste streams. Recycling of nonprocess wastes would result in approximately 190 tons of brine waste; this amount is included in the overall brine waste numbers shown in Table 7.4-3.

No significant impacts are expected from the generation of hazardous wastes during operation of an ACWA pilot facility. It is assumed that most hazardous wastes generated during operation would be collected and disposed of off post in accordance with U.S. Army, state, and federal regulations. Any wastes determined to be hazardous in the RCRA regulations would be stored and disposed of off post as prescribed by the EPA and applicable state and local regulations.

If the brine salts failed RCRA TCLP tests, some type of stabilization of the salt would be necessary. Depending on the technology chosen and the amount of loading of the salt wastes in the stabilization matrix, the amount of stabilized salt waste could easily exceed the salt waste estimate given in Table 7.4-3 by a factor of approximately 2.5. If stabilization of the solid salt waste was required, either a waste management process for stabilizing the waste would be needed, or, alternatively, the waste would need to be shipped off post to an appropriately permitted treatment facility. Depending on the treatment chosen, a new facility might need to be constructed or an existing off-post commercial facility might need to handle the off-post shipment of solid salt waste.

Electrochemical Oxidation. The operation of this technology would involve several sources of waste. Both agent and energetics would be destroyed by Elchem Ox in the SILVER II process. The SILVER II process would use electrochemical oxidation, which would generate Ag^{+2} ions in aqueous nitric acid. The acid would be circulated through stirred tank reactors (the anolyte and catholyte circuits). Agent and energetics would be oxidized in similar but separate systems. The generated Ag^{+2} ions would oxidize the organic feed when the current was turned on. In reactions with mustard and other organochlorine substances, chloride would be precipitated. The silver chloride salt cake containing various metal particulates would be collected, dried, and sent away for silver recovery. The remaining salts, solids, and metal impurities would be disposed of as hazardous salts (listed in Table 7.4-3 as anolyte-catholyte waste). The anode-cathode reaction would also generate a number of off-gases, including nitrogen oxides (NO_X). Most of the NO_X would be recovered at the NO_X reformer unit as concentrated nitric acid and recycled. Small amounts of dilute nitric acid would be neutralized and disposed of as a hazardous liquid (see Table 7.4-3). The remaining off-gas would be swept to a caustic scrubber, where the remaining corrosive gases would be neutralized and dried for disposal as hazardous brine salts (see Table 7.4-3). All liquids from this unit would be recycled as make-up water.

Various types of nonprocess wastes would be generated from the operation of this technology. They would include dunnage, PPE, spent carbon filters, pallets, and decontamination solution. All of these nonprocess wastes could be contaminated by agent, and such contamination would require treatment. Under this alternative, nonprocess wastes would be treated by the MPT. Treatment of nonprocess wastes would result in approximately 130 tons of residual brine waste; this amount is included in the overall brine waste numbers shown in Table 7.4-3.

No significant impacts are expected from the generation of hazardous waste during the operation of an ACWA pilot facility. It is assumed that most wastes generated during operations would be collected and disposed of off post in accordance with U.S. Army, state, and federal regulations. Any wastes determined to be hazardous in the RCRA regulations would be stored and disposed of off post as prescribed by the EPA and applicable state and local regulations.

If the salts and the anolyte-catholyte wastes failed the RCRA TCLP tests, some type of stabilization of these wastes would be necessary. Depending on the technology chosen and the amount of loading of the wastes in the stabilization matrix, the amount of stabilized waste could easily exceed the hazardous waste estimates given in Table 7.4-3 by a factor of approximately 2.5. If stabilization of the solid salt waste was required, either a waste management process for stabilizing the waste would be needed, or, alternatively, the waste would need to be shipped off post to an appropriately permitted treatment facility. Depending on the treatment chosen, a new facility might need to be constructed or an existing off-site commercial facility might need to handle the off-post shipment of solid salt waste.

Nonhazardous Wastes. Nonhazardous solid wastes associated with ACWA pilot test facility operations were estimated by scaling data on comparable buildings for the size of the operating work force (Kimmell et al. 2001) (Table 7.4-4). These numbers are expected to be nearly the same for each operating day for the four technologies, since the facilities would be of similar size and have similar work force numbers. No significant impacts are expected from the generation of nonhazardous solid wastes during the operation of an ACWA facility.

Nonhazardous solid wastes would be collected and disposed of by a licensed waste hauler. In each technology, recyclable metals would be generated from the decontamination of various munition parts. These are listed in Table 7.4-4. Nonprocess waste would also generate small amounts of metal waste which are included in Table 7.4-4.

During normal operations, an estimated 7.5 million gal (29,000 m^3) of sanitary waste (i.e., sewage or wastewater) would be generated per operating year (276 operating days), except for the Neut/Bio facility, which would operate for only about 16 days and generate an estimated 400,000 gal (1,500 m^3) of sanitary waste (Table 7.4-4) (Kimmell et al. 2001). Wastewater would be treated in a new wastewater treatment plant, and treated effluent would be discharged to Muddy Creek. Alternatively, the Army could route sanitary wastewater to WWTP #1 or to the existing infrastructure in the city of Richmond. No significant impacts are expected from the generation of wastewater during operation of the ACWA pilot test facility.

7.4.4 Impacts of No Action

7.4.4.1 Hazardous Wastes

No construction activities would be anticipated under the no action/continued storage alternative. Continued storage of munitions at BGAD would generate relatively small quantities of hazardous wastes from leaks of hazardous wastes, spills, and contaminated solids such as PPE, pallets, and dunnage. The estimated annual generation associated with storage would be 0.8 ton of liquid wastes (decontamination water) and about 5 tons of hazardous solid waste from PPE and pallets (Williams 2001). The continued degradation of agent containers over time would probably generate slowly increasing amounts of waste from leaks, but these quantities would be relatively small.

Continued storage of chemical weapons at BGAD would not adversely affect waste management. Hazardous wastes would be collected and disposed of off post in accordance with U.S. Army, state, and federal regulations. Any wastes determined to be hazardous under the RCRA regulations would be stored and disposed of off post as prescribed by the EPA and applicable state and local regulations.

7.4.4.2 Nonhazardous Wastes

No construction activities would be anticipated under the no action/continued storage alternative. A small amount of nonhazardous solid waste and nonhazardous sanitary waste would continue to be generated from storage of chemical weapons.

Continued storage of chemical weapons at BGAD would not adversely affect waste management. Facilities exist to handle sanitary waste, and solid wastes would continue to be hauled off post by a licensed contractor.

7.5 AIR QUALITY — CRITERIA POLLUTANTS

This section describes the existing meteorology, air emissions, and air quality at BGAD and the air emissions and impacts on air quality that might result from constructing and operating an ACWA pilot test facility at BGAD. Data on potential emissions and impacts on air quality under the no action alternative are also presented. Potential impacts on human health as a result of air emissions during construction and normal operations are described in Sections 7.6 and 7.7. Potential impacts on air quality and human health as a result of air emissions from accidents involving explosives and chemical agents are described in Section 7.21.

The analysis of impacts on air quality from both construction and operations was conducted for Proposed Area B (see Figure 7.1-2), which is the area that is closest to the BGAD installation boundary and to the nearest off-post residence. The two potential locations for pilot test facilities are adjacent to one another and would require similar infrastructures. Therefore, the analysis for one location provides an adequate representation of the potential impacts from construction and operations for either of the two locations.

Because the facility size, number of construction workers, and infrastructure required for each of the ACWA technologies proposed for pilot testing would be similar, only one model analysis of the impacts from construction on air quality was conducted. The technologies are expected to differ in the amount of fossil fuel they would combust to generate heat.

The analyses presented in the following sections conclude that the total (modeled plus background) concentrations associated with fugitive dust emissions during construction would be below applicable standards, except for annual average concentrations of $PM_{2.5}$, for which the background levels at statewide monitoring stations are already over the standard.[2] Because the Neut/Bio technology has lower process heat requirements because of its shorter period of operations (16 days), its emission levels from fossil fuel combustion would be less than those for the other three technologies (Neut/SCWO, Neut/GPCR/TW-SCWO, and Elechem Ox). However, concentration increments of air pollutants due to these emissions, by themselves or added to background, would be within applicable standards, except for the annual average concentration of $PM_{2.5}$.

---

[2] PM = particulate matter. PM_{10} = coarse, inhalable PM with a mean aerodynamic diameter of 10 μm or less. $PM_{2.5}$ = fine, inhalable PM with a mean aerodynamic diameter of 2.5 μm or less.

7.5.1 Current Meteorology, Emissions, and Air Quality

7.5.1.1 Meteorology

The climate of the area surrounding BGAD is continental and temperate, with a rather large diurnal temperature range. The following description of climate is based on data recorded at Lexington Airport (Bluegrass Field), which is located about 30 mi (50 km) northwest of BGAD (National Oceanic and Atmospheric Administration [NOAA] 1999). Wind data measured at a BGAD on-post meteorological tower (Demil tower[3]) are also presented (Rhodes 2000).

The average wind speed measured at a height of 23 ft (7 m) aboveground at Lexington Airport, Kentucky, is about 9.1 miles per hour (mph) (4.1 m/s). Average wind speeds from November through April are 10.5 mph (4.7 m/s); these speeds are higher than average speeds from May through October of 7.6 mph (3.4 m/s). The dominant wind direction is from the south throughout the year.

Wind data at the Demil tower, which is located at the northeast corner of BGAD, have been measured at three heights aboveground (33, 100, and 200 ft [10, 30, and 60 m]) since August 1998. The wind roses at the three heights at the Demil tower for the two-year period (August 1998 through July 2000) are shown in Figure 7.5-1(a-c). For comparison, the wind rose at 23 ft (7 m) at Lexington Airport for the eight-year period (1984–1992) is also presented in Figure 7.5-1(d) (EPA 2000a). Wind patterns at 100 and 200 ft (30 and 60 m) levels at the Demil tower were almost the same, but the wind speed at 100 ft (30 m) was lower. These wind patterns at the Demil tower were similar to those at Lexington Airport, but the predominant wind direction was slightly different. The predominant wind direction was from the south-southwest at the Demil tower, whereas it was from the south at Lexington Airport. However, wind patterns at 33 ft (10 m) at the Demil tower showed bimodal (southeast and southwest) dominance, with the average wind speed being half the speed at Lexington Airport. This result suggests that winds measured at heights of 33 ft (10 m) at BGAD were strongly influenced by nearby vegetation. In the two-year period, the average wind speed measured at 33 ft (10 m) at the Demil tower was about 4.5 mph (2.0 m/s), while the highest wind speed was about 28.6 mph (12.8 m/s).

The average annual temperature at Lexington Airport is 55.1°F (12.8°C). January is the coldest month, averaging 32.2°F (0.1°C), and July is the warmest month, averaging 76.2°F (24.6°C). The area is subject to sudden and large changes in temperature that are generally of

---

[3] Currently, four meteorological towers (three CSEPP [Chemical Stockpile Emergency Preparedness Program] towers and one Demil tower) are operating at BGAD. Wind data from the Demil tower were selected to represent the conditions at BGAD because the tower meets the EPA's siting criteria and because the instruments and associated data were checked for quality assurance/quality control (QA/QC) more comprehensively than were the data from CSEPP towers (Rhodes 2000).

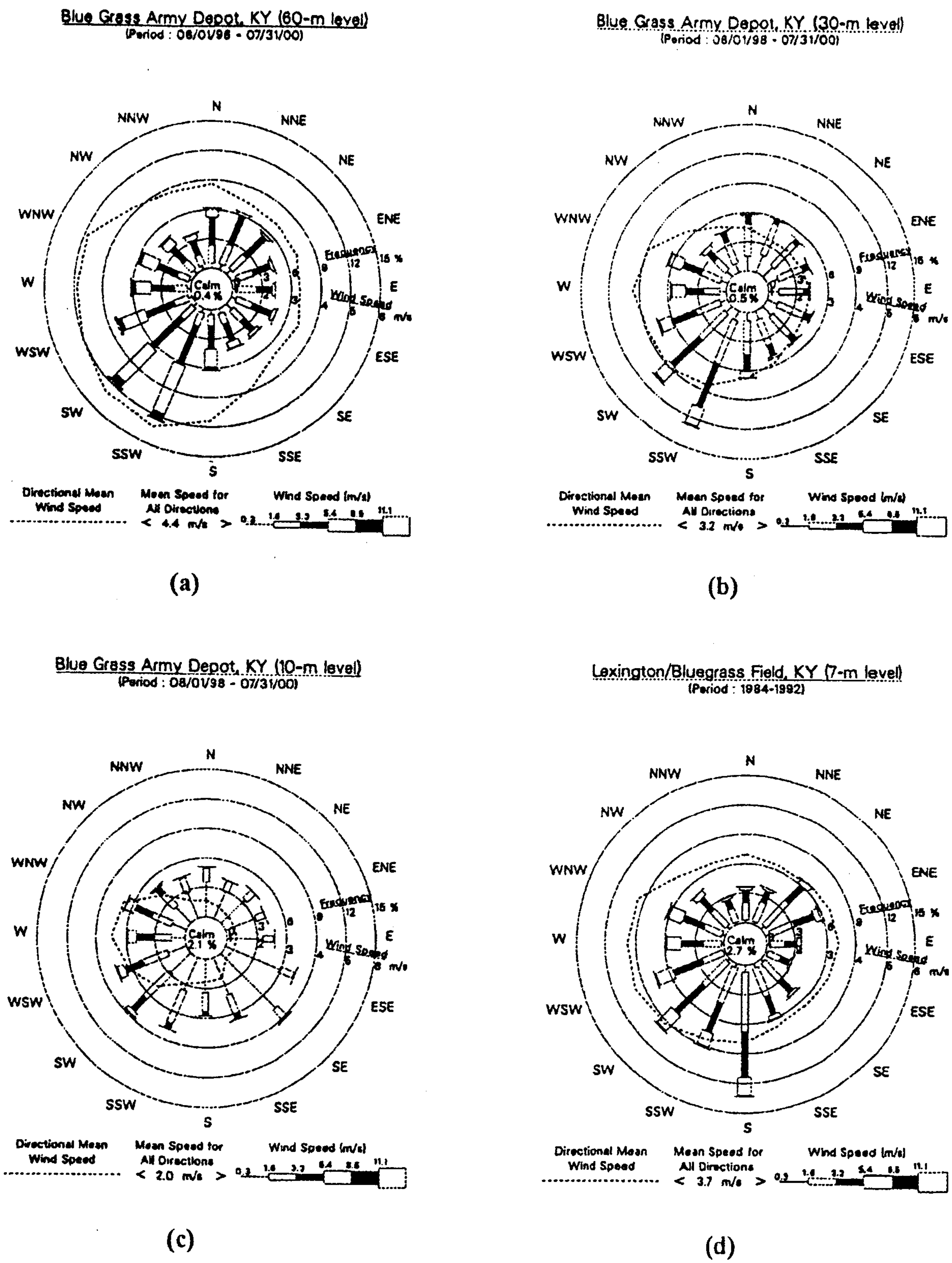

FIGURE 7.5-1 Annual Wind Roses for Three Heights Aboveground at the Demil Tower at BGAD from August 1998 through July 2000 (a = 60 m, b = 30 m, c = 10 m) and for One Height at Lexington Airport from 1984 through 1992 (d = 7 m) (Sources: Rhodes 2000 for a, b, c; EPA 2000a for d)

short duration. Temperatures above 100°F (37.8°C) and below 0°F (–17.8°C) are relatively rare. Extreme temperatures have ranged from –21°F (–29.4°C) in January 1963 to 103°F (39.4°C) in July 1988. There are approximately 269 freeze-free days per year (i.e., days when the daily minimum temperature is greater than 32°F [0°C]); this period extends from the beginning of May through the end of September. Temperatures of 90°F (32°C) or higher occur on an average of about 18 days per year, most of which fall (16 days) during June, July, and August.

Average annual precipitation at the Lexington Airport is 44.6 in. (113 cm). Precipitation is evenly distributed throughout the winter, spring, and summer seasons, with about 12 in. (30.5 cm) recorded, on average, for each season. The fall season averages nearly 8.5 in. (21.6 cm). The greatest amount of precipitation in a single month was 16.7 in. (42.3 cm) in January 1950, and the greatest amount in a day (i.e., 24-hour period) was 5.9 in. (14.9 cm) in June 1960. Winter snowfall averages about 17.5 in. (44.5 cm). The greatest amount of snow reported in a month was 21.9 in. (55.6 cm) in January 1978, and the greatest amount in a day was 14.0 in. (35.6 cm) also in January 1978. Snowfall amounts vary, and the ground does not retain snow cover more than a few days at a time.

Average annual relative humidity at Lexington Airport is 70%, ranging from 77% to 82% during the first half of the day and 60% to 64% during the second half. Heavy fogs are rather rare in the area. The average number of days with heavy fog (visibility $\leq$ 0.25 mi [0.4 km]) is about 19, and these days are relatively evenly distributed throughout the year except during spring. Thunderstorms can occur in any month but are more frequent from March through September. The mean number of days with thunderstorms at Lexington Airport is about 44. The storms are occasionally accompanied by damaging hail, but the area affected is nearly always small.

Three tornadoes struck Madison County in the 1990s. However, data for the 46-year period of 1950 through 1995 indicate that tornadoes are less frequent and destructive in Kentucky (average of nine tornadoes per year) than they are elsewhere in the Midwest (averages from 14 per year in Ohio to 48 per year in Kansas) (Storm Prediction Center 2000). From 1950 through 1995, 403 tornadoes were reported in Kentucky (tornado event frequency of $2.2 \times 10^{-4}/\text{mi}^2$ per year) and 10 tornadoes were reported in Madison County (tornado event frequency of $4.9 \times 10^{-4}/\text{mi}^2$ per year). Except for a deadly tornado in April 1974, most tornadoes that occurred in Madison County were relatively weak.

7.5.1.2 Emissions

The existing sources of criteria pollutants and their precursors at BGAD include boilers, ovens, incinerators, surface coating and metal cleaning operations, fuel storage and handling, woodworking, and other miscellaneous industrial operations. These sources are being operated under a permit from KDEP's Division of Air Quality (previously Division of Air Pollution Control [DAPC]) in the Kentucky Natural Resources and Environmental Protection Cabinet (Cabinet 1986). Other emissions include vehicle exhaust emissions and fugitive particulate emissions, including road dust. Emission estimates for these sources based on operation information are presented in Table 7.5-1 (Elliott 2000). Emissions from open burning and open detonation are included in the Toxics Release Inventory (TRI) report and discussed separately in Section 7.6.1.

Actual annual total emissions from all categories of BGAD sources with permits from the Kentucky DAPC during 1998 were about 4.9 tons/yr of volatile organic compounds (VOCs); 1.9 tons/yr of particulate matter (PM_{10}); 1.1 tons/yr of sulfur dioxide (SO_2); 1.0 ton/yr of NO_x; 0.2 ton/yr of carbon monoxide (CO); and 0.0018 ton/yr of lead (Pb). Annual estimates of air pollutant emissions in 1998 from Madison County and BGAD are listed in Table 7.5-2. The significance of BGAD emissions is expressed as a percentage of the total Madison County emissions. As the table indicates, BGAD emissions account for very small fractions of the emissions released from Madison County (i.e., about 1.2%, 0.9%, 0.8%, 0.3%, 0.1%, and 0.1%, respectively, of the total Madison County emissions for VOCs, Pb, PM_{10}, SO_2, NO_x, and CO.

7.5.1.3 Air Quality

The Kentucky State Ambient Air Quality Standards (SAAQS) for six criteria pollutants — SO_2, PM (both PM_{10} and $PM_{2.5}$), CO, ozone (O_3), nitrogen dioxide (NO_2), and Pb — are identical to the National Ambient Air Quality Standards (NAAQS) (401 *Kentucky Administration Regulation* [KAR] 53:010) (Table 7.5-3). In 1997, the EPA revised the NAAQS

TABLE 7.5-1 Estimated Emissions of Air Pollutants from Existing BGAD Sources in 1999

Stationary Source Category[a]	Emissions (tons/yr)[b]					
	SO_2	No_x	CO	VOCs	PM_{10}	Pb
Boilers/ovens	32.36	23.37	5.80	0.45	1.22	0.0005
Solid waste disposal	1.04	1.82	4.16	1.25	0.53	-
Surface coating	-	-	-	80.18	1.40	0.0013
Metal cleaning	-	-	-	-	0.06	-
Fuel storage and handling	-	-	-	5.89	-	-
Woodworking	-	-	-	-	1.95	-
Miscellaneous industrial processes	4.72	12.00	8.44	-	3.15	-
Total	38.13	37.20	18.39	87.74	8.30	0.0018

[a] The potential of stationary sources to emit is usually based on 24-h, 7-d/wk operations and a worst-case assumption that pollution control equipment is not functioning (Elliott 2000).

[b] A hyphen means that there was no emission, the emission was negligible, or the emission was not estimated.

TABLE 7.5-2 Estimated Emissions of Air Pollutants from Madison County, Kentucky, and BGAD Sources in 1998

	Emissions (tons/yr)	
Air Pollutant	Madison County	BGAD[a]
SO_2	351.5	1.1 (0.3)
NO_x	686.1	1.0 (0.1)
CO	205.2	0.2 (0.1)
VOC	420.8	4.9 (1.2)
PM_{10}	227.0	1.9 (0.8)
Pb	0.2	0.0018 (0.9)

[a] Numbers in parentheses are BGAD emissions as a percent of Madison County emissions.

Source: Kentucky Division for Air Quality (2000a).

for O_3 and PM. The standards were challenged, and the lower court decision was appealed to the U.S. Supreme Court. On February 27, 2001, the U.S. Supreme Court unanimously upheld the constitutionality of the CAA as the EPA had interpreted it in setting the $PM_{2.5}$ and O_3 standards. However, the case was remanded back to the D.C. Circuit Court of Appeals to resolve the remaining issues, which include EPA's justification for the numerical levels. While the case is pending, the O_3 and fine particle standards remain in effect as a legal matter, because the D.C. Circuit Court decision did not vacate the standards. The EPA has not, however, started implementing the revised $PM_{2.5}$ and O_3 standards. States or commonwealths may set standards that are more stringent than the NAAQS or that address specific pollutants not covered by the NAAQS. As mentioned above, Kentucky has adopted the NAAQS and, in addition, has adopted standards for hydrogen sulfide (H_2S), gaseous fluorides [expressed as hydrogen fluoride [HF]), total fluorides, and odors. These additional standards are presented in Table 7.5-4.

The monitoring station for SO_2, NO_2, CO, and O_3 nearest to BGAD is in Lexington, while the stations for PM_{10} and $PM_{2.5}$ nearest to BGAD are in Richmond. $PM_{2.5}$ monitoring was started in Richmond in January 1999, but the annual average values are near or above the standard, as are those values at most statewide monitoring stations. As a direct result of the phase-out of leaded gasoline in automobiles, lead concentrations in urban areas decreased dramatically. Thus, ambient lead concentration is no longer monitored in many parts of the country including the Commonwealth of Kentucky. Fluorides are of concern near the Paducah Gaseous Diffusion Plant in western Kentucky but are not monitored near Lexington. Odors from hydrogen sulfide and other chemicals are of local concern around facilities that produce odoriferous chemicals. Monitoring for such pollutants is often prompted by citizen complaints, is

TABLE 7.5-3 National Ambient Air Quality Standards (NAAQS), Kentucky State Ambient Air Quality Standards (SAAQS), Maximum Allowable Increments for Prevention of Significant Deterioration (PSD), and Highest Background Levels Representative of BGAD[a]

		NAAQS[b]		PSD Increment (µg/m³)		Highest Background Level		
Pollutant	Averaging Time	Primary	Secondary	Class I	Class II	Concentration[c]	Location	Year
SO_2	3 hours	-	0.50 ppm (1,300 µg/m³)	25	512	0.066 ppm (13)	Lexington	1998
	24 hours	0.14 ppm (365 µg/m³)	-	5	91	0.031 ppm (22)	Lexington	1998
	Annual	0.03 ppm (80 µg/m³)	-	2	20	0.008 ppm (27)	Lexington	1999
NO_2	Annual	0.053 ppm (100 (µg/m³)	0.053 ppm (100 µg/m³)	2.5	25	0.017 ppm (32)	Lexington	1995
CO	1 hour	35 ppm (40,000 µg/m³)	-	-	-	8.6 ppm (25)	Lexington	1997
	8 hours	9 ppm (10,000 µg/m³)	-	-	-	6.0 ppm (67)	Lexington	1997
O_3	1 hour	0.12 ppm (235 µg/m³)	0.12 ppm (235 µg/m³)	-	-	0.122 ppm (102)	Lexington	1998
	8 hours	0.08 ppm (157 µg/m³)	0.08 ppm (157 µg/m³)	-	-	0.111 ppm (139)	Lexington	1998
PM_{10}	24 hours	150 µg/m³	150 µg/m³	8	30	70 µg/m³ (47)	Richmond	1995
	Annual	50 µg/m³	50 µg/m³	4	17	29 µg/m³ (57)	Richmond	1995
$PM_{2.5}$	24 hours	65 µg/m³	65 µg/m³	-	-	35 µg/m³ (53)	Richmond	1999
	Annual	15 µg/m³	15 µg/m³	-	-	17 µg/m³ (114)	Richmond	2000
Pb	Calendar quarter	1.5 µg/m³	1.5 µg/m³	-	-	-	-	-

[a] A hyphen indicates that no standards or monitoring data exist.

[b] Refer to 40 CFR 50 for detailed information on the implementation of the new $PM_{2.5}$ and O_3 standard and the interim treatment of the existing standards.

[c] Values in parentheses are monitored concentrations as a percentage of NAAQS.

Sources: 40 CFR 50; Kentucky Division for Air Quality (1999, 2000b); 40 CFR 52.21; EPA (2001a).

TABLE 7.5-4 Commonwealth of Kentucky Ambient Air Quality Standards[a]

		Standard (μg/m^3)	
Pollutant	Averaging Time	Primary	Secondary
Hydrogen sulfide	1 hour	-	14 (0.01 ppm)[b]
Gaseous fluorides (expressed as HF)	12 hours	-	3.68 (4.50 ppb)[b]
	24 hours	800 (1.0 ppm)[b]	2.86 (3.50 ppb)[b]
	1 week	-	1.64 (2.00 ppb)[b]
	1 month	-	0.82 (1.00 ppb)[b]
	1 year	400 (0.5 ppm)	-
Total fluorides	1 month	80 ppm	-
	2 months	60 ppm	-
	Growing season[c]	40 ppm	-
Odors	At any time when one volume unit of ambient air is mixed with seven volume units of odorless air, the mixture must have no detectable odor		

[a] These standards are in addition to the Kentucky SAAQS listed in Table 7.5-3. A hyphen indicates that no standard exists.

[b] This average is not to be exceeded more than once per year.

[c] Average concentration of monthly samples over the growing season (not to be exceeded during six consecutive months).

Source: Appendix A to 401 *Kentucky Administrative Regulation* (KAR) 53:010.

very localized, and seldom continues for very long time periods. The highest values for background air quality measured at the monitoring station closest to BGAD for pollutants subject to the NAAQS are also presented in Table 7.5-3.

BGAD, situated near the center of Madison County, is located in the southeastern part of the Bluegrass Intrastate Air Quality Control Region (AQCR), which covers the east central part of Kentucky (Figure 7.5-2). Currently, Madison County is designated as being in attainment for all federal and Commonwealth of Kentucky ambient air quality standards (40 CFR 81.318). On the basis of monitoring data from 1995 to 2000, concentration levels for SO_2, NO_2, CO, and PM_{10} around BGAD are below their respective NAAQS. However, the highest O_3 concentrations are somewhat higher than the applicable NAAQS. These high concentrations of regional concern are associated with high precursor emissions from the Ohio Valley Region and long-range transport from Southern states. In addition, the annual averages of $PM_{2.5}$ at most statewide monitoring stations are over the standard.

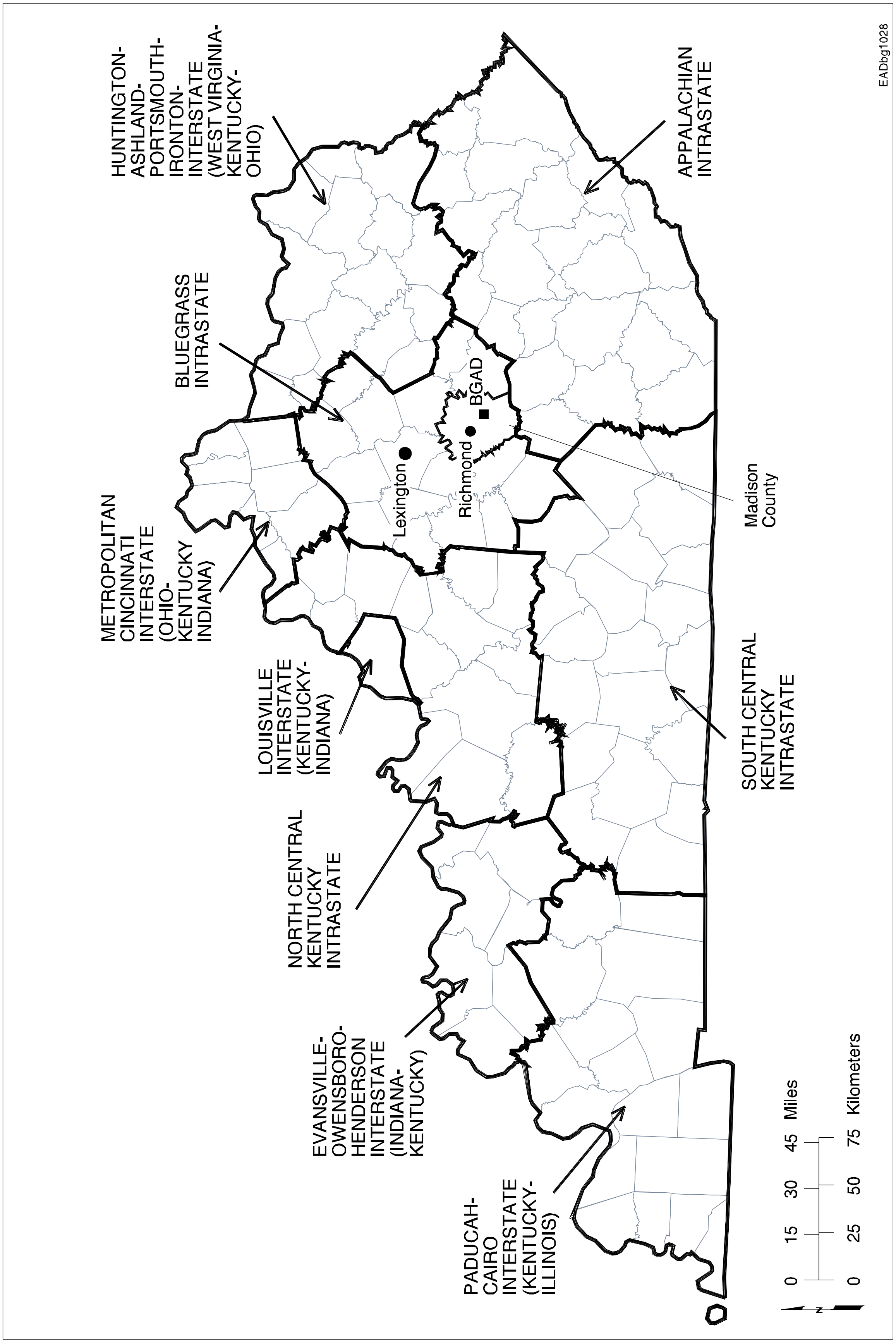

FIGURE 7.5-2 BGAD and Air Quality Control Regions in Kentucky

Prevention of significant deterioration (PSD) regulations (40 CFR 52.21) limit the maximum allowable incremental increases in ambient concentrations of SO_2, NO_2, and PM_{10} above established baseline levels, as shown in Table 7.5-3. The PSD regulations, which are designed to protect ambient air quality in Class I and Class II attainment areas,[4] apply to major new sources and major modifications to existing sources. Mammoth Cave National Park is the PSD Class I area nearest to BGAD (it is the only PSD Class I area in Kentucky). Mammoth Cave National Park is located 100 mi (161 km) west-southwest of BGAD, upwind of prevailing winds. All remaining areas in Kentucky are designated as PSD Class II areas.

7.5.2 ACWA Facility Emissions

7.5.2.1 Emissions from Construction

Emissions of criteria pollutants (such as SO_2, NO_x, CO, PM_{10}, and $PM_{2.5}$) and VOCs during the construction period would include fugitive dust emissions from earth-moving activities and exhaust emissions from equipment and commuter and delivery vehicles. Exhaust emissions are expected to be relatively small when compared with fugitive dust emissions from earth-moving activities (Kimmell et al. 2001). Also, impacts from exhaust emissions would be smaller because of their elevated buoyant release, which is different from ground-level fugitive dust emissions. Accordingly, only the potential impacts on ambient air quality from fugitive emissions of PM_{10} and $PM_{2.5}$ from earth-moving activities were analyzed. Emission factors and other assumptions used in estimating emission rates of PM_{10} and $PM_{2.5}$ are described in Appendix B.

7.5.2.2 Emissions from Operations

BGAD has a permit that allows it to emit less than 100 tons/yr of any regulated air pollutant (Section 1 of 401 *Kentucky Administrative Regulation* [KAR] 50:035). BGAD is therefore classified as a minor source. Emission factors and other assumptions that were used to estimate emission rates of criteria pollutants and VOCs during operations are described in Appendix B. Maximum short-term and annual total emission rates, along with stack parameters (heights, inside diameters, gas exit temperatures, gas exit velocities) used in the dispersion modeling are listed in Table 7.5-5 for Neut/Bio, Table 7.5-6 for Neut/SCWO, Table 7.5-7 for Neut/GPCR/TW-SCWO, and Table 7.5-8 for Elchem Ox.

---

[4] In 1975, the EPA developed a classification system to allow some economic development in clean air areas while still protecting air from significant deterioration. These classes are defined in the 1977 *Clean Air Act Amendments* (CAAA). Very little deterioration is allowed in Class I areas (e.g., larger national parks and wilderness areas). Class II areas allow moderate deterioration. Class III areas allow deterioration up to the secondary standard.

TABLE 7.5-5 Emission Rates of Criteria Air Pollutants and Volatile Organic Compounds and Stack Parameters Associated with Normal Operations of the Neutralization/Biotreatment Technology at BGAD

Stack Parameters and Estimated Peak Emission Rates	Steam Boilers	Emergency Diesel Generators
Stack parameters[a]		
Height	70 ft (21.3 m)	47 ft (14.3 m)
Inside diameter	1.4 ft (0.42 m)	0.67 ft (0.20 m)
Gas exit temperature	325°F (436 K)	925°F (769 K)
Gas exit velocity	60 ft/s (18 m/s)	323 ft/s (98 m/s)
Emission rates[b]		
SO_2	0.03 lb/h (0.003 ton/yr)	3.2 lb/h (0.06 ton/yr)
NO_x	6.5 lb/h (0.63 ton/yr)	48.4 lb/h (0.85 ton/yr)
CO	3.9 lb/h (0.38 ton/yr)	10.4 lb/h (0.18 ton/yr)
PM_{10}	0.35 lb/h (0.03 ton/yr)	3.4 lb/h (0.06 ton/yr)
$PM_{2.5}$[c]	0.35 lb/h (0.03 ton/yr)	3.4 lb/h (0.06 ton/yr)
VOCs	0.26 lb/h (0.02 ton/yr)	4.0 lb/h (0.07 ton/yr)

[a] For the modeling analysis, emissions from the three boilers were assumed to come from one stack location. Similarly, emissions from the two emergency generators were assumed to come from one stack location.

[b] Estimated peak emission rates are for the simultaneous operations of three steam boilers and two emergency generators at full load.

[c] $PM_{2.5}$ emissions were conservatively assumed to be 100% of PM_{10} emissions for natural-gas-fired boilers and diesel generators (EPA 2000b).

Source: Kimmell et al. (2001).

Neutralization/Biotreatment. In a Neut/Bio pilot test facility, air pollutants would be emitted from five types of stacks. Three would be similar to the first three types of stacks used in the Neut/SCWO facility described in the next paragraph. The fourth stack would be a biotreatment vent (waste gas) instead of a SCWO stack. The fifth stack would be a laboratory filter area stack. (In other systems, the laboratory effluents are combined with other emission streams.) No emissions from the laboratory filter area stack would be expected during normal (incident-free) operations. Because the Neut/Bio facility at BGAD would operate for only 16 days, its total emissions would be much lower than those from the other technology facilities, which would operate for longer than a year.

TABLE 7.5-6 Emission Rates of Criteria Air Pollutants and Volatile Organic Compounds and Stack Parameters Associated with Normal Operations of the Neutralization/SCWO Technology at BGAD

Stack Parameters and Estimated Peak Emission Rates	Steam Boilers	Emergency Diesel Generators
Stack parameters[a]		
Height	70 ft (21.3 m)	47 ft (14.3 m)
Inside diameter	0.81 ft (0.25 m)	0.67 ft (0.20 m)
Gas exit temperature	325°F (436 K)	925°F (769 K)
Gas exit velocity	60 ft/s (18 m/s)	323 ft/s (98 m/s)
Emission rates[b]		
SO_2	0.01 lb/h (0.02 ton/yr)	3.2 lb/h (0.95 ton/yr)
NO_x	2.2 lb/h (3.64 tons/yr)	48.4 lb/h (14.5 tons/yr)
CO	1.3 lb/h (2.18 tons/yr)	10.4 lb/h (3.12 ton/yr)
PM_{10}	0.12 lb/h (0.20 ton/yr)	3.4 lb/h (1.02 tons/yr)
$PM_{2.5}$[c]	0.12 lb/h (0.20 ton/yr)	3.4 lb/h (1.02 tons/yr)
VOCs	0.09 lb/h (0.14 ton/yr)	4.0 lb/h (1.18 tons/yr)

[a] For the modeling analysis, emissions from the three boilers were assumed to come from one stack location. Similarly, emissions from the two emergency generators were assumed to come from one stack location.

[b] Estimated peak emission rates are for the simultaneous operations of three steam boilers and two emergency generators at full load.

[c] $PM_{2.5}$ emissions were conservatively assumed to be 100% of PM_{10} emissions for natural-gas-fired boilers and diesel generators (EPA 2000b).

Source: Kimmell et al. (2001).

Neutralization/SCWO. In a Neut/SCWO pilot test facility, air pollutants would be emitted from four types of stacks: (1) three stacks for the natural-gas-burning boilers (two operating, one on standby) used to generate process steam and building heat, (2) two stacks for the diesel-powered generators used as a backup system to provide emergency electricity, (3) a filter farm stack for building circulating exhaust air and non-SCWO air effluents (e.g., rotary hydrolyzer, MPT), and (4) a stack for exhaust from the SCWO process. The principal sources of criteria pollutant and VOC emissions would be boilers and emergency generators, while the primary sources of hazardous air pollutant (HAP) emissions would be the filter farm stack and SCWO stack (HAPs are discussed in Sections 7.6 and 7.7).

TABLE 7.5-7 Emission Rates of Criteria Air Pollutants and Volatile Organic Compounds and Stack Parameters Associated with Normal Operations of the Neutralization/GPCR/TW-SCWO Technology at BGAD

Stack Parameters and Estimated Peak Emission Rates	Steam Boilers	Emergency Diesel Generators	Process Gas Burner
Stack parameters[a]			
Height	70 ft (21.3 m)	47 ft (14.3 m)	80 ft (24.4 m)
Inside diameter	1.1 ft (0.32 m)	0.67 ft (0.20 m)	0.42 ft (0.13 m)
Gas exit temperature	325°F (436 K)	925°F (769 K)	77°F (298 K)
Gas exit velocity	60 ft/s (18 m/s)	323 ft/s (98 m/s)	62 ft/s (19 m/s)
Emission rates[b]			
SO_2	0.02 lb/h (0.003 ton/yr)	3.2 lb/h (0.95 ton/yr)	0.004 lb/h (0.08 ton/yr)
NO_x	4.0 lb/h (6.65 tons/yr)	48.4 lb/h (14.5 tons/yr)	0.11 lb/h (0.18 ton/yr)
CO	2.4 lb/h (3.99 tons/yr)	10.4 lb/h (3.12 tons/yr)	0.17 lb/h (0.29 ton/yr)
PM_{10}	0.22 lb/h (0.36 ton/yr)	3.4 lb/h (1.02 tons/yr)	0.03 lb/h (0.05 ton/yr)
$PM_{2.5}$[c]	0.22 lb/h (0.36 ton/yr)	3.4 lb/h (1.02 tons/yr)	0.03 lb/h (0.05 ton/yr)
VOCs	0.16 lb/h (0.26 ton/yr)	4.0 lb/h (1.18 tons/yr)	0.05 lb/h (0.08 ton/yr)

[a] For the modeling analysis, emissions from the three boilers were assumed to come from one stack location. Similarly, emissions from the two emergency generators were assumed to come from one stack location.

[b] Estimated peak emission rates are for the simultaneous operations of three steam boilers and two emergency generators at full load.

[c] $PM_{2.5}$ emissions were conservatively assumed to be 100% of PM_{10} emissions for natural-gas-fired boilers, diesel generators, and a process gas burner (EPA 2000b).

Source: Kimmell et al. (2001).

Neutralization/GPCR/TW-SCWO. In a Neut/GPCR/TW-SCWO pilot test facility, air pollutants would be emitted from four different kinds of stacks, similar to those of the Neut/SCWO facility. The only difference is that a process gas burner stack would replace a SCWO stack. This stack would be used to discharge treated supplementary process fuel gas produced from the GPCR process (which consists of a central reactor for destroying organic waste streams). This stack would emit criteria pollutants, VOCs, and various HAPs. Its criteria pollutant and VOC emissions would amount to much less than those from boilers or diesel generators. In lieu of using a process gas burner stack, the fuel gas could be used as fuel by the facility boilers.

TABLE 7.5-8 Emission Rates of Criteria Air Pollutants and Volatile Organic Compounds and Stack Parameters Associated with Normal Operations of the Electrochemical Oxidation Technology at BGAD

Stack Parameters and Estimated Peak Emission Rates	Steam Boilers	Emergency Diesel Generators
Stack parameters[a]		
Height	70 ft (21.3 m)	47 ft (14.3 m)
Inside diameter	0.77 ft (0.23 m)	0.67 ft (0.20 m)
Gas exit temperature	325°F (436 K)	925°F (769 K)
Gas exit velocity	60 ft/s (18 m/s)	323 ft/s (98 m/s)
Emission rates[b]		
SO_2	0.01 lb/h (0.02 ton/yr)	3.2 lb/h (0.95 ton/yr)
NO_x	2.2 lb/h (3.64 tons/yr)	48.4 lb/h (14.5 tons/yr)
CO	1.3 lb/h (2.18 tons/yr)	10.4 lb/h (3.12 tons/yr)
PM_{10}	0.12 lb/h (0.20 ton/yr)	3.4 lb/h (1.02 tons/yr)
$PM_{2.5}$[c]	0.12 lb/h (0.20 ton/yr)	3.4 lb/h (1.02 tons/yr)
VOCs	0.09 lb/h (0.14 ton/yr)	4.0 lb/h (1.18 tons/yr)

[a] For the modeling analysis, emissions from the three boilers were assumed to come from one stack location. Similarly, emissions from the two emergency generators were assumed to come from one stack location.

[b] Estimated peak emission rates are for the simultaneous operations of three steam boilers and two emergency generators at full load.

[c] $PM_{2.5}$ emissions were conservatively assumed to be 100% of PM_{10} emissions for natural-gas-fired boilers and diesel generators (EPA 2000b).

Source: Kimmell et al. (2001).

Electrochemical Oxidation. In an Elchem Ox pilot test facility, air pollutants would be emitted from three different kinds of stacks. The major difference from a Neut/SCWO facility is the absence of a SCWO stack. Thus, the assumption is that all air effluents from all treatment processes would be emitted into the atmosphere via the filter farm stack.

Other Sources. Other sources of air pollution during operations would include vehicular traffic, such as cars, pickup trucks, and buses transporting personnel to and from the facility. Trucks and forklifts would be used to deliver supplies to the facility. Parking lots and access roads to the facility would be paved with asphalt concrete to minimize fugitive dust emissions. Other potential emissions would include VOCs from the aboveground and underground fuel storage tanks. However, these emissions would be negligible because diesel fuel has a low volatility and because facility operations would consume a low level of fuel and thus require infrequent refilling.

7.5.3 Impacts of the Proposed Action

Potential impacts of air pollutant emissions during pilot facility construction and operation were evaluated by estimating maximum ground-level concentration increments of criteria air pollutants resulting from construction and operations, adding these estimates to background concentrations, and comparing the results with applicable ambient air quality standards. As indicated in Table 7.5-3, the Kentucky SAAQS for criteria air pollutants are identical to the NAAQS (401 KAR 53:010).

To evaluate air quality impacts from BGAD operations with respect to PSD requirements, estimated maximum increments in ground-level concentrations that would result from the operation of the proposed facility were compared with allowable PSD increments above the baseline. Applicable PSD increments are summarized in Table 7.5-3.

The air quality model, model input data (meteorological data, source and receptor locations, elevation data), and other assumptions used in estimating potential construction and operational impacts on ambient air quality at the BGAD boundaries and surrounding areas are described in Appendix B.

7.5.3.1 Impacts of Construction

The modeling results for both PM_{10} and $PM_{2.5}$ concentration increments that would result from construction-related fugitive emissions are summarized in Table 7.5-9. At the installation boundaries, for both PM_{10} and $PM_{2.5}$, the maximum 24-hour and annual average concentration increments above background would occur about 1.2 mi (1.9 km) north and 1.3 mi (2.2 km) north-northeast of the proposed facility, respectively. At these locations, for PM_{10}, the maximum 24-hour and annual average concentration increments above background would be about 36% and 1.2% annual of the NAAQS, respectively. For $PM_{2.5}$, the maximum 24-hour and annual average concentration increments above background would be about 42% and 2% of the NAAQS, respectively.

To obtain the overall concentrations for comparison with applicable NAAQS, the maximum PM_{10} and $PM_{2.5}$ concentration increments (Table 7.5-9) were added to background values (from Table 7.5-3). For PM_{10}, the estimated maximum 24-hour and annual average concentrations would be about 83% and 58% of the NAAQS, respectively. For $PM_{2.5}$, the estimated maximum 24-hour and annual average concentrations would be about 95% and 116% of the NAAQS, respectively. The annual average $PM_{2.5}$ background concentration of 17.1 $\mu g/m^3$ around the BGAD area is already above the standard of 15 $\mu g/m^3$. Accordingly, construction activities should be conducted so as to minimize further impacts on ambient air quality.

TABLE 7.5-9 Maximum Predicted Off-Post Concentration Increments and Total Concentrations of PM_{10} and $PM_{2.5}$ during Construction at BGAD

		Concentration (µg/m^3)				
Pollutant	Averaging Time	Maximum Increment[a,b]	Background[c]	Total[d]	NAAQS	Percent of NAAQS[e]
PM_{10}	24 hours	54	70	124	150	83 (36)
	Annual	0.6	29	29	50	58 (1.2)
$PM_{2.5}$	24 hours	27	35	62	65	95 (42)
	Annual	0.3	17	17	15	116 (2.0)

[a] The maximum concentration increments were estimated by using the Industrial Source Complex ISCST3 model (Version 00101; EPA 1995).

[b] Modeled maximum 24-hour and annual average concentrations occur at hypothetical boundary receptor locations about 1.2 mi (1.9 km) and 1.3 mi (2.2 km) to the north and north-northeast of the proposed facility, respectively.

[c] See Table 7.5-3.

[d] Total equals maximum modeled concentration plus background concentration.

[e] The values are total concentration as a percent of NAAQS. The values in parentheses are maximum concentration increments as a percent of NAAQS.

In summary, the estimated maximum 24-hour and annual average concentration increments of PM_{10} and $PM_{2.5}$ that would result from construction-related fugitive emissions would be relatively small fractions of the applicable NAAQS. The total (maximum increments plus background) estimated maximum 24-hour and annual average concentrations of PM_{10} and annual concentrations of $PM_{2.5}$ would be below the applicable NAAQS. However, the total estimated annual average concentrations of $PM_{2.5}$ would be above the applicable NAAQS, primarily because of high background concentration levels.

7.5.3.2 Impacts of Operations

In the air quality analysis for the operational period, air quality impacts were modeled for each of the four ACWA technologies. The results are presented in tabular format for each case. The modeling results for concentration increments of SO_2, NO_2, CO, PM_{10}, and $PM_{2.5}$ due to emissions from the proposed facility operations are summarized in Tables 7.5-10, 7.5-11, 7.5-12, and 7.5-13, respectively, for the Neut/Bio, Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox systems. The receptor locations where maximum concentration increments would occur are also listed in these tables.

TABLE 7.5-10 Maximum Predicted Off-Post Concentration Increments and Total Concentrations of Criteria Pollutants during Normal Operations of the Neutralization/Biotreatment Technology at BGAD

		Concentration ($\mu g/m^3$)					Receptor Location[e]	
Pollutant	Averaging Time	Maximum Increment[a]	Background[b]	Total[c]	NAAQS	Percent of NAAQS[d]	Distance [mi (km)]	Direction
SO_2	3 hours	6.8	172	179	1,300	14 (0.52)	2.8 (4.6)	SW
	24 hours	1.7	81	83	365	23 (0.47)	1.2 (1.9)	W
	Annual	0.0004	21	21	80	26 (0.0005)	1.4 (2.2)	NW
NO_2	Annual	0.011	32	32	100	32 (0.011)	1.4 (2.2)	NW
CO	1 hour	53	9,800	10,000	40,000	25 (0.13)	2.5 (4.1)	WSW
	8 hours	16	6,700	6,700	10,000	67 (0.16)	1.3 (2.1)	N
PM_{10}	24 hours	2.0	70	72	150	48 (1.3)	1.2 (1.9)	W
	Annual	0.001	29	29	50	57 (0.002)	1.4 (2.2)	NW
$PM_{2.5}$	24 hours	2.0	35	37	65	56 (3.1)	1.2 (1.9)	W
	Annual	0.001	17	17	15	114 (0.007)	1.4 (2.2)	NW

[a] Maximum concentration increments were estimated by using the ISCST3 model (Version 00101; EPA 1995).

[b] See Table 7.5-3.

[c] Total equals maximum concentration increment plus background concentration.

[d] The values are total concentration as percent of NAAQS. The values in parentheses are maximum concentration increments as percent of NAAQS.

[e] Receptor locations (distance and directions) of maximum concentrations are from the approximate center of the Neut/Bio facility.

The estimated maximum concentration increments due to operation of the proposed facility would contribute less than 3% of applicable NAAQS for all pollutants (Tables 7.5-10 through 7.5-13). It is also expected that potential impacts from proposed facility operations on the air quality of nearby communities would be negligible. Short-term concentration increments for all four ACWA technologies would be almost the same. However, because of the Neut/Bio process's short operational period of 16 days, annual averages for Neut/Bio would be much lower than those for the other technologies. Irrespective of the ACWA technology used, maximum concentration increments would occur mostly in the west-to-north quadrant from the proposed facility.

The maximum 3-hour, 24-hour, and annual SO_2 concentration increments predicted to result from the proposed facility operations (Tables 7.5-10 through 7.5-13) would be less than 2% of the applicable PSD increments (Table 7.5-3). The maximum predicted increments in annual average NO_2 concentrations due to the proposed facility operations would be about 0.6% of the applicable PSD increments. The increases in 24-hour and annual PM_{10} concentrations

TABLE 7.5-11 Maximum Predicted Off-Post Concentration Increments and Total Concentrations of Criteria Pollutants during Normal Operations of the Neutralization/SCWO Technology at BGAD

		Concentration (µg/m^3)					Receptor Location[e]	
Pollutant	Averaging Time	Maximum Increment[a]	Background[b]	Total[c]	NAAQS	Percent of NAAQS[d]	Distance [mi (km)]	Direction
SO_2	3 hours	6.7	172	179	1,300	14 (0.52)	2.8 (4.6)	SW
	24 hours	1.7	81	83	365	23 (0.47)	1.2 (1.9)	W
	Annual	0.007	21	21	80	26 (0.009)	1.4 (2.2)	NW
NO_2	Annual	0.14	32	32	100	32 (0.14)	1.4 (2.2)	NW
CO	1 hour	45	9,800	9,900	40,000	25 (0.11)	2.5 (4.0)	W
	8 hours	14	6,700	6,700	10,000	67 (0.14)	1.3 (2.1)	N
PM_{10}	24 hours	1.9	70	72	150	48 (1.3)	1.2 (1.9)	W
	Annual	0.009	29	29	50	57 (0.018)	1.4 (2.2)	NW
$PM_{2.5}$	24 hours	1.9	35	36	65	56 (2.9)	1.2 (1.9)	W
	Annual	0.009	17	17	15	114 (0.06)	1.4 (2.2)	NW

[a] Maximum concentration increments were estimated by using the ISCST3 model (Version 00101; EPA 1995).

[b] See Table 7.5-3.

[c] Total equals maximum concentration increment plus background concentration.

[d] The values are total concentration as percent of NAAQS. The values in parentheses are maximum concentration increments as percent of NAAQS.

[e] Receptor locations (distance and directions) of maximum concentrations are from the approximate center of the Neut/SCWO facility.

predicted to result from the proposed operations would be less than about 7% of the applicable PSD increments. The predicted concentration increment at a receptor located 30 mi (50 km) away from the proposed facility (the maximum distance the ISCST3 model could reliably estimate concentrations) in the direction of the nearest Class I PSD area (Mammoth Cave National Park) would be less than 1% of the applicable PSD increments. Concentration increments at Mammoth Cave National Park, which is located about 100 mi (161 km) west-southwest of BGAD, would be much lower.

Concentration increments for the two remaining criteria pollutants, lead and ozone, were not modeled. As a direct result of the phase-out of leaded gasoline in automobiles, average lead concentrations in urban areas throughout the country have decreased dramatically. It is expected that emissions of lead from the proposed facility operations would be negligible and therefore would have no adverse impacts on lead concentrations in surrounding areas. Contributions to the production of ozone, a secondary pollutant formed from complex photochemical reactions involving ozone precursors (including NO_X and VOCs), cannot be accurately quantified. As

TABLE 7.5-12 Maximum Predicted Off-Post Concentration Increments and Total Concentrations of Criteria Pollutants during Normal Operations of the Neutralization/GPCR/TW-SCWO Technology at BGAD

		Concentration ($\mu g/m^3$)					Receptor Location[e]	
Pollutant	Averaging Time	Maximum Increment[a]	Background[b]	Total[c]	NAAQS	Percent of NAAQS[d]	Distance [mi (km)]	Direction
SO_2	3 hours	6.7	172	179	1,300	14 (0.52)	2.8 (4.6)	SW
	24 hours	1.7	81	83	365	23 (0.47)	1.2 (1.9)	W
	Annual	0.007	21	21	80	26 (0.009)	1.4 (2.2)	NW
NO_2	Annual	0.16	32	32	100	32 (0.16)	1.4 (2.2)	NW
CO	1 hour	49	9,800	9,900	40,000	25 (0.12)	2.5 (4.1)	WSW
	8 hours	15	6,700	6,700	10,000	67 (0.15)	1.3 (2.1)	N
PM_{10}	24 hours	2.0	70	72	150	48 (1.3)	1.2 (1.9)	W
	Annual	0.011	29	29	50	57 (0.032)	1.4 (2.2)	NW
$PM_{2.5}$	24 hours	2.0	35	37	65	56 (3.1)	1.2 (1.9)	W
	Annual	0.011	17	17	15	114 (0.07)	1.4 (2.2)	NW

[a] Maximum concentration increments were estimated by using the ISCST3 model (Version 00101; EPA 1995).

[b] See Table 7.5-3.

[c] Total equals maximum concentration increment plus background concentration.

[d] The values are total concentration as percent of NAAQS. The values in parentheses are maximum concentration increments as percent of NAAQS.

[e] Receptor locations (distance and directions) of maximum concentrations are from the approximate center of the Neut/GPCR/TW-SCWO facility.

discussed in Section 7.5.1, Madison County, including BGAD, is currently in attainment for ozone (40 CFR 81.318). The amounts of ozone precursor emissions that would result from the proposed facility's operations would be small, accounting for about 2.6% and 0.3% of the actual emissions of NO_x and VOCs, respectively, from Madison County in 1998. As a consequence, the cumulative impacts of potential releases from BGAD facility operations on regional ozone concentrations would not be of any concern.

The total concentrations of criteria pollutants obtained by adding the predicted maximum concentration increments to background values (from Table 7.5-3) are compared with applicable NAAQS (Tables 7.5-10 through 7.5-13). The maximum estimated concentrations of all criteria pollutants except $PM_{2.5}$, for which the background level is already over the standard, would be less than or equal to 67% of the NAAQS.

TABLE 7.5-13 Maximum Predicted Off-Post Concentration Increments and Total Concentrations of Criteria Pollutants during Normal Operations of the Electrochemical Oxidation Technology at BGAD

		Concentration (µg/m³)					Receptor Location[e]	
Pollutant	Averaging Time	Maximum Increment[a]	Background[b]	Total[c]	NAAQS	Percent of NAAQS[d]	Distance [mi (km)]	Direction
SO_2	3 hours	6.7	172	179	1,300	14 (0.52)	2.8 (4.6)	SW
	24 hours	1.7	81	83	365	23 (0.47)	1.2 (1.9)	W
	Annual	0.007	21	21	80	26 (0.009)	1.4 (2.2)	NW
NO_2	Annual	0.14	32	32	100	32 (0.14)	1.4 (2.2)	NW
CO	1 hour	45	9,800	9,900	40,000	25 (0.11)	2.5 (4.0)	W
	8 hours	14	6,700	6,700	10,000	67 (0.14)	1.3 (2.1)	N
PM_{10}	24 hours	1.9	70	72	150	48 (1.3)	1.2 (1.9)	W
	Annual	0.009	29	29	50	57 (0.018)	1.4 (2.2)	NW
$PM_{2.5}$	24 hours	1.9	35	36	65	56 (2.9)	1.2 (1.9)	W
	Annual	0.009	17	17	15	114 (0.06)	1.4 (2.2)	NW

[a] Maximum concentration increments were estimated by using the ISCST3 model (Version 00101; EPA 1995).

[b] See Table 7.5-3.

[c] Total equals maximum concentration increment plus background concentration.

[d] The values are total concentration as percent of NAAQS. The values in parentheses are maximum concentration increments as percent of NAAQS.

[e] Receptor locations (distance and directions) of maximum concentrations are from the approximate center of the Elchem Ox facility.

7.5.3.3 Impacts of Fluctuating Operations

To assess the impacts that could result from possible fluctuations in operations that could occur during pilot testing, it was assumed that levels of organic compound emissions would be 10 times higher than the estimated annual average for 5% of the time and that levels of inorganic compound emissions would be 10 times higher than the estimated annual average for 20% of the time. These assumptions were based on EPA guidance (EPA 1994, as cited in National Research Council 1997a).

Over long periods, such conditions would be assumed to increase organic emissions to 145% of their normal values and metal emissions to 280% of their normal values (National Research Council 1997a). VOCs contribute to the formation of ozone, a criteria pollutant; multiplying VOC emissions from the proposed facility by 1.45 would result in less than 2 tons per year, or less than 0.5% of the 1998 VOC emissions in Madison County (Kentucky Division for Air Quality 1999a). Therefore, the potential increase in ozone concentration that could result from VOC emissions from proposed facility operations under fluctuating conditions would be almost the same as that under normal operating conditions. Lead (Pb) is the only metal among criteria pollutants. Emissions of lead from the proposed facility are currently too small to quantify; therefore, increasing these emissions by 280% of their normal value would probably not cause any appreciable increase in atmospheric lead concentrations. Therefore, when fluctuating operations are considered, the potential impacts of criteria pollutants involved would still be expected to be insignificant.

7.5.4 Impacts of No Action

The principal sources of air pollutant emissions associated with stockpile maintenance are the exhaust and road dust generated by vehicles. These emissions contribute to the background air quality at the installation. Emissions of air pollutants from these sources are minor both in absolute terms and in comparison with emissions from other natural and anthropogenic sources of emissions on and off BGAD. Therefore, impacts on air quality that would occur as a result of the continued storage of the stockpile are expected to be minimal.

7.6 AIR QUALITY — TOXIC AIR POLLUTANTS

7.6.1 Current Emissions and Air Quality

The reportable emissions from BGAD for 1999 under the TRI regulations resulted from open burning and open detonation. A total of approximately 1,200 lb (540 kg) of materials were subjected to open burning, and a total of about 36,000 lb (16,300 kg) of materials were subjected to belowground open detonation (Allen 2000). Because the open burning and open detonation processes destroy most of the material, the actual quantities released to the air are much lower than those reported. The largest contributor to open burning releases was dinitrotoluene; about 800 lb (360 kg) were burned. The largest contributor to open detonation releases was zinc (about 19,000 lb or 8,600 kg); releases of this relatively nontoxic substance do not have to be reported under the TRI.

A summary of the materials and quantities released is given in Table 7.6-1. Not all of the materials released as given in Table 7.6-1 had to be reported under the TRI; several were recorded for other purposes and are included here for completeness. No TRI threshold values were exceeded.

Other minor sources of emissions at BGAD include boilers; gasoline, fuel oil, and diesel storage; surface coating work; abrasive blasting of metal parts; operation of small furnaces; and miscellaneous industrial processes. In addition, a total of about 1 ton of HAPs (as defined in Title III, Section 112 of the *Clean Air Act* [CAA]) were emitted from these sources in 1999

TABLE 7.6-1 Emissions from BGAD in 1999

	Quantity (lb)[a]	
Substance	Open Burning	Open Detonation
Aluminum		8,334
Antimony compounds		2*
Barium compounds		17*
Benzene		
Beryllium		<0.1
Cadmium		345
Chromium	0.2	345
Chromium (IV) compounds		17*
Cobalt		40
Copper	0.1	5,265 (441*)
Dibutylphthalate	278*	30*
Dinitrotoluene	805*	75*
Diphenylamine	81*	4*
Ethylene		3
Lead		154
Lead compounds (inorganic)	18*	26*
Manganese	<0.1	949 (103*)
Nickel	<0.1	72
Nitroglycerin		789 (294*)
Phosphorus	<0.1	51
Silver		53
Sodium o-phenylphenate		<0.1
Thiourea		0.2
Toluene		<0.1
Vanadium		10
Vinyl acetate		<0.1
Zinc	<0.1	19,268
Zinc compounds		131
Total	1,183	35,981

[a] Value given is larger value from either the TRI chemicals summary report or the MIDAS database for calendar year 1999 (Allen 2000). No TRI threshold values were exceeded. Items marked with an asterisk were reported under TRI; the other values were from MIDAS reporting. Items in parentheses were TRI-reported values, for comparison with larger MIDAS-reported values. A blank space means that this substance was not emitted in 1999.

(Kentucky Division for Air Quality 2000c). The largest emission of a non-HAP substance in 1999 was about 4 tons of 2-ethoxyethanol acetate, associated with surface coating operations.

7.6.2 ACWA Facility Emissions

A summary of the estimated emissions of toxic air pollutants[5] that would result from operation of an ACWA pilot facility at BGAD is given in Kimmell et al. (2001). Estimated emissions (including those from diesel generators and boilers) from a Neut/Bio, Neut/SCWO, a Neut/GPCR/TW-SCWO, and an Elchem Ox facility are provided in Tables 7.6-2 through 7.6-5. For the ACWA facility stacks (SCWO vent, biotreatment vent, product gas burner vent, and catalytic oxidation unit [CatOx]/filter farm stack vent), emission estimates were based on demonstration test data and installation-specific munitions inventories compiled by Mitretek (2001a–d). Estimates of emissions from diesel generators and boilers were based on standard algorithms that used fuel consumption estimates as input (Kimmell et al. 2001). For many substances (e.g., acetaldehyde, formaldehyde), the estimated emissions from boilers and diesel generators would exceed the after-treatment emissions from ACWA facility processes by many orders of magnitude (Tables 7.6-2 through 7.6-5).

The estimates of air emissions from operating the pilot facilities were based on the assumption that organic substances from the filter farm stacks and the SCWO vent would be filtered from stack emissions by a series of six carbon filters, each having a removal efficiency of 95%. For particulate matter (e.g., dioxins and furans on PM and metals), it was assumed that two HEPA filters, each with a removal efficiency of 99.97%, would be used for treatment. For the Neut/Bio facility (Table 7.6-2), it is not known whether the emissions from the biotreatment vent would require further treatment. The provider of the equipment used during the ACWA technology demonstrations has stated that further treatment would not be necessary. In this assessment, both treatment and no treatment of biovent stack emissions are assessed. For the Neut/GPCR/TW-SCWO facility (Table 7.6-4), it was assumed that emissions from the product gas burner vent would not be further treated after release from the facility's scrubber system.

7.6.3 Impacts of the Proposed Action

7.6.3.1 Impacts of Construction

During construction, low-level emissions of potentially toxic air pollutants would result from the use of construction chemicals such as paints, thinners, and aerosols. These emissions

---

[5] Many of the toxic air pollutants that would be emitted are HAPs as defined in Section 112, Title III, of the CAA. The term "toxic air pollutants" is broader in that it includes some pollutants that are not HAPs.

TABLE 7.6-2 Estimated Toxic Air Pollutant Emissions from Neutralization/Biotreatment Technology at BGAD

	Emissions (μg/s)[b]				
Compound[a]	Diesel Generator	Boiler	Biotreatment Vent, Treated[c]	Biotreatment Vent, Untreated[c]	Filter Farm Stack[d]
1,1,1-Trichloroethane	-	-	-	-	1.1×10^{-10}
1,2,3,4,6,7,8,9-OCDD	-	-	1.1×10^{-9}	1.6×10^{-2}	3.2×10^{-13}
1,2,3,4,6,7,8,9-OCDF	-	-	2.6×10^{-10}	2.6×10^{-3}	7.4×10^{-13}
1,2,3,4,6,7,8-HpCDD	-	-	2.6×10^{-10}	2.6×10^{-3}	6.3×10^{-13}
1,2,3,4,6,7,8-HpCDF	-	-	2.6×10^{-10}	3.2×10^{-3}	6.3×10^{-13}
1,2,3,4,7,8,9-HpCDF	-	-	5.3×10^{-11}	1.1×10^{-3}	7.4×10^{-14}
1,2,3,4,7,8-HxCDD	-	-	1.1×10^{-11}	1.6×10^{-4}	7.4×10^{-14}
1,2,3,4,7,8-HxCDF	-	-	1.1×10^{-10}	1.1×10^{-3}	6.3×10^{-13}
1,2,3,6,7,8-HxCDD	-	-	2.6×10^{-11}	2.6×10^{-4}	2.1×10^{-13}
1,2,3,6,7,8-HxCDF	-	-	3.7×10^{-11}	4.2×10^{-4}	3.2×10^{-13}
1,2,3,7,8,9-HxCDD	-	-	4.7×10^{-11}	5.3×10^{-4}	2.1×10^{-13}
1,2,3,7,8,9-HxCDF	-	-	-	-	3.2×10^{-14}
1,2,3,7,8-PeCDD	-	-	1.6×10^{-12}	1.6×10^{-5}	7.4×10^{-14}
1,2,3,7,8-PeCDF	-	-	3.7×10^{-11}	4.2×10^{-4}	1.1×10^{-13}
1,2-Dichloroethane*	-	-	4.7×10^{-7}	2.6×10^{1}	2.1×10^{-5}
1,2-Dichloropropane*	-	-	-	-	3.2×10^{-10}
1,3-Butadiene*	1.1	-	-	-	-
1,4-Dichlorobenzene*	-	-	-	-	3.2×10^{-9}
2,3,4,6,7,8-HxCDF	-	-	3.7×10^{-11}	4.2×10^{-4}	3.2×10^{-13}
2,3,4,7,8-PeCDF	-	-	5.3×10^{-11}	5.3×10^{-4}	4.2×10^{-13}
2,3,7,8-TCDD*	-	-	2.1×10^{-12}	2.1×10^{-5}	-
2,3,7,8-TCDF	-	-	5.3×10^{-11}	5.3×10^{-4}	1.1×10^{-12}
2-Methylnaphthalene	-	1.4×10^{-1}	-	-	-
3/4-Methyl phenol*	-	-	-	-	1.1×10^{-9}
3-Methylchloranthrene	-	1.1×10^{-2}	-	-	-
Acenaphthene	3.9×10^{-2}	1.1×10^{-2}	-	-	-
Acenaphthylene	1.4×10^{-1}	1.1×10^{-2}	-	-	-
Acetaldehyde*	2.1×10^{1}	-	1.1×10^{-6}	5.3×10^{1}	-
Acrolein*	2.6	-	-	-	-
Aldehydes	1.9×10^{3}	-	-	-	-
Anthracene	5.2×10^{-2}	1.4×10^{-2}	-	-	-
Arsenic*	-	1.2	-	-	-
Barium	-	2.6×10^{1}	-	-	-
Benz(a)anthracene	2.6×10^{1}	1.1×10^{-2}	-	-	-
Benzene*	4.7×10^{-2}	1.2×10^{1}	-	-	9.5×10^{-9}
Benzo(a)pyrene	5.2×10^{-3}	7.1×10^{-3}	-	-	-
Benzo(b)fluoranthene	2.7×10^{-3}	1.1×10^{-2}	-	-	-
Benzo(g,h,i)perylene	1.4×10^{-2}	7.1×10^{-3}	-	-	-
Benzo(k)fluoranthene	4.3×10^{-3}	1.1×10^{-2}	-	-	-
Beryllium*	-	7.1×10^{-2}	-	-	-
Bis (2-chloroethyl) ether*	-	-	3.2×10^{-7}	2.1×10^{1}	-
Bis (2-ethylhexyl) phthalate*	-	-	4.7×10^{-7}	3.2×10^{1}	8.4×10^{-9}

TABLE 7.6-2 (Cont.)

Compound[a]	Emissions (μg/s)[b] Diesel Generator	Boiler	Biotreatment Vent, Treated[c]	Biotreatment Vent, Untreated[c]	Filter Farm Stack[d]
Bromomethane*	-	-	1.1×10^{-6}	1.1×10^{2}	3.2×10^{-7}
Butane	-	1.2×10^{4}	-	-	-
Cadmium*	-	6.5	-	-	-
Carbon disulfide*	-	-	-	-	2.1×10^{-7}
Carbon tetrachloride*	-	-	-	-	3.2×10^{-9}
Chlorobenzene*	-	-	-	-	3.2×10^{-7}
Chloroethane*	-	-	-	-	4.2×10^{-9}
Chloroform*	-	-	-	-	6.3×10^{-7}
Chloromethane*	-	-	1.1×10^{-6}	5.3×10^{1}	3.2×10^{-6}
Chromium*	-	8.2	-	-	2.1×10^{-7}
Chrysene	9.8×10^{-3}	1.1×10^{-2}	-	-	-
Cobalt*	-	4.9×10^{-1}	-	-	2.1×10^{-7}
Copper	-	5.0	-	-	-
Dibenzo(a,h)anthracene	1.6×10^{-2}	7.1×10^{-3}	-	-	-
Dibenzofuran*	-	-	-	-	3.2×10^{-9}
Dichlorobenzene*	-	7.1	-	-	-
Diethylphthalate	-	-	5.3×10^{-7}	3.2×10^{1}	-
Dimethylbenz(a)anthracene	-	9.4×10^{-2}	-	-	-
Dimethylphthalate*	-	-	-	-	2.1×10^{-8}
Ethane	-	1.8×10^{4}	-	-	
Ethyl benzene*	-	-	3.7×10^{-6}	2.6×10^{2}	8.4×10^{-10}
Fluoranthene	2.1×10^{-1}	1.8×10^{-2}	-	-	-
Fluorene	8.1×10^{-1}	1.6×10^{-2}	-	-	-
Formaldehyde*	3.3×10^{1}	4.4×10^{2}	1.1×10^{-5}	5.3×10^{2}	-
Glycol ethers (2-butoxy ethanol)	-	-	3.2×10^{-6}	2.1×10^{2}	-
H (mustard)[e]	-	-	-	-	2.8×10^{2}
Hexane(n)*	-	1.1×10^{4}	-	-	-
Indeno(1,2,3-cd)pyrene	1.0×10^{-2}	1.1×10^{-2}	-	-	-
Lead*	-	2.9	-	-	8.4×10^{-9}
m,p-Xylene*	7.9	-	3.2×10^{-5}	2.1×10^{3}	4.2×10^{-8}
Manganese*	-	2.2	-	-	6.3×10^{-8}
Mercury*	8.3×10^{-3}	1.5	1.6×10^{-4}	1.6×10^{1}	2.1×10^{-8}
Methyl ethyl ketone*	-	-	-	-	1.1×10^{-5}
Methyl ethyl ketone/butyraldehydes*	-	-	4.2×10^{-7}	2.6×10^{1}	-
Methylene chloride*	-	-	1.1×10^{-5}	5.3×10^{2}	3.2×10^{-8}
Molybdenum	-	6.5	-	-	-
Naphthalene*	2.3	3.6	3.2×10^{-7}	2.1×10^{1}	5.3×10^{-8}
Nickel*	-	1.2×10^{1}	-	-	1.1×10^{-7}
OCDD	-	-	2.1×10^{-10}	2.6×10^{-3}	-
OCDF	-	-	1.1×10^{-10}	1.1×10^{-3}	-
o-Xylene*	-	-	-	-	2.1×10^{-9}
Particulates	-	-	-	-	5.3×10^{-4}

TABLE 7.6-2 (Cont.)

	Emissions (µg/s)[b]				
Compound[a]	Diesel Generator	Boiler	Biotreatment Vent, Treated[c]	Biotreatment Vent, Untreated[c]	Filter Farm Stack[d]
Pentane(n)	-	1.5×10^{4}	-	-	-
Phenanthrene	8.1×10^{-1}	1.0×10^{-1}	-	-	-
Phenol*	-	-	1.6×10^{-7}	1.1×10^{1}	5.3×10^{-9}
Phosphorus*	-	-	-	-	2.1×10^{-8}
PAHs*	4.7	-	-	-	-
POM (fluorene)	-	-	-	-	3.2×10^{-8}
Propanal (propionaldehyde)*	-	-	4.7×10^{-7}	3.2×10^{1}	-
Propane	-	9.4×10^{3}	-	-	-
Propylene	7.1×10^{1}	-	-	-	-
Pyrene	1.3×10^{-1}	2.9×10^{-2}	-	-	-
Selenium*	-	1.4×10^{-1}	-	-	2.1×10^{-9}
Styrene*	-	-	-	-	9.5×10^{-13}
Tetrachloroethene*	-	-	-	-	2.1×10^{-10}
Toluene*	1.1×10^{1}	2.0×10^{1}	5.3×10^{-7}	4.2×10^{1}	4.2×10^{-8}
Total HpCDD	-	-	4.7×10^{-10}	5.3×10^{-3}	1.1×10^{-12}
Total HpCDF	-	-	4.7×10^{-10}	5.3×10^{-3}	8.4×10^{-13}
Total HxCDD	-	-	3.2×10^{-10}	3.7×10^{-3}	2.1×10^{-12}
Total HxCDF	-	-	3.2×10^{-10}	3.2×10^{-3}	2.1×10^{-12}
Total PeCDD	-	-	-	-	2.1×10^{-12}
Total PeCDF	-	-	4.2×10^{-10}	4.7×10^{-3}	4.2×10^{-12}
Total TCDD*	-	-	1.1×10^{-11}	1.1×10^{-4}	1.1×10^{-12}
Total TCDF	-	-	2.1×10^{-10}	2.1×10^{-3}	2.1×10^{-8}
Vanadium	-	1.4×10^{1}	-	-	-

[a] Substances designated with an asterisk (*) are listed as HAPs under Title III, Section 112 of the CAA. PAHs = polycyclic aromatic hydrocarbons. POM = polycyclic organic matter. Polychlorinated dioxins/ furans are as follows: HpCDD = heptachlorodibenzo-p-dioxin, HpCDF = heptachlorodibenzo-p-furan, HxCDD = hexachlorodibenzo-p-dioxin; HxCDF = hexachlorodibenzo-p-furan, OCDD = octachlorodibenzo-p-dioxin, OCDF = octachlorodibenzo-p-furan, PeCDD = pentachlorodibenzo-p-dioxin; PeCDF = pentachlorodibenzo-p-furan; TCDD = tetrachlorodibenzo-p-dioxin; TCDF = tetrachlorodibenzo-p-furan.

[b] A hyphen indicates that the compound was not detected from this source during demonstration testing.

[c] The untreated values assume direct release to the stack after processing through the catalytic oxidation unit (CatOx). The treated values for organics assume that after passing through the CatOx, emissions are passed through six carbon filters in series, each at 95% efficiency. It is assumed that PM passes through two high-efficiency particulate air (HEPA) filters in series, each at 99.97% efficiency.

[d] Filter farm stack emissions are assumed to be treated by using carbon filters to capture organics and by using HEPA filters to capture PM, as in footnote c above.

[e] The after-treatment emission rate from the filter farm stack for mustard agent is a worst-case estimate; it assumes emissions at the detection limit of 0.006 µg/m^3 (Kimmell et al. 2001). It is assumed that no mustard would be emitted from the biotreatment vent; none would be present after neutralization and treatment in the immobilized cell bioreactor (ICB).

TABLE 7.6-3 Estimated Toxic Air Pollutant Emissions from Neutralization/SCWO Technology at BGAD

	Emissions (μg/s)[b]					
			Mustard Agent Processing[c]		Nerve Agent Processing[c]	
Compound[a]	Diesel Generator	Boiler	SCWO Vent	Filter Farm Stack	SCWO Vent	Filter Farm Stack
	-	-	-	-	-	-
1,3-Butadiene*	1.1	-	-	-	-	-
2-Methylnaphthalene	-	4.8×10^{-2}	-	-	-	-
3-Methylchloranthrene	-	3.6×10^{-3}	-	-	-	-
Acenaphthene	3.9×10^{-2}	3.6×10^{-3}	-	-	-	-
Acenaphthylene	1.4×10^{-1}	3.6×10^{-3}	-	-	-	-
Acetaldehyde*	2.1×10^{1}	-	2.8×10^{-7}	-	1.0×10^{-6}	-
Acrolein*	2.6	-	-	-	-	-
Aldehydes	1.9×10^{3}	-	-	-	-	-
Anthracene	5.2×10^{-2}	4.8×10^{-3}	-	-	-	-
Antimony*	-	-	3.7×10^{-7}	-	8.2×10^{-8}	-
Arsenic*	-	4.0×10^{-1}	1.4×10^{-7}	-	2.5×10^{-8}	-
Barium	-	8.8	-	-	-	-
Benz(a)anthracene	2.6×10^{1}	3.6×10^{-3}	-	-	-	-
Benzene*	4.7×10^{-2}	4.2	-	-	-	-
Benzo(a)pyrene	5.2×10^{-3}	2.4×10^{-3}	-	-	-	-
Benzo(b)fluoranthene	2.7×10^{-3}	3.6×10^{-3}	-	-	-	-
Benzo(g,h,i)perylene	1.4×10^{-2}	2.4×10^{-3}	-	-	-	-
Benzo(k)fluoranthene	4.3×10^{-3}	3.6×10^{-3}	-	-	-	-
Beryllium*	-	2.4×10^{-2}	2.7×10^{-8}	-	5.0×10^{-9}	-
Butane	-	4.2×10^{3}	-	-	-	-
Cadmium*	-	2.2	2.7×10^{-8}	-	1.3×10^{-7}	-
Chromium*	-	2.8	8.0×10^{-7}	-	1.2×10^{-6}	-
Chrysene	9.8×10^{-3}	3.6×10^{-3}	-	-	-	-
Cobalt*	-	1.7×10^{-1}	1.9×10^{-7}	-	1.5×10^{-7}	-
Copper	-	1.7	-	-	-	-
Dibenzo(a,h)anthracene	1.6×10^{-2}	2.4×10^{-3}	-	-	-	-
Dichlorobenzene*	-	2.4	-	-	-	-
Dimethylbenz(a)anthracene	-	3.2×10^{-2}	-	-	-	-
Ethane	-	6.2×10^{3}	-	-	-	-
Ethyl benzene*	-	-	2.5×10^{-6}	-	-	-
Fluoranthene	2.1×10^{-1}	6.0×10^{-3}	-	-	-	-
Fluorene	8.1×10^{-1}	5.6×10^{-3}	-	-	-	-
Formaldehyde*	3.3×10^{1}	1.5×10^{2}	3.7×10^{-7}	-	1.3×10^{-7}	-
GB[d]	-	-	-	-		2.8
H (mustard)[d]	-	-	-	2.8×10^{2}	-	-
Hexane(n)*	-	3.6×10^{3}	-	-	-	-
Indeno(1,2,3-cd)pyrene	1.0×10^{-2}	3.6×10^{-3}	-	-	-	-
Lead*	-	1.0	4.4×10^{-7}	-	1.3×10^{-6}	-

TABLE 7.6-3 (Cont.)

	Emissions (µg/s)[b]					
			Mustard Agent Processing[c]		Nerve Agent Processing[c]	
Compound[a]	Diesel Generator	Boiler	SCWO Vent	Filter Farm Stack	SCWO Vent	Filter Farm Stack
m,p-Xylene*	7.9	-	-	-	-	-
Manganese	-	7.6×10^{-1}	6.9×10^{-7}	-	1.2×10^{-6}	-
Mercury*	8.3×10^{-3}	5.2×10^{-1}	-	-	1.0×10^{-7}	-
Methyl ethyl ketone/butyraldehydes*	-	-	9.1×10^{-8}	-	2.6×10^{-8}	-
Molybdenum	-	2.2	-	-	-	-
m-Xylene*	-	-	2.2×10^{-6}	-	-	-
Naphthalene*	2.3	1.2	-	-	8.5×10^{-10}	-
Nickel*	-	4.2	2.7×10^{-6}	-	5.6×10^{-6}	-
Particulates	-	-	1.5×10^{-4}	-	9.6×10^{-5}	-
p-Cresol (4-methylphenol)*	-	-	1.9×10^{-7}	-		-
Pentane(n)	-	5.2×10^{3}	-	-		-
Phenanthrene	8.1×10^{-1}	3.4×10^{-2}	-	-		-
Phosphorus*	-	-	4.3×10^{-5}	-	3.0×10^{-5}	-
PCBs[e]	-	-	-	-	1.5×10^{-9}	-
PAHs*	4.7	-	-	-	-	-
Propane	-	3.2×10^{-3}	-	-	-	-
Propylene	7.1×10^{1}	-	-	-	-	-
Pyrene	1.3×10^{-1}	1.0×10^{-2}	-	-	-	-
Selenium*	-	4.8×10^{-2}	1.4×10^{-7}	-	2.0×10^{-7}	-
Toluene*	1.1×10^{1}	6.8	-	-	-	-
Total HpCDF	-	-	3.9×10^{-16}	-	-	-
Total TCDD	-	-	2.6×10^{-12}	-	-	-
Vanadium	-	4.6	-	-	-	-
VX[d]	-	-	-	-		2.8

[a] Substances designated with an asterisk (*) are listed as HAPs under Title III, Section 112 of the CAA. PAHs = polycyclic aromatic hydrocarbons. PCBs = polychlorinated biphenyls. HpCDF = heptachlorodibenzo-p-furan. TCDD = tetrachlorodibenzo-p-dioxin.

[b] A hyphen indicates that the compound was not detected from this source during demonstration testing.

[c] For SCWO and filter farm stack emissions, organics are assumed to be treated by being passed through six carbon filters in series, each at 95% efficiency. PM is assumed to pass through two HEPA filters in series, each at 99.97% efficiency.

[d] The after-treatment emission rate from the filter farm stack for chemical agent (GB, VX, mustard) is a worst-case estimate; it assumes emissions at the detection limit (Kimmell et al. 2001). It is assumed that no agent would be emitted from the SCWO stack; none would be present after neutralization and SCWO treatment.

[e] Although PCB destruction was not included in demonstration testing, for these analyses, it was assumed that SCWO technology would have a destruction efficiency of 99.9999%, and that further treatment as in footnote c would be applied.

TABLE 7.6-4 Estimated Toxic Air Pollutant Emissions from Neutralization/GPCR/TW-SCWO Technology at BGAD

	Emissions (μg/s)[b]							
			Mustard Processing[c]		GB Processing[c]		VX Processing[c]	
Compound[a]	Diesel Generator	Boiler	Product Gas Burner	Filter Farm Stack	Product Gas Burner	Filter Farm Stack	Product Gas Burner	Filter Farm Stack
(R)-(-)-2,2-Dimethyl-1,3-dioxolane-4-methanol	-	-	-	9.0×10^{-8}	-	-	-	-
1,1,1-Trichloroethane	-	-	7.6×10^{-2}	-	8.3×10^{-2}	7.2×10^{-8}	8.5×10^{-2}	-
1,2,3,4,6,7,8-HpCDD	-	-		-	-	-	-	-
1,2,3,4,6,7,8-HpCDF	-	-	1.2×10^{-8}	-	1.3×10^{-8}	-	1.3×10^{-8}	-
1,2,3,4,7,8-HxCDF	-	-	9.2×10^{-8}		1.0×10^{-7}		1.0×10^{-7}	-
1,2,3,6,7,8-HxCDD	-	-	-	-	-	-	-	-
1,2,3,6,7,8-HxCDF	-	-	3.4×10^{-8}		3.7×10^{-8}		3.8×10^{-8}	-
1,2,3,7,8,9-HxCDD	-	-	-	-	-	-	-	-
1,2,3,7,8-PeCDD	-	-	-	-	-	-	-	-
1,2,4-Trimethylbenzene	-	-	-		-	7.9×10^{-9}	-	2.1×10^{-6}
1,3-Butadiene*	1.1	-	-	-	-	-	-	-
1,4-Dichlorobenzene*	-	-	-	-	-	-	-	4.9×10^{-9}
1-Ethyl-2,2,6-trimethylcyclohexane	-	-	-	-	-	-	-	1.6×10^{-6}
1-Hexanol, 2-ethyl-	-	-	2.4×10^{1}	-	2.6×10^{1}	-	2.6×10^{1}	-
1H-Indene	-	-	5.8	-	6.4	-	6.5	-
1H-Indene, 2,3-dihydro-	-	-	-	-	-	4.7×10^{-8}	-	-
1-Propene, 3,3,3-trichloro-	-	-	-	1.5×10^{-8}	-	-	-	-
2-(2-Butoxyethoxy) ethanol	-	-		-	-	-	-	1.8×10^{-6}
2,3,4,7,8-PeCDF	-	-	-	-	-	-	-	-
2,3,7,8-TCDF	-	-	5.4×10^{-8}	-	5.9×10^{-8}	-	6.0×10^{-8}	-
2,4-Dimethylphenol	-	-	2.3		2.5	-	2.6	-
2-Butanone (methyl ethyl ketone)*	-	-	8.1×10^{-1}	-	8.8×10^{-1}	-	9.0×10^{-13}	-
2-Methylnaphthalene	-	8.7×10^{-2}	-	2.5×10^{-7}	-	1.8×10^{-8}	-	7.9×10^{-7}
2-Nitrophenol	-	-	-	-	-	5.2×10^{-9}	-	-
3-Methylchloranthrene	-	6.5×10^{-3}	-	-	-	-	-	-
9H-Fluoren-9-one	-	-	-	-	-	2.8×10^{-6}	-	-
Acenaphthene	3.9×10^{-2}	6.5×10^{-3}	-	-	-	9.3×10^{-10}	-	-
Acenaphthylene	1.4×10^{-1}	6.5×10^{-3}	-	-	-	-	-	-
Acetaldehyde*	2.1×10^{1}	-	-	2.0×10^{-8}	-	-	-	-
Acetic acid	-	-	-	-	-	-	-	5.9×10^{-7}
Acetone	-	-	2.2×10^{1}	1.3×10^{-6}	2.3×10^{2}	-	2.3×10^{2}	-
Acrolein*	2.6	-	-	-	-	-	-	-
Aldehydes	1.9×10^{3}	-	-	-	-	-	-	-
Aluminum	-	-	7.8	-	8.5	-	8.7	-
Anthracene	5.2×10^{-2}	8.7×10^{-3}	-	-	-	1.0×10^{-8}	-	4.4×10^{-9}
Antimony*	-	-	-	-	2.8×10^{-2}	1.7×10^{-9}	2.9×10^{-2}	1.1×10^{-6}
Arsenic*	-	7.2×10^{-1}	5.8×10^{-2}	6.9×10^{-9}	4.0×10^{-1}	6.9×10^{-9}	4.1×10^{-1}	-
Barium	-	1.6×10^{1}	3.4×10^{-1}	-	3.7×10^{-1}	-	3.8×10^{-1}	-
Benz(a)anthracene	4.7×10^{-2}	6.5×10^{-3}	-	-	6.8×10^{-2}	2.0×10^{-9}	6.9×10^{-2}	-
Benzaldehyde	-	-	-	8.9×10^{-8}	8.9	2.8×10^{-8}	9.1	-
Benzaldehyde, 4-ethyl-	-	-	1.8	-	2.0	-	2.1	-
Benzaldehyde, ethyl-	-	-	1.1	-	1.2	-	1.3	-
Benzaldehyde, ethyl-benzenemethanol, 4-(1-methylethyl)-	-	-	1.1	-	1.1	-	1.2	-
Benzene*	2.6×10^{1}	7.6	5.4	3.6×10^{-7}	6.2	1.3×10^{-6}	6.4	1.4×10^{-6}
Benzene, 1,2,3-trimethyl-	-	-	-	-	-	-	-	4.1×10^{-7}
Benzene, 1,2,4,5-tetramethyl-	-	-	-	-	-	-	-	2.0×10^{-6}
Benzene, 1-methyl-2-propyl-	-	-	-	-	-	-	-	1.9×10^{-6}
Benzene, 1-methyl-3-propyl-	-	-	-	-	-	-	-	4.7×10^{-7}

TABLE 7.6-4 (Cont.)

	Emissions (µg/s)[b]							
			Mustard Processing[c]		GB Processing[c]		VX Processing[c]	
Compound[a]	Diesel Generator	Boiler	Product Gas Burner	Filter Farm Stack	Product Gas Burner	Filter Farm Stack	Product Gas Burner	Filter Farm Stack
Benzo(a)pyrene	5.2×10^{-3}	4.3×10^{-3}	-	-	-	-	-	-
Benzo(b)fluoranthene	2.7×10^{-3}	6.5×10^{-3}	-	-	-	-	-	-
Benzo(g,h,i)perylene	1.4×10^{-2}	4.3×10^{-3}	-	-	-	-	-	-
Benzo(k)fluoranthene	4.3×10^{-3}	6.5×10^{-3}	-	-	-	-	-	-
Benzyl alcohol	-	-	1.1	4.2×10^{-8}	1.6	-	1.6	1.8×10^{-6}
Beryllium*	-	4.3×10^{-2}	-	-	7.3×10^{-3}	7.4×10^{-10}	7.4×10^{-3}	-
Bis(2-ethylhexyl)phthalate*	-	-	4.3×10^{-1}	1.7×10^{-8}	1.9	6.8×10^{-9}	1.9	6.7×10^{-9}
Butanal	-	-	-	1.5×10^{-7}	-	8.1×10^{-9}	-	3.1×10^{-8}
Butane	-	7.6×10^{3}	-	-	-	-	-	-
C3-Alkyl benzenes	-	-	-	7.7×10^{-6}	-	4.9×10^{-7}	-	-
Cadmium*	-	4.0	1.1×10^{-2}	5.4×10^{-9}	1.2×10^{-1}	3.1×10^{-9}	1.2×10^{-1}	3.2×10^{-7}
Calcium	-	-	1.5×10^{1}	1.7×10^{-5}	1.9×10^{1}	8.8×10^{-6}	2.0×10^{1}	7.3×10^{-5}
Carbon disulfide*	-	-	2.2×10^{-1}	-	2.4×10^{-1}	-	2.5×10^{-1}	-
Chloroform*	-	-	3.4	-	3.7	-	3.8	-
Chromium*	-	5.1	9.5×10^{-1}	1.1×10^{-8}	1.0	-	1.1	-
Chrysene	9.8×10^{-3}	6.5×10^{-3}	-	-	-	4.0×10^{-9}	-	-
Cobalt*	-	3.0×10^{-1}	3.0×10^{-2}	1.0×10^{-7}	3.4×10^{-2}	9.7×10^{-9}	3.5×10^{-2}	1.9×10^{-7}
Copper	-	3.1	6.4×10^{-1}	-	1.9	-	2.0	-
Cyclododecane	-	-	-	-	2.7	-	2.8	-
Cyclohexane, 2-butyl-1,1,3-trimethyl-	-	-	-	-	-	-	-	3.7×10^{-7}
Cyclohexane, butyl-	-	-	-	6.7×10^{-7}	-	5.8×10^{-9}	-	2.9×10^{-6}
Cyclohexane, hexyl-	-	-	-	-	-	-	-	4.2×10^{-7}
Cyclohexane, propyl-	-	-	-	7.7×10^{-7}	-	-	-	-
Cyclohexanol	-	-	-	-	-	-	-	9.4×10^{-7}
Cyclohexanone	-	-	-	5.6×10^{-8}	-	3.9×10^{-8}	-	8.1×10^{-9}
Cyclohexasiloxane, dodecamethyl-	-	-	-	3.0×10^{-8}	-	-	-	-
Cyclotetrasiloxane, octamethyl-	-	-	2.5	-	2.7	-	2.8	-
Decane	-	-	-	3.1×10^{-6}	-	6.4×10^{-8}	-	1.2×10^{-5}
Decane, 2,6,7-trimethyl-	-	-	-	-	-	5.3×10^{-9}	-	-
Decane, 2-methyl-	-	-	-	-	-	-	-	2.7×10^{-6}
Decane, 3-methyl-	-	-	-	7.9×10^{-7}	-	-	-	2.0×10^{-6}
Decane, 4-methyl-	-	-	-	1.1×10^{-8}	-	6.9×10^{-9}	-	1.5×10^{-6}
Decane, 5-methyl-	-	-	-	-	-	2.5×10^{-8}	-	-
Dibenzo(a,h)anthracene	1.6×10^{-2}	4.3×10^{-3}	-	-	-	-	-	-
Dibenzofuran*	-	-	-	-	9.8×10^{-1}	6.1×10^{-8}	1.0	7.3×10^{-8}
Dichlorobenzene*	-	4.3	-	-	-	-	-	-
Diethylene glycol	-	-	-	-	-	-	-	5.5×10^{-6}
Diethylphthalate	-	-	1.5	-	1.7	-	1.7	-
Dimethylbenz(a)anthracene	-	5.8×10^{-2}	-	-	-	-	-	-
Di-n-butylphthalate (bis-(2-ethylhexyl)phthalate)*	-	-	3.2	-	3.5	-	3.5	-
Diphenylmethane	-	-	-	-		5.1×10^{-9}	-	-
Dodecane	-	-	9.9×10^{-1}	1.2×10^{-6}	1.1	1.2×10^{-7}	1.1	4.6×10^{-6}
Dodecane, 2,6,10-trimethyl-	-	-	-	-	-	7.4×10^{-9}	-	-
Dodecane, 4-methyl-	-	-	-	-	-	2.1×10^{-8}	-	-
Dodecane, 6-methyl-	-	-	-	1.2×10^{-8}	-	1.3×10^{-8}	-	1.4×10^{-6}
Ethane	-	1.1×10^{4}	-	–	-	-	-	-
Ethanol, 2-(2-butoxyethoxy)-, acetate	-	-	-	5.1×10^{-8}	-	2.5×10^{-8}	-	-
Ethanone, 1-(3-methylphenyl)-	-	-	-	-	-	7.8×10^{-9}	-	-
Ethanone, 1-phenyl-	-	-	-	-	-	5.6×10^{-8}	-	-
Ether	-	-	-	-	1.9×10^{2}	-	- 1.9×10^{2}	-

TABLE 7.6-4 (Cont.)

	Emissions (μg/s)[b]							
			Mustard Processing[c]		GB Processing[c]		VX Processing[c]	
Compound[a]	Diesel Generator	Boiler	Product Gas Burner	Filter Farm Stack	Product Gas Burner	Filter Farm Stack	Product Gas Burner	Filter Farm Stack
Ethylbenzene*	-	-	7.6×10^{-2}	-	5.7	-	5.8	-
Ethylene glycol*	-	-	-	4.9×10^{-7}	-	2.2×10^{-7}	-	1.9×10^{-6}
Fluoranthene	2.1×10^{-1}	1.1×10^{-2}	-	-	-	1.2×10^{-8}	-	8.8×10^{-9}
Fluorene	8.1×10^{-1}	1.0×10^{-2}	-	-	4.5×10^{-2}	2.2×10^{-8}	4.6×10^{-2}	2.5×10^{-8}
Formaldehyde*	3.3×10^{1}	2.7×10^{2}	-	-	-	-	-	-
GB (Sarin)[d]	-	-	-	-	-	3.7	-	-
H (mustard)[d]	-	-	-	3.7×10^{2}	-	-	-	-
Heptdecane	-	-	-	-	-	1.7×10^{-8}	-	-
Heptanal	-	-	-	3.6×10^{-7}	-	2.9×10^{-7}	-	-
Heptane, 3-ethyl-2-methyl-	-	-	-	-	-	1.7×10^{-8}	-	9.1×10^{-7}
Hexadecane, 2,6,10,14-tetramethyl-	-	-	-	-	-	3.3×10^{-8}	-	-
Hexanal	-	-	-	9.3×10^{-8}	-	1.0×10^{-7}	-	1.1×10^{-7}
Hexane(n)*	-	6.5×10^{3}	-	-	1.2×10^{2}	-	1.2×10^{2}	-
Hydrochloric acid*	-	-	2.5×10^{1}	1.1×10^{3}	7.3×10^{1}	4.6×10^{-6}	7.4×10^{1}	3.0×10^{1}
Hydrogen fluoride*	-	-	1.2	-	1.3	4.8×10^{1}	1.3	-
Hydrogen cyanide*	-	-	4.6	-	5.1	-	5.2	-
Hydrogen sulfide*	-	-	1.1×10^{1}	-	7.4×10^{3}	-	7.5×10^{3}	-
Indeno(1,2,3-cd)pyrene	1.0×10^{-2}	6.5×10^{-3}	-	-	-	-	-	-
Iron	-	-	1.2×10^{1}	1.5×10^{-6}	1.3×10^{1}	8.6×10^{-7}	1.3×10^{1}	-
Isobutyl alcohol	-	-	-	-	-	9.1×10^{-8}	-	1.8×10^{-6}
Lead*	-	1.8	6.8×10^{-2}	5.7×10^{-8}	1.5×10^{-1}	3.8×10^{-8}	1.5×10^{-1}	1.2×10^{-5}
m,p-Xylene*	7.9	-	-	-	-	-	-	-
Magnesium	-	-	2.2	5.0×10^{-6}	2.9	2.7×10^{-6}	3.0	2.0×10^{-5}
Malonic acid	-	-	-	2.3×10^{-5}	-	2.1×10^{-5}	-	-
Manganese*		1.4	8.0	6.6×10^{-7}	2.8×10^{1}	1.2×10^{-7}	2.9×10^{1}	6.5×10^{-5}
Mercury*	8.3×10^{-3}	9.4×10^{-1}	-	-	-	1.7×10^{-8}	-	-
Methylene chloride*	-	-	6.2×10^{-1}	9.9×10^{-7}	1.0×10^{1}	1.3×10^{-4}	1.0×10^{1}	7.4×10^{-7}
Molybdenum	-	4.0	5.5×10^{-1}	4.1×10^{-8}	8.2×10^{1}	4.5×10^{-8}	8.4×10^{1}	2.3×10^{-6}
m-Tolualdehyde	-	-	-	-	-	7.2×10^{-8}	-	5.3×10^{-8}
Naphthalene*	2.3	2.2	-	3.3×10^{-7}	1.4×10^{-1}	1.2×10^{-7}	1.5×10^{-1}	6.2×10^{-7}
Naphthalene, 1,2,3,4-tetrahydro-	-	-	-	-	-	-	-	1.0×10^{-6}
Naphthalene, 1,2,3,4-tetrahydro-6-methyl-	-	-	-	-	-	-	-	5.4×10^{-7}
Naphthalene, 1,7-dimethyl	-	-	-	-	-	-	-	5.9×10^{-7}
Naphthalene, 1-methyl	-	-	-	-	-	1.9×10^{-8}	-	-
Nickel*	-	7.6	1.1	6.3×10^{-8}	1.2	2.5×10^{-8}	1.2	-
Nitrobenzene*	-	-	-	-	4.3×10^{-1}	6.5×10^{-8}	4.4×10^{-1}	-
Nonane, 2,6-dimethyl-	-	-	-	-	-	2.0×10^{-8}	-	5.0×10^{-6}
Nonane, 3,7-dimethyl-	-	-	-	-	-	-	-	7.4×10^{-7}
Nonane, 3-methyl-	-	-	-	-	-	-	-	3.8×10^{-7}
n-Propylbenzene	-	-	-	4.8×10^{-7}	-	-	-	0.0
Octane, 2,6-dimethyl-	-	-	-	1.2×10^{-6}	-	-	-	0.0
Octane, 3,6-dimethyl-	-	-	-	-	-	-	-	1.8×10^{-6}
Octane, 3-methyl-	-	-	-	4.4×10^{-7}	-	-	-	0.0
Pentadecane	-	-	-	1.2×10^{-8}	-	-	-	1.2×10^{-6}
Pentanal	-	-	-	2.9×10^{-7}	-	1.3×10^{-7}	-	-
Pentane(n)	-	9.4×10^{3}	-	-	-	-	-	-
Phenanthrene	8.1×10^{-1}	6.1×10^{-2}	-	2.2×10^{-9}	-	5.4×10^{-8}	-	5.9×10^{-8}
Phenol*	-	-	4.2×10^{-1}	-	3.7	1.5×10^{-8}	3.7	-
Phosphorus*	-	-	4.1	2.2×10^{-6}	5.5	1.3×10^{-5}	5.6	2.1×10^{-4}
PCBs[e]	-	-	-	-	9.6×10^{-2}	-	9.6×10^{-2}	-

TABLE 7.6-4 (Cont.)

	Emissions (µg/s)[b]							
			Mustard Processing[c]		GB Processing[c]		VX Processing[c]	
Compound[a]	Diesel Generator	Boiler	Product Gas Burner	Filter Farm Stack	Product Gas Burner	Filter Farm Stack	Product Gas Burner	Filter Farm Stack
PAHs*	4.7	-	-	-	-	-	-	-
Potassium	-	-	-	2.2×10^{-6}	-	-	-	9.7×10^{-5}
Propanal (propionaldehyde)*	-	-	-	-	-	9.7×10^{-8}	-	9.8×10^{-8}
Propane	-	5.8×10^{3}	-	-	-	-	-	-
Propylene	7.1×10^{1}	-	-	-	-	-	-	-
Pyrene	1.3×10^{-1}	1.8×10^{-2}	-	-	-	6.7×10^{-9}	-	4.1×10^{-9}
Selenium*	-	8.7×10^{-2}	1.5×10^{-1}	1.4×10^{-8}	1.6×10^{-1}	-	1.6×10^{-1}	-
Silver	-	-	1.3×10^{-2}	1.7×10^{-9}	1.0×10^{-1}	8.8×10^{-9}	1.0×10^{-1}	6.9×10^{-8}
Sodium	-	-	2.1×10^{2}	-	2.5×10^{2}	-	2.5×10^{2}	7.1×10^{-5}
Styrene*	-	-	4.8×10^{-1}	-	5.2×10^{-1}	-	5.3×10^{-1}	-
Sulfur, mol. (S8)	-	-	-	3.6×10^{-7}	-	-	-	-
Tetrachloroethene*	-	-	6.9×10^{-2}	-	7.5×10^{-2}	-	7.6×10^{-2}	-
Tetradecane	-	-	-	7.1×10^{-7}	-	7.3×10^{-8}	-	5.7×10^{-6}
Thallium	-	-	-	-	3.7×10^{-2}	-	3.7×10^{-2}	-
Tin	-	-	1.4	-	1.5	-	1.5	-
Toluene*	1.1×10^{1}	1.2×10^{1}	7.6×10^{-1}	-	8.3×10^{-1}	4.1×10^{-7}	8.5×10^{-1}	2.6×10^{-7}
Total HpCDD	-	-	-	1.2×10^{-13}	-	-	-	-
Total HpCDF	-	-	1.3×10^{-6}	-	1.4×10^{-9}	-	1.5×10^{-6}	-
Total HxCDD	-	-	6.8×10^{-7}	5.6×10^{-14}	7.4×10^{-7}	-	7.6×10^{-7}	-
Total HxCDF	-	-	1.4×10^{-6}	-	1.5×10^{-6}	-	1.6×10^{-6}	-
Total PeCDD	-	-	3.9×10^{-7}	1.1×10^{-12}	4.2×10^{-7}	-	4.3×10^{-7}	-
Total PeCDF	-	-	4.8×10^{-7}	7.0×10^{-14}	5.3×10^{-7}	-	5.4×10^{-7}	-
Total TCDD	-	-	3.2×10^{-7}	6.9×10^{-12}	3.5×10^{-7}	-	3.5×10^{-7}	-
Total TCDF	-	-	6.9×10^{-7}	6.5×10^{-13}	7.5×10^{-7}	-	7.7×10^{-7}	-
Trichloroethene*	-	-	6.9×10^{-2}	-	7.5×10^{-2}	-	7.6×10^{-2}	-
Tridecane	-	-	-	8.5×10^{-7}	-	1.1×10^{-7}	-	2.6×10^{-6}
Tridecane, 2-methyl	-	-	-	-	-	-	-	1.6×10^{-6}
Tridecane, 4-methyl-	-	-	-	-	-	-	-	7.3×10^{-7}
Tridecane, 6-propyl-	-	-	-	-	-	-	-	5.6×10^{-7}
Undecane	-	-	-	2.1×10^{-6}	-	1.1×10^{-7}	-	7.6×10^{-6}
Undecane, 2,10-dimethyl-	-	-	-	-	-	3.3×10^{-8}	-	3.3×10^{-7}
Undecane, 2,6-dimethyl-	-	-	-	-	-	4.0×10^{-8}	-	-
Undecane, 2-methyl-	-	-	-	-	-	2.6×10^{-8}	-	-
Undecane, 3,6-dimethyl-	-	-	-	-	-	-	-	1.2×10^{-6}
Undecane, 4-methyl-	-	-	-	-	-	-	-	7.7×10^{-7}
VX[d]	-	-	-	-	-	-	-	3.7
Vanadium	-	8.3	2.6×10^{-2}	1.2×10^{-9}	1.1×10^{-1}	1.6×10^{-9}	1.1×10^{-1}	1.1×10^{-7}
m,p-Xylene*	7.9	-	-	-	-	-	-	-
p-Xylene*	-	-	-	1.1×10^{-6}	-	2.4×10^{-8}	-	-
Xylenes*	-	-	3.6×10^{-1}	-	3.9×10^{-1}	-	4.0×10^{-1}	-
Zinc	-	-	1.4	1.4×10^{-7}	1.5	-	1.6	-

Footnotes appear on next page.

TABLE 7.6-4 (Cont.)

[a] Substances designated with an asterisk (*) are listed as HAPs under Title III, Section 112 of the CAA. PAHs = polycyclic aromatic hydrocarbons. PCBs = polychlorinated biphenyls. Polychlorinated dioxins/furans are as follows: HpCDD = heptachlorodibenzo-p-dioxin, HpCDF = heptachlorodibenzo-p-furan, HxCDD = hexachlorodibenzo-p-dioxin; HxCDF = hexachlorodibenzo-p-furan, PeCDD = pentachlorodibenzo-p-dioxin; PeCDF = pentachlorodibenzo-p-furan; TCDD = tetrachlorodibenzo-p-dioxin; TCDF = tetrachlorodibenzo-p-furan.

[b] A hyphen indicates that the compound was not detected from this source during demonstration testing.

[c] For the filter farm stack emissions, organics are assumed to be treated by passing through six carbon filters in series, each at 95% efficiency. Particulate matter (metals, dioxins/furans) is assumed to pass through two HEPA filters in series, each at 99.97% efficiency. Product gas burner emissions are assumed not to receive further treatment after release from facility scrubbers.

[d] The after-treatment emission rate from the filter farm stack for chemical agent (GB, VX, mustard) is a worst-case estimate; it assumes emissions at the detection limit (Kimmell et al. 2001). It is assumed that no agent would be emitted from the product gas burner stack; none would be present after neutralization and SCWO treatment.

[e] Although PCB destruction was not included in demonstration testing, for these analyses, it was assumed that Neut/GPCR/TW-SCWO technology would have a destruction efficiency of 99.9999%.

would be expected to be minor and were not quantitatively estimated for this EIS. The main emissions from construction-related heavy equipment and from the commuter vehicles used by construction workers would consist of criteria pollutants (Kimmell et al. 2001) and HAPs. HAPs emissions were not quantified for this assessment because of insufficient data (e.g., whether the engine type is two-stroke, four-stroke, or diesel) (EPA 2000c). Although not quantified for this assessment, the emission levels would be expected to be less than reportable quantities and similar across the technology systems evaluated.

7.6.3.2 Impacts of Operations

Estimates of emissions of toxic air pollutants that would result from the operation of an ACWA pilot facility are provided in Tables 7.6-2 through 7.6-5. Many of the toxic air pollutants that would be emitted from the pilot test facility stacks are HAPs as defined in Title III, Section 112 of the *Clean Air Act* (CAA). However, a pilot test facility would not be a major source of HAP emissions and would not fall into any of the source categories regulated by EPA National Emission Standards for Hazardous Air Pollutants (NESHAP). Therefore, no regulatory action under NESHAP would be necessary for the HAP emissions from a pilot test facility.

PCBs have been identified as a constituent in the firing tubes of M55 rockets (see Section 7.4.2.2). PCBs were not tested as part of the ACWA demonstration project, since doing so would have triggered regulatory requirements under TSCA that would have added considerably to the cost and difficulty of the demonstration. Demonstration tests were conducted by using wood spiked with pentachlorophenol (PCP, a chlorinated substance similar to PCBs). Results showed degradation of the PCP in the test systems, indicating that PCBs would also likely be destroyed. For pilot testing of M55 rocket destruction systems, appropriate TSCA regulations on monitoring PCBs and limiting them in effluents would be followed, and a permit with treatment standards would be obtained before rocket pilot testing. For the purposes of this

TABLE 7.6-5 Estimated Toxic Air Pollutant Emissions from Electrochemical Oxidation Technology at BGAD

	Emissions (μg/s)[b]				
			CatOx/Filter Farm Stack		
Compound[a]	Diesel Generator	Boiler	Mustard Processing[c]	GB Processing[c]	VX Processing[c]
1,1-Dichloroethene*	-	-	1.5×10^{-6}	-	-
1,3-Butadiene*	1.1	-	-	-	-
1,5-Pentanediol, dinitrate	-	-	-	5.4×10^{-6}	5.0×10^{-6}
1-Butanol, 3-methyl-, nitrate	-	-	-	2.4×10^{-5}	2.2×10^{-5}
1-Hexanol, 2-ethyl-	-	-	-	3.0×10^{-7}	2.8×10^{-7}
2-Heptanone	-	-	-	5.5×10^{-7}	5.1×10^{-7}
2-Hexanone	-	-	1.4×10^{-7}	5.1×10^{-6}	4.7×10^{-6}
2-Methylnaphthalene	-	4.7×10^{-2}	-	-	-
2-Octanone	-	-	3.2×10^{-8}	9.1×10^{-7}	8.5×10^{-7}
2-Pentanol, nitrate	-	-	-	3.4×10^{-5}	3.1×10^{-5}
3-Methylchloranthrene	-	3.6×10^{-3}	-	-	-
4-Methyl-2-pentanone	-	-	1.0×10^{-7}	2.2×10^{-7}	2.8×10^{-7}
4-Octene, (E)-	-	-	4.6×10^{-8}	9.8×10^{-8}	1.2×10^{-7}
Acenaphthene	3.9×10^{-2}	3.6×10^{-3}	-	-	-
Acenaphthylene	1.4×10^{-1}	3.6×10^{-3}	-	-	-
Acetaldehyde*	2.1×10^{1}	-	-	-	-
Acetamide, N,N-dimethyl-	-	-	-	1.8×10^{-6}	1.7×10^{-6}
Acetic acid	-	-	1.3×10^{-6}	2.8×10^{-6}	3.6×10^{-6}
Acetone	-	-	3.6×10^{-6}	1.7×10^{-8}	2.1×10^{-8}
Acrolein*	2.6	-	-	-	-
Aldehydes	1.9×10^{3}	-	-	-	-
Anthracene	5.2×10^{-2}	4.7×10^{-3}	-	-	-
Arsenic*	-	4.0×10^{-1}	-	-	-
Barium	-	8.7	-	-	-
Benz(a)anthracene	4.7×10^{-2}	3.6×10^{-3}	-	-	-
Benzene*	2.6×10^{1}	4.1	4.1×10^{-8}	1.9×10^{-6}	1.8×10^{-6}
Benzo(a)pyrene	5.2×10^{-3}	2.4×10^{-3}	-	-	-
Benzo(b)fluoranthene	2.7×10^{-3}	3.6×10^{-3}	-	-	-
Benzo(g,h,i)perylene	1.4×10^{-2}	2.4×10^{-3}	-	-	-
Benzo(k)fluoranthene	4.3×10^{-3}	3.6×10^{-3}	-	-	-
Beryllium*	-	2.4×10^{-2}	-	-	-
Bis(2-ethylhexyl)phthalate*	-	-	-	8.4×10^{-7}	7.7×10^{-7}
Butane	-	4.1×10^{3}	-	-	-
Cadmium*	-	2.2	-	-	-
Carbon disulfide*	-	-	2.1×10^{-6}	7.1×10^{-5}	6.5×10^{-5}
Chloroethane*	-	-	3.3×10^{-7}	-	-
Chloroform*	-	-	4.2×10^{-7}	-	-
Chloromethane	-	-	1.3×10^{-6}	-	-
Chromium*	-	2.8	-	-	-
Chrysene	9.8×10^{-3}	3.6×10^{-3}	-	-	-

TABLE 7.6-5 (Cont.)

	Emissions (µg/s)[b]				
			CatOx/Filter Farm Stack		
Compound[a]	Diesel Generator	Boiler	Mustard Processing[c]	GB Processing[c]	VX Processing[c]
Cobalt*	-	1.7×10^{-1}	-	-	-
Copper	-	1.7	-	-	-
Cyclohexane, 1,2,3-trimethyl-	-	-	1.6×10^{-7}	3.4×10^{-7}	4.3×10^{-7}
Cyclotetrasiloxane, octamethyl-	-	-	-	3.6×10^{-7}	-
Decane	-	-	1.8×10^{-7}	4.9×10^{-6}	4.6×10^{-6}
Decanenitrile	-	-	3.8×10^{-8}	8.3×10^{-7}	7.8×10^{-7}
Dibenzo(a,h)anthracene	1.6×10^{-2}	2.4×10^{3}	-	-	-
Dichlorobenzene*	-	2.4	-	-	-
Dimethylbenz(a)anthracene	-	3.2×10^{-2}	-	-	-
Dodecane	-	-	2.2×10^{-7}	6.7×10^{-6}	6.3×10^{-6}
Ethane	-	6.1×10^{3}	-	-	
Ethylbenzene*	-	-	-	1.3×10^{-7}	1.2×10^{-7}
Fluoranthene	2.1×10^{-1}	5.9×10^{-3}	-	-	-
Fluorene	8.1×10^{-1}	5.5×10^{-3}	-	-	-
Formaldehyde*	3.3×10^{1}	1.5×10^{2}	-	-	-
GB[d]	-	-	-	3.4	-
H (mustard)[d]	-	-	3.4×10^{2}	-	-
Heptanal	-	-	5.3×10^{-8}	1.2×10^{-6}	1.1×10^{-6}
Heptanenitrile	-	-	-	7.2×10^{-7}	6.5×10^{-7}
Hexadecane	-	-	2.6×10^{-8}	1.2×10^{-6}	2.7×10^{-6}
Hexane(n)*	-	3.6×10^{3}	-	-	-
Hexanenitrile	-	-	-	6.4×10^{-7}	5.9×10^{-7}
Indeno(1,2,3-cd)pyrene	1.0×10^{-2}	3.6×10^{-3}	-	-	-
Isopropyl nitrate	-	-	7.7×10^{-7}	1.5×10^{-4}	1.4×10^{-4}
Lead*	-	9.9×10^{-1}	-	-	-
m,p-Xylene*	7.9	-	-	-	-
Manganese*	-	7.5×10^{-1}	-	-	-
Mercury*	8.3×10^{-3}	5.1×10^{-1}	-	-	-
Methylene chloride*	-	-	1.5×10^{-6}	-	-
Molybdenum		2.2	-	-	-
MPA	-	-	-	-	8.4×10^{-12}
Naphthalene*	2.3	1.2	1.6×10^{-5}	3.3×10^{-5}	4.2×10^{-5}
Nickel*	-	4.1	-	-	-
Nitric acid esters	-	-	-	5.8×10^{-6}	5.2×10^{-6}
Nitric acid, butyl ester	-	-	-	2.7×10^{-5}	2.4×10^{-5}
Nitric acid, decyl ester	-	-	5.4×10^{-8}	2.3×10^{-6}	2.1×10^{-6}
Nitric acid, ethyl ester	-	-	-	1.5×10^{-5}	1.4×10^{-5}
Nitric acid, hexyl ester	-	-	-	1.5×10^{-5}	1.4×10^{-5}
Nitric acid, nonyl ester	-	-	1.7×10^{-7}	5.0×10^{-6}	4.7×10^{-6}
Nitric acid, pentyl ester	-	-	-	1.6×10^{-5}	1.4×10^{-5}
Nitric acid, propyl ester	-	-	-	1.6×10^{-5}	1.5×10^{-5}

TABLE 7.6-5 (Cont.)

	Emissions (μg/s)[b]				
			CatOx/Filter Farm Stack		
Compound[a]	Diesel Generator	Boiler	Mustard Processing[c]	GB Processing[c]	VX Processing[c]
Nonanal	-	-	4.3×10^{-7}	9.2×10^{-7}	1.2×10^{-6}
Nonanenitrile	-	-	4.8×10^{-8}	1.4×10^{-6}	1.3×10^{-6}
Octanal	-	-	2.9×10^{-7}	1.5×10^{-6}	1.6×10^{-6}
Octanenitrile	-	-	-	1.6×10^{-6}	1.5×10^{-6}
Pentadecane	-	-	4.1×10^{-8}	2.4×10^{-6}	2.2×10^{-6}
Pentane(n)	-	5.1×10^{3}	-	-	-
Phenanthrene	8.1×10^{-1}	3.4×10^{-2}	-	-	-
PCBs[e]	-	-	-	1.5×10^{-9}	1.5×10^{-9}
PAHs*	4.7	-	-	-	-
Propane	-	3.2×10^{3}	-	-	-
Propylene	7.1×10^{1}	-	-	-	-
Pyrene	1.3×10^{-1}	9.9×10^{-3}	-	-	-
Selenium*	-	4.7×10^{-2}	-	-	-
Tetradecane	-	-	2.0×10^{-7}	7.8×10^{-6}	7.3×10^{-6}
Toluene*	1.1×10^{1}	6.7	-	5.0×10^{-7}	4.6×10^{-7}
Trichloroethene*	-	-	2.0×10^{-6}	-	-
Tridecane	-	-	1.9×10^{-7}	7.0×10^{-6}	6.5×10^{-6}
Undecane	-	-	2.1×10^{-7}	5.9×10^{-6}	5.5×10^{-6}
VX[d]	-	-	-	-	3.4
Vanadium	-	4.5	-	-	-
Vinyl chloride*	-	-	1.7×10^{-6}	-	-
Xylenes*	-	-	7.8×10^{-8}	-	-

[a] Substances designated with an asterisk (*) are listed as HAPs under Title III, Section 112 of the CAA. PAHs = polycyclic aromatic hydrocarbons. PCBs = polychlorinated biphenyls.

[b] A hyphen indicates that the compound was not detected from this source during demonstration testing.

[c] For the CatOx/filter farm stack emissions, organics are assumed to be treated by being passed through six carbon filters in series, each at 95% efficiency. Particulate matter (metals, dioxins/furans) is assumed to pass through two HEPA filters in series, each at 99.97% efficiency.

[d] The after-treatment emission rate from the filter farm stack for chemical agent (GB, VX, mustard) is a worst-case estimate; it assumes emissions at the detection limit (Kimmell et al. 2001).

[e] Although PCB destruction was not included in demonstration testing, for these analyses it was assumed that Elchem Ox technology would have a destruction efficiency of 99.9999% and that further treatment, as in footnote c, would be applied.

assessment, it was assumed that the technology systems evaluated would achieve a PCB destruction efficiency of 99.9999. For filtered stacks, further removal by carbon filtration was also assumed.

In order to assess health risks associated with toxic air pollutant emissions (Section 7.7), the locations of maximum on-post and off-post concentrations of the emitted compounds listed in Tables 7.6-2 through 7.6-5 were identified through air modeling. The ISCST3 model (EPA 1995) was used in the same way as it was used for assessing criteria air pollutant emissions in Section 7.5. Details on the modeling conducted are presented in Appendix C.

The main emissions from commuter vehicles and delivery trucks are criteria pollutants (Kimmell et al. 2001); toxic air pollutant emissions have not been quantified for these vehicles (see Section 7.6.3.1).

7.6.3.3 Impacts of Fluctuating Operations

To account for possible fluctuations in operations that could occur during pilot testing, it was assumed that levels of organic compounds would be 10 times higher than the estimated annual average for 5% of the time and that levels of inorganic compounds would be 10 times higher than the estimated annual average for 20% of the time. These assumptions were based on EPA guidance (National Research Council 1997a) and were used to generate ambient air concentrations for exposure estimates, as detailed in Appendix C.

During fluctuating operations, it is possible that agent could be released from the filter farm stack, which is the ventilation stack for the Munitions Demilitarization Building (MDB) process area. Regardless of the ACWA technology selected for implementation at BGAD, the filter farm stack would be equipped with multiple carbon filter banks and with agent monitoring devices between banks. These devices would ensure that, in the unlikely event that some agent was not destroyed in the neutralization process and subsequent treatment, it would be detected and the causes mitigated immediately.

For the purpose of estimating the maximum potential emissions of chemical agent, only the MDB process area was assumed to be a potential source. The filter systems would be designed to remove agent from the ventilation air stream to a level below the detectable level (Kimmell et al. 2001). Therefore, if any agent were detected in the exhaust stream, alarms would sound, the cause would be identified and mitigated, and the emission of agent (if any) would be short-term and at low levels. Since no estimates of potential chemical agent emission levels were made on the basis of demonstration test results, it was conservatively assumed for this assessment that an agent could hypothetically be emitted continuously from the stack at the detection limit level for that agent. However, this situation would be extremely unlikely because it would require that all filters within the filter bank failed and no corrective action would be taken. Modeling dispersion from the source at these levels resulted in the maximum hypothetical on-post and off-post agent concentrations presented in Table 7.6-6. All these values are less than

TABLE 7.6-6 Maximum Annual Average Estimated On-Post and Off-Post Concentrations of Agent during ACWA Pilot Facility Operations at BGAD[a]

	Maximum Annual Average Off-Post Concentration ($\mu g/m^3$)		Maximum Annual Average On-Post Concentration ($\mu g/m^3$)		Percent of Limit Off Post[b]		Percent of Limit On Post[b]	
Technology	Mustard	GB/VX	Mustard	GB/VX	Mustard	GB/VX	Mustard	GB/VX
Neut/SCWO	2.8×10^{-5}	2.8×10^{-7}	2.3×10^{-4}	2.3×10^{-6}	0.03	0.01	0.23	0.08
Neut/Bio	2.8×10^{-5}	NA[c]	2.3×10^{-4}	NA	0.03	NA	0.23	NA
Neut/GPCR/ TW-SCWO	3.8×10^{-5}	3.8×10^{-7}	2.6×10^{-4}	2.6×10^{-6}	0.04	0.01	0.26	0.09
Elchem Ox	3.5×10^{-5}	3.5×10^{-7}	2.6×10^{-4}	2.6×10^{-6}	0.04	0.01	0.26	0.09

[a] Estimated concentrations account for fluctuating operations.

[b] The general population exposure limits for 72-hour time-weighted average exposures, as estimated by CDC (1988), are as follows: mustard = 0.1 $\mu g/m^3$, GB and VX = 0.003 $\mu g/m^3$.

[c] NA = not applicable.

1% of the allowable concentrations for general public exposure established by the Centers for Disease Control and Prevention (CDC 1988). In practice, the facility stacks would have continuous agent monitoring devices that would sound if any agent were detected in the stacks. The reasons for the presence of the agent would then be identified, and the agent would be eliminated.

7.6.4 Impacts of No Action

Activities associated with continued storage at BGAD would include inspecting, monitoring, and conducting an annual inventory of all munitions; overpacking any leaking munitions discovered during inspections; and transporting overpacked leakers to a separate storage igloo. All chemical munition storage igloos would continue to be routinely inspected and monitored in accordance with strict U.S. Army regulations. All of the igloos containing the overpacked leakers would continue to be inspected and monitored in accordance with applicable Army and Commonwealth of Kentucky RCRA requirements. Upon discovery of a leaker, a filter would be installed and the entry door would be sealed. The amount of agent that might spill from a leaking munition would likely be small, and any vapor that might form as a result of the spill would likely be contained within the igloo. These statements are especially true for mustard agent and VX, which have very low volatilities (900 and 10 mg/m^3 at 25°C [77°F], respectively). Liquid that could leak from a munition would tend to spill slowly over the munition(s) and onto the igloo floor. A VX or mustard liquid spill would evaporate very slowly because of the still air conditions inside the igloo and the low volatility of the agent. In addition, with igloo temperatures typically below 15.6°C [60°F], a mustard leak (liquid spill on igloo floor) would be much less likely considering the relatively high melting point, 14.5°C (58°F), of mustard. Because of GB's greater volatility (21,000 mg/m^3), a liquid spill would more readily evaporate. However, because of the still air conditions inside igloos and the small spill areas that typically occur, spilled liquid and vapors coming from a GB munition leak would remain contained inside the igloo long enough for inspection crews to detect and remediate them. If the munition leak were from an M55 rocket, the shipping and handling containers for these munitions would contain any GB or VX liquid that might leak from the rocket. During Chemical Stockpile Emergency Preparedness Program (CSEPP) exercises, maximum credible events (MCEs) involving the spill of agent onto the igloo floor have been simulated with the D2PC model. These exercises have shown that the hazard zone from such an event would be contained within the Chemical Limited Area for BGAD.

7.7 HUMAN HEALTH AND SAFETY — ROUTINE OPERATIONS

Impacts on human health from routine operations are generally assessed by estimating exposures to the toxic substances that are emitted from a facility on a routine basis and by estimating the potential for those exposures to cause adverse health effects. Because the degree of exposure is partially determined by where the human population is located with respect to the emission points, this section gives data on the locations of workers and the general public around the proposed facilities. Guidance for the estimation of exposure and risk from routine low-level exposures is available from the EPA. The assessment for this EIS generally followed the principles of the EPA's Risk Assessment Guidance for Superfund, which includes the estimation of risk for a reasonably maximally exposed individual (MEI) (EPA 1989, 1997). For example, the risk for the off-site public would be assessed by assuming that the MEI resided in the area of off-site maximum contaminant concentrations (generally but not always the fence line). Other assumptions on intake levels and susceptibility are made to ensure that, whenever possible, exposures and risks will be overestimated rather than underestimated. The reasoning is that if the MEI risk is found to be within acceptable limits, then the risk to the general public will be lower and also generally acceptable.

In addition to risks from exposures to facility emissions, occupational hazard risks of injury and fatality are presented for the facility workers. Some risk of on-the-job injury or fatality is associated with any industry, and a screening estimation of this risk is presented. The main determination of this type of risk is the type of work (construction or facility operation) being done and the number of employees who are doing it.

7.7.1 Current Environment

7.7.1.1 Existing Environmental Contamination and Remediation Efforts

Contamination of surface water, groundwater, and soil has been detected at BGAD. This contamination is a result of historical activities associated with the storage, handling, use, and disposal of hazardous chemicals. Chemical agent contamination of environmental media has not been detected. Environmental cleanup is being addressed in other environmental compliance documents and is beyond the scope of this EIS.

Several solid waste management units (SWMUs) have been identified at BGAD. These are being evaluated and remediated in accordance with RCRA regulations. SWMUs or past contamination have not been identified at either of the sites being considered for an ACWA facility or at the proposed locations for support facilities.

7.7.1.2 On-Post Workers and Residents

Employment at BGAD stands at approximately 400. In addition, approximately 50 employees work at the BGCA. Since base realignment in the 1990s, a number of commercial and industrial tenants have occupied land and buildings formerly used by the military. Commercial and industrial activities employ approximately 300 civilians (Elliott 2001).

The types of workers employed at BGAD include environmental protection specialists, fire and emergency services specialists, munitions specialists, facility management and maintenance workers, and administrative and office workers. The hazards associated with these jobs vary; workers receive training to address their specific job hazards. Although occupational hazards exist for all types of work (rates for various industry classifications are published in various documents; see National Safety Council [1999] for an example), hazards can be minimized when workers adhere to safety standards and use protective equipment as necessary.

On-post workers and residents at BGAD could be exposed to chemicals released to air, water, or soil. As discussed in Section 7.6.1, the only releases at BGAD reportable under TRI regulations are from open burning and open detonation. These activities take place in an area in the south central portion of the installation, more than a mile from the administrative area where most workers and residents at BGAD are located (see Figure 7.2-1). The annual quantities of materials subject to open burning and open detonation are not very large; no TRI threshold values were exceeded for 1999. Therefore, although health risks from ongoing operations at the BGAD have not been quantitatively estimated, the above information suggests that risks for BGAD workers and residents from air emissions would be minimal.

The background level for $PM_{2.5}$ in the vicinity of BGAD is at the health-based annual NAAQS standard level, so there is an existing potential for adverse health impacts from PM inhalation. The source of the airborne $PM_{2.5}$ is unknown.

Contaminant levels in BGAD releases to water are subject to applicable Kentucky Pollutant Discharge Elimination System (KPDES) regulations. Nonhazardous solid waste is sent to off-post landfills, and hazardous solid waste is stored in approved facilities (see Section 7.4), so that any contamination of water or soil at BGAD from routine operations should be minor and not result in increased health risk to workers or on-post residents.

7.7.1.3 Off-Post Public

Demographic information on the off-post public is contained in Section 7.19. No increased health risks to the off-post public are associated with normal BGAD operations. Procedures are in place to minimize risks associated with accidents (see Section 7.7.1.4).

7.7.1.4 Emergency Response

Procedures for on-post emergency response actions involving toxic chemical munitions are contained in *BGAD Disaster Control Plan Annex C* (BGAD 2000d). This plan establishes policies and procedures to ensure that adequately trained personnel and appropriate equipment are present on post at all times to respond to emergency situations.

The Chemical Stockpile Emergency Preparedness Program (CSEPP) has further enhanced the depot's ability to respond to a chemical accident by providing facilities and equipment and by supporting a framework for exchanging information and coordinating assistance with the state and county. As part of CSEPP, BGCA operates an emergency operations center (EOC) during duty hours (hours are to be expanded to 24 hours per day by 2002). This facility enables the BGCA to respond expeditiously to any accident that might occur. In the unlikely event of a chemical accident or incident, EOC staff could readily run plume projections by using the Emergency Management Information System (EMIS), determine the protective action recommendation (PAR), alert the off-post response community, signal depot staff to respond, and activate the outdoor warning system (made up of three on-post sirens and several off-post sirens capable of emitting several tones and voice messages). Many of these activities would occur simultaneously. The sirens are part of the Madison County CSEPP siren system and are normally activated by Madison County.

CSEPP has also encouraged cooperation among BGAD, BGCA, the county, the state, and local hospitals with regard to communications, event classification and notification, exercises, public affairs, and planning. Joint communication links include telephones, radios, e-mail, and microwave transmissions. A memorandum of agreement (MOA) for notification allows for the rapid exchange of information and sounding of outdoor warning devices. Joint exercises have been held annually since 1993. Public affairs efforts are coordinated and include a joint information center (formalized by an MOA), annual calendars, and quarterly newsletters. Finally, emergency response plans have been synchronized.

Tone-alert radios were installed on the Depot by BGCA. They will provide emergency information to employees, tenants, contractors, and on-post residents. The county has also installed more than 13,000 tone-alert radios; they were put in every home and business in the immediate response zone if requested by the owners.

BGAD also has plans for responding to other potential spill hazards. Procedures for responding to spills of oil or hazardous substances are contained in BGAD's *Spill Prevention Control and Countermeasure Plan* (COE 2000). Emergency response plans establish policies and procedures to ensure that adequately trained personnel and appropriate equipment are present on post at all times to respond to emergency situations.

The BGAD Fire Prevention/Protection Department is staffed at all times. Equipment present on post for use in emergency situations includes fire-fighting equipment and vehicles, an emergency response vehicle, heavy equipment, and spill kits.

BGAD has mutual aid agreements with local fire departments and medical facilities to augment its emergency services. These local fire departments have agreed to provide emergency response assistance to BGAD, upon request, when it is possible to do so. In return, the BGAD Fire Department has agreed to do the same for these local entities. In addition, an MOA has been established by BGAD and the U.S. Army Medical Department Activity located at Fort Knox, Kentucky, with Pattie A. Clay Hospital located in the city of Richmond. This MOA addresses the treatment of casualties, illnesses, and injuries requiring off-post assistance.

7.7.2 Impacts of the Proposed Action

This section discusses the potential environmental consequences on human health and safety from constructing and operating an ACWA pilot test facility at BGAD. Factors affecting human health and safety include occupational hazards to workers during continued storage and construction and operations, and potential release of chemical agent or other hazardous materials during routine operations.

7.7.2.1 Impacts of Construction

Facility Workers. Impacts from construction would include occupational hazards to workers. While such hazards can be minimized when workers adhere to safety standards and use protective equipment, as necessary, injuries associated with construction work can still occur.

The expected annual number of worker fatalities and injuries associated with the construction of an ACWA facility was calculated on the basis of estimates of total worker hours required for construction activities for each option as given in Kimmell et al. (2001) and rate data from the U.S. Bureau of Labor Statistics (BLS) as reported by the National Safety Council (1999). Construction of the Neut/Bio, Neut/SCWO, Neut/GPCR/TW-SCWO, or Elchem Ox facility is estimated to require an annual average of approximately 390, 490, 500, or 550 FTEs per year, respectively, and could require up to 34 months. Annual construction fatality and injury rates used were as follows: 13.9 fatalities per 100,000 full-time workers and 4.4 injuries per 100 full-time workers. Annual fatality and injury risks were calculated as the product of the appropriate incidence rate (given above), and the number of FTE employees.

The fatality and injury rates for construction of an ACWA facility are shown in Table 7.7-1. No distinctions were made among categories of workers (e.g., supervisors, laborers), because the available fatality and injury statistics by industry are not refined enough to warrant analysis of worker rates in separate categories. The estimated number of fatalities for all the ACWA technologies assessed is less than 1; the estimated annual number of injuries for construction of a Neut/Bio facility is 17, a Neut/SCWO facility is 22, a Neut/GPCR/TW-SCWO facility is 22, and an Elchem Ox facility is 24.

The calculation of risks of fatality and injury from industrial accidents was based solely on historical industrywide statistics and therefore did not consider a threshold (i.e., it was assumed that any activity would result in some estimated risk of fatality and injury). Whatever technology is implemented will be accompanied by best management practices, which should reduce fatality and injury incidence rates.

Other On-Post Workers and Residents. The main pollutant emissions associated with construction of an ACWA facility would be PM (see Section 7.5). The on-post administrative and residential areas are located about 2.5 mi (4 km) from the proposed ACWA facility sites. PM_{10} and $PM_{2.5}$ levels associated with ACWA facility construction at off-post residential locations about 1.2 mi (2 km) north of the proposed sites were estimated (Section 7.5). PM concentrations at the on-post administrative and residential areas would presumably be lower because of the greater distance. The incremental PM levels estimated varied between 1% and 42% of the health-based 24-hour or annual NAAQS levels; therefore, adverse health impacts to on-post workers and residents would not be expected from the inhalation of construction-related

TABLE 7.7-1 Annual Occupational Hazard Rates Associated with Continued Munitions Maintenance (No Action) and ACWA Pilot Facility Construction and Operations at BGAD

Impact to Workers[a]	Neut/Bio	Neut/SWCO	Neut/GPCR/ TW-SCWO	Elchem Ox	No Action
Fatalities					
Construction	0.05	0.07	0.07	0.08	NA[b]
Systemization	0.01	0.01	0.01	0.01	NA
Operations	0.02	0.02	0.02	0.02	0.002
Injuries					
Construction	17	22	22	24	NA
Systemization	15	15	15	15	NA
Operations	35	35	35	35	3

[a] Impacts are based on the projected work force over the lifetime of the project. Fatality estimates of less than one should be interpreted as "no expected fatalities." For the ACWA technologies, construction is estimated to require up to 34 months, and operations are conservatively estimated to require a maximum of about 1.5 years (except for Neut/Bio, which would require only about 1 month for mustard-only processing). Under the terms of the CWC, the no action alternative could not extend beyond 2012, or about 11 years.

[b] NA = not applicable; i.e., construction and systemization phases are not associated with the no action alternative.

emissions. However, the background level for $PM_{2.5}$ is already at the annual NAAQS standard level, so there is a potential for adverse health impacts from the existing environment.

Off-Post Public. The main pollutant emissions associated with construction of an ACWA facility would be PM. PM_{10} and $PM_{2.5}$ levels associated with ACWA facility construction at a hypothetical boundary receptor location about 1.2 mi (1.9 km) north of the proposed sites were estimated (Section 7.5). The incremental PM levels estimated varied between 1% and 42% of the health-based 24-hour or annual NAAQS levels; therefore, adverse health impacts to the off-post public would not be expected from the inhalation of construction-related emissions. However, the background level for $PM_{2.5}$ is already at the annual NAAQS standard level, so there is a potential for adverse health impacts from the existing environment.

7.7.2.2 Impacts of Operations

Facility Workers

Occupational Hazards. Occupational hazards associated with systemization and operation of an ACWA pilot test facility at BGAD were estimated by using the same method as that discussed for construction (Section 7.7.2.1). The expected number of worker fatalities and injuries was calculated on the basis of rate data from the BLS as reported by the National Safety Council (1999) and estimates of total worker hours required for systemization and operational activities for each option as given in Kimmell et al. (2001). Operation of any of the ACWA technology systems is estimated to require approximately 721 FTE/yr, and systemization testing would require 12 months with a peak work force of 315 FTEs. Annual fatality and injury rates used were as follows: 3.2 fatalities per 100,000 full-time workers and 4.8 injuries per 100 full-time workers. Annual fatality and injury rates for the manufacturing sector were used because that sector was assumed to be the most representative for systemization and operational work at an ACWA facility.

The annual fatality and injury rates for systemization and operation of ACWA facilities are shown in Table 7.7-1. The estimated number of annual injuries is the same for each technology: 15 per year for systemization and 35 per year during operations.

Inhalation Risks. For routine operations, inhalation exposures and risks for facility workers would depend in part on detailed facility designs that are not yet available. In this EIS, facility workers are generally excluded from health risk evaluation for occupational exposures because such exposures are covered by other guidance and regulations (EPA 1998b). Although quantitative estimates of risks to ACWA facility workers from inhalation of substances emitted during facility operations were not generated for this EIS, the workplace environment would be monitored to ensure that airborne chemical concentrations were below applicable occupational exposure limits. Health risks from occupational exposure through all pathways would be minimized because operations would be enclosed insofar as possible and because protective equipment would be used if remote handling of munitions was not possible during processing.

Other On-Post Workers and Residents

Inhalation of Toxic Air Pollutants. Estimated maximum on-post and off-post concentrations of toxic air pollutants from the ACWA technologies are discussed in Appendix C. The maximum on-post concentrations were found to occur close to the Chemical Limited Area at BGAD; therefore, people most likely to be exposed would be on-post workers. (The residential area at BGAD is quite removed from the location of maximum modeled air concentrations; it is in the Administrative Area, which is more than 2.5 mi (4 km) from the Chemical Limited Area.) On-site exposures were modeled on the basis of exposure assumptions typical for the maximum exposed individual (MEI). This person would be a worker assumed to be present at the location of maximum on-post air concentration for 8 hours per day and 250 days per year, for the duration of the pilot test operations for each technology. Exposure estimates generated on the basis of these assumptions were compared with cancer and noncancer toxicity values to generate estimates of increased cancer risk and of the potential for noncancer health impacts. A summary of the results of this assessment is shown in Table 7.7-2. Details of the assessment are provided in Appendix C.

As shown in Table 7.7-2, estimated hazard indexes and carcinogenic risks from exposure to toxic air pollutants estimated for the on-site MEI were far below the benchmarks considered representative of negligible risk levels. The typical benchmark indicator for significant noncarcinogenic hazards is a hazard index of greater than 1, and for carcinogenic hazards, it is an increased lifetime carcinogenic risk level of greater than 1×10^{-6}. During the demonstration, although many fewer chemicals were detected in gas samples from Neut/SCWO than in samples from the other three technologies, the estimated risk levels for routine emissions from the technologies were very comparable, generally on the same order of magnitude. Almost all of the estimated noncarcinogenic and carcinogenic risks were associated with boiler emissions and not with destruction facility processes. Note that exposures and risks are slightly higher for the off-post MEI than for the on-post MEI because the annual exposure duration for the off-post MEI is assumed to be longer (see next subsection on off-post public).

There are some uncertainties in the demonstration test data used to estimate emissions of toxic air pollutants that should be considered in interpreting the results. Some unit operations were not characterized in demonstration testing, so trace effluents were not estimated for all unit operations that would make up the complete systems. Generally, data were available for unit operations that would be expected to generate the most gaseous emissions during actual operations (Mitretek 2000a–d). However, the emission levels and health risk estimates provided here should be considered only indicative of likely levels. They may need to be revised as technology designs near completion and as estimates of process efficiencies become more reliable (Kimmell et al. 2001). Nevertheless, the values used for the risks from operations presented in this EIS were designed to be very conservative (i.e., potentially resulting in overestimates of risk) and to bound minor variations in the way that the ACWA destruction systems would be engineered.

In general, toxicity benchmark levels were available to allow quantitative risk estimates for the majority of toxic air pollutants detected. For Neut/SCWO operations, 14 of the detected chemicals (22%) did not have established (i.e., peer-reviewed) noncarcinogenic or carcinogenic toxicity benchmark levels (see Appendix C). For Neut/GPCR/TW-SCWO operations, 99 of the detected chemicals (53%) did not have established toxicity benchmark levels. For Elchem Ox operations, 50 of the detected chemicals (49%) did not have established toxicity benchmark levels. For Neut/Bio operations, 17 of the detected chemicals (16%) did not have established

TABLE 7.7-2 Toxic Air Pollutant Emissions and Impact on Human Health and Safety during Normal Operations at BGAD[a]

Emissions and Impacts	Neut/Bio[b]	Neut/SCWO	Neut/GPCR/ TW-SCWO	Elchem Oxidation
Hazardous air emissions				
Number of chemicals detected	107	63	188	103
Number of chemicals with quantitative data on toxic, noncarcinogenic effects[c]	79	38	77	42
Number of chemicals with quantitative data on carcinogenic effects[d]	57	22	44	28
Impacts[e]				
Hazard index (*hazard index of <1 means adverse health impacts are unlikely*)				
For MEI[e] in off-post general public, nerve agent processing	NA[f]	4×10^{-4}	2×10^{-3}	3×10^{-4}
For MEI in off-post general public, mustard agent processing	4×10^{-5} (9×10^{-5})	2×10^{-5}	4×10^{-5}	2×10^{-5}
For MEI in on-post population, nerve agent processing	NA	8×10^{-5}	1×10^{-3}	9×10^{-5}
For MEI in on-post population, mustard agent processing	1×10^{-5} (2×10^{-5})	6×10^{-6}	1×10^{-5}	7×10^{-6}
Increased lifetime carcinogenic risk *(risk of 10^{-6} is generally considered negligible)*				
For MEI in off-post general public, nerve agent processing	NA	9×10^{-10}	1×10^{-9}	1×10^{-9}
For MEI in off-post general public, mustard agent processing	8×10^{-11} (1×10^{-10})	3×10^{-11}	6×10^{-11}	4×10^{-11}
For MEI in on-post population, nerve agent processing	NA	2×10^{-10}	3×10^{-10}	3×10^{-10}
For MEI in on-post population, mustard agent processing	2×10^{-11} (3×10^{-11})	1×10^{-11}	2×10^{-11}	1×10^{-11}
Increased lifetime carcinogenic risk to population due to worst-case mustard emissions *(risk of 10^{-6} is generally considered negligible)*[g]				
Off post	2×10^{-9}	2×10^{-9}	2×10^{-9}	2×10^{-9}
On post	4×10^{-10}	4×10^{-10}	4×10^{-10}	4×10^{-10}

[a] Based on emission estimates from demonstration testing (Kimmell et al. 2001) and model estimates of maximum on-post and off-post concentrations and adjusted to account for fluctuating operations. ISCST3 model was used. Estimates for general public assumed 24-h/d exposures for the duration of operations. Estimates for the on-post population assumed 8-h/d exposures and 250-d/yr for the duration of operations. See Appendix C for details.

[b] For Neut/Bio, the value in parentheses assumes no further treatment of emissions from the biotreatment vent after they have been processed in the immobilized cell bioreactor (ICB) unit.

[c] Potential noncarcinogenic impacts from some detected chemicals could not be evaluated quantitatively because toxicity data were not available (see text discussion). For Neut/Bio, Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox, 17, 14, 99, and 50 chemicals, respectively, could not be quantitatively evaluated for either noncarcinogenic or carcinogenic effects (see text).

[d] All known carcinogens were evaluated for carcinogenic risk.

[e] Carcinogenic risks are less than 10^{-6} and hazard indexes are less than 0.01 for all technologies; thus, they are in the negligible range. Although calculated cancer risks range from approximately 10^{-10} to 10^{-8}, and calculated hazard indexes range from 10^{-5} to 10^{-2}, there is no significant difference in risk among the technologies. Thus, for all the technologies, increased cancer and noncancer risks from inhalation of emissions are in a range considered to be negligible.

[f] NA = not applicable; MEI = maximum exposed individual.

[g] Although the facilities would be designed to operate without mustard releases, these values were estimated as a worst case by assuming continuous emission at the detection limit (Kimmell et al. 2001). The estimated concentrations are all 1% or less of the allowable concentrations for general population exposures.

toxicity benchmark levels. For most of the substances for which toxicity could not be quantitatively evaluated, emission levels were very low (e.g., less than 10 g/d). Although not quantitatively assessed, toxic effects would be highly unlikely in association with these very low emission levels. For several substances emitted from boilers and diesel generators (aldehydes, propane, butane, pentane, and ethane), emission levels were somewhat higher (up to about 1 kg/d). Although potential health effects from inhalation of these substances could not be quantitatively evaluated because of the lack of toxicity benchmark levels, such data would not distinguish among risks associated with the alternate technologies, because each of the technologies evaluated uses boilers and diesel generators.

Per Executive Order 13045 (1997), it is also necessary to consider whether sensitive subpopulations, such as children or the elderly, could be more affected than the general population by the estimated exposures to toxic air pollutants. The reference concentrations used to evaluate the noncarcinogenic toxicity of the emitted substances already include factors to account for the possible added sensitivity of certain subpopulations. Chemical-specific potency estimates for carcinogens also include conservative uncertainty factors and so can be used to assess risks for sensitive subpopulations. However, the exposure parameters used to estimate intake (i.e., 154 lb [70 kg] body weight; 20 m^3/d inhalation rate) are typical for adults. To consider intake for young children (less than 1 year old), an inhalation rate of 4.5 m^3/d and a body weight of 20 lb (9 kg) (EPA 1997) could be assumed. Use of these assumptions would result in an estimate of dose (in mg/kg/d) for a young child that would be 1.7 times greater than the dose assumed for an adult, and overall hazard indices and cancer risks would also increase by a factor of 1.7. Since the hazard indices and cancer risks estimated for toxic air pollutant emissions during normal operations were low (Table 7.7-4), risk levels for sensitive subpopulations, such as children, would still be far less than benchmark levels.

Inhalation of Chemical Agent. Maximum potential concentrations from emissions of agent (including consideration of fluctuating operations) were discussed in Section 7.6.3.3. For all three chemical agent types stored at BGAD, modeling dispersion from the estimated maximum emissions resulted in a maximum estimated on-post concentration of less than 1% of the allowable concentration for general public exposures. In practice, the facility stacks would have continuous agent monitoring devices that would sound if any agent were detected in the stacks. By this means, the source could be identified and eliminated quickly; emissions would not be allowed to continue at the detection limit level, as was assumed in the modeling exercise.

Mustard has been classified as a known carcinogen (see Appendix C). The maximum incremental cancer risk for the on-post MEI due to hypothetical mustard emissions was estimated to be 4×10^{-10} (Table 7.7-2). This risk level is 2,500 times lower than the benchmark risk value of 1×10^{-6}, and, as stated above, emission levels would not be allowed to continue at the detection limit level for more than a short time, so the exposure estimate based on the entire duration of operations is a large overestimate. Therefore, even under hypothetical worst-case emission levels, carcinogenic risks from mustard emissions associated with a pilot facility would be very small.

Exposures from Other Pathways. Other potential exposure pathways to be considered are water (if effluent from the pilot facility were to be released to nearby waterways) and soil and food (if soil were to become contaminated by releases to air and subsequent deposition). For pilot testing each of the ACWA technologies, plans are to recycle all process water through the system. The pilot test facility is not expected to generate any aqueous effluent except for the sanitary wastewater generated by employees. Also, exposure through soil and food chain pathways from deposition onto soil and/or water is expected to be very low, since the level of air emissions that would result from routine operations is expected to be very low and since the duration of operations would be short. All facility releases would be in conformance with applicable local and state permit requirements. Therefore, exposures through water, soil, or foodchain pathways would result in very minimal, if any, additional risk to on-post workers and residents.

Off-Post Public

Inhalation of Toxic Air Pollutants. Maximum off-post concentrations of toxic air pollutants that would result from the ACWA technologies are estimated in Appendix C. Off-post exposures were modeled by using exposure assumptions typical for the MEI in the off-post residential population. This hypothetical person is considered to be an individual who is present at the location of the maximum off-post concentration of a pollutant in air for 24 hours per day and 365 days per year, for the duration of the pilot test operations for each technology. Exposure estimates generated on the basis of these assumptions were compared with cancer and noncancer toxicity values to generate estimates of increased cancer risk and of the potential for noncancer health impacts. A summary of the results of this assessment is shown in Table 7.7-2. A detailed presentation of the results, including a list of substances detected during demonstration testing, the estimated air concentrations and intake levels, and risk estimates for individual chemicals, is provided in Appendix C.

This assessment was limited to the estimation of risks associated with inhalation of emitted substances. For some of the emitted substances (e.g., PCBs, dioxins, and furans), exposure to the off-post public through the food-chain pathways could be as large or larger than exposure through inhalation, because these substances are bioaccumulative. Estimates of exposure through these alternate pathways can be highly uncertain and are beyond the scope of this EIS. However, for all the technologies, the emission rates for these substances are quite low (less than 0.00001 lb/yr for all forms of dioxins and furans and 0.005 lb/yr or less for PCBs). For the purpose of this assessment (i.e., to compare the risks associated with pilot testing the alternate ACWA technology systems), estimation of the risk associated with inhalation should be indicative of the risk from all pathways.

As shown in Table 7.7-2, estimated hazard indexes and carcinogenic risks from exposure to toxic air pollutants estimated for the off-post MEI were well below levels considered to be hazardous. The typical benchmark indicator for significant noncarcinogenic risks is a hazard index of greater than 1, and for carcinogenic hazards, it is an increased lifetime carcinogenic risk level of greater than 1×10^{-6}. During the demonstration, although many fewer chemicals were detected in gas samples from Neut/SCWO than in samples from the other three technologies, the estimated risk levels for routine emissions from the technologies were very comparable, generally on the same order of magnitude. Almost all of the estimated noncarcinogenic and carcinogenic risks were associated with boiler emissions and not with ACWA pilot facility processes. Note that exposures and risks were slightly higher for the off-post MEI than for the on-site MEI because the annual exposure duration was assumed to be longer for the off-post MEI. Even if it is assumed that children have an exposure risk up to 1.7 times greater than that of adults, risks would still remain well below levels of concern. A more detailed discussion of assumptions and data limitations for this assessment is provided in Appendix C.

Inhalation of Chemical Agent. Maximum potential off-post concentrations from emissions of agent (including consideration of fluctuating operations) were discussed in Section 7.6.3.3. For all three chemical agent types stored at BGAD, modeling dispersion from the estimated maximum emissions resulted in a maximum estimated off-post concentration of less than 1% of the allowable concentration for general public exposures (CDC 1988). In practice, the facility stacks would have continuous agent monitoring devices that would sound if any agent was detected in the stacks, so that the source would be identified and eliminated quickly; emissions would not be allowed to continue at the detection limit level, as was assumed in the modeling exercise.

Mustard has been classified as a known carcinogen (see Appendix C). The maximum incremental cancer risk for the off-post MEI due to hypothetical mustard emissions was estimated to be 2×10^{-9} (Table 7.7-2). This risk level is almost 500 times lower than the benchmark risk value of 1×10^{-6}, and, as stated above, emission levels would not be allowed to continue at the detection limit level for more than a short time, so the exposure estimate based on the entire duration of operations is a large overestimate. Therefore, even under hypothetical worst-case emission levels, carcinogenic risks from mustard emissions associated with an ACWA pilot facility would be very small.

Exposures from Other Pathways. Exposures through water, soil, or food chain pathways would result in very minimal, if any, additional risk to off-post residents (see previous discussion on exposures from other pathways for other on-post workers and residents).

7.7.3 Impacts of No Action

Activities associated with continued storage (no action) at BGAD would include inspecting and conducting an annual inventory of all munitions, overpacking any leaking munitions discovered during inspections, and transporting the overpacked leakers to a separate storage igloo. Before a worker can enter into any igloo, the air inside is monitored for the presence of agent. Workers are required to wear respiratory protection and protective clothing while in the storage igloos. Therefore, during routine operations under the no action alternative, no worker would be exposed to chemical agent. Routine use of other chemicals would not be required for continued storage operations, so exposure to other chemicals would be limited. A potential hazard would be heat stress associated with the heavy protective clothing and equipment required for the work. However, workers are trained to control this hazard. For the other on-post workers and residents and for the general public, no impacts on human health are expected in association with the no action alternative.

Risk calculations for occupational fatalities and injuries resulting from the no action alternative (i.e., continued storage and maintenance of the BGAD stockpile) are presented in Table 7.7-1. The expected number of worker fatalities and injuries associated with continued maintenance of the munitions stockpile at BGAD was calculated on the basis of rate data from the BLS as reported by the National Safety Council (1999) and an estimate of approximately 50 FTE employees required for munitions maintenance activities each year (Elliott 2001). Annual fatality and injury rates for the manufacturing sector were used because this sector was assumed to be the most representative for munitions maintenance work. The specific rates were as follows: fatality rate of 3.2 per 100,000 full-time workers and injury rate of 4.8 per 100 full-time workers. Annual fatality and injury risks were calculated as the product of the appropriate incidence rate (given above), and the number of FTE employees. No distinctions were made among categories of workers (e.g., supervisors, inspectors, security personnel), because the available fatality and injury statistics by industry are not refined enough to warrant analysis of worker rates in separate categories. The estimated number of fatalities was less than 1; the estimated total number of injuries was 3.

7.7.4 Impacts from Transportation

Chemical agent would not be transported on or off post for any of the alternative technologies evaluated. However, transportation can have adverse impacts on human health because of the associated emission of toxic air pollutants such as benzene, 1,3-butadiene, and formaldehyde. Emissions consist of engine exhaust from diesel- and gasoline-powered vehicles and fugitive dust raised from the road by transport vehicles. Increased incidence of lung cancer has been associated with prolonged occupational exposure to diesel exhaust (Dawson and Alexeeff 2001); toxic air pollutants are also emitted from gasoline-burning vehicles (EPA 2000d). Also, transportation results in some increased risk of injuries and fatalities from mechanical causes; that is, the transport vehicles may be involved in accidents. This type of risk is termed "vehicle-related." Both the chronic health hazard from inhalation of emissions from transport vehicles and the injury risk are directly proportional to the number of vehicle miles traveled.

For the transportation impacts in this EIS, the annual number of vehicle miles traveled by delivery vehicles (used for delivery of construction materials) and commuter vehicles (used to transport construction and operation workers) was compared for each of the alternative technologies and for the no action alternative. In addition, the annual number of shipments of raw materials and waste required for each alternative was tabulated. It was assumed that the distances for shipping raw materials and waste would be similar for each of the alternatives. This assumption was necessary because actual origin and destination locations had not been determined. Therefore, the data did not support risk calculations using diesel emission factors. The comparison of the number of vehicle miles traveled and the number of shipments by alternative is useful for an overall comparison of the potential transportation impacts to human health from each alternative.

The transportation impacts for BGAD are summarized in Table 7.7-3. The number of miles traveled annually by construction and operations worker commuter vehicles is similar for each technology. For mustard processing, the Neut/SCWO and Neut/GPCR-TW-SCWO technologies would require a similar number of shipments. These technologies would require about 50% more shipments annually than the Neut/Bio or Elchem Ox technologies. For nerve

TABLE 7.7-3 Comparison of Annual Transportation Requirements for Construction and Routine Operations for Alternative Technology Systems at BGAD[a]

Parameter	Neut/Bio[b]	Neut/SCWO	Neut/GPCR/ TW-SCWO	Elchem Ox	No Action[c]
Number of vehicle miles traveled [d]					
Construction delivery vehicle	200,000	200,000	200,000	200,000	NA[e]
Construction worker commuter vehicle	3,800,000	4,700,000	4,800,000	5,300,000	NA
Operations worker commuter vehicle	500,000	8,000,000	8,000,000	8,000,000	560,000
Number of shipments[f]					
Mustard agent					
Raw materials	20	82	20	26	NA
Waste	98	74	140	73	NA
Total	118	156	160	99	NA
Nerve agent					
Raw materials	NA	99	233	109	NA
Waste	NA	437	431	186	NA
Total	NA	536	664	295	<1

[a] Number of vehicle miles traveled and number of shipments are used as indicators of potential transportation-associated health impacts, since emission and vehicle-related risks increase with increasing transportation.

[b] Neut/Bio totals are for mustard agent processing only.

[c] No action alternative assumes approximately 50 employees would be required for continued storage maintenance.

[d] Annual miles are calculated as the number of workers $\times$ 276 work days per yr $\times$ 40 mi per round trip.

[e] NA = not applicable.

[f] Raw material and waste shipments for nerve agent are the maximum annual for either GB or VX processing.

Input data sources: Kimmel et al. (2001).

agent processing, the Neut/GPCR/TW-SCWO technology would require the greatest number of shipments, about 25% more than Neut/SCWO and about twice as many as Elchem Ox.

7.8 NOISE

The *Noise Control Act* of 1972, along with its subsequent amendments (*Quiet Communities Act* of 1978; see *United States Code*, Title 42, Parts 4901–4918 [42 USC 4901–4918]), delegates to the states the authority to regulate environmental noise and directs government agencies to comply with local community noise statues and regulations. The Commonwealth of Kentucky and Madison County, where BGAD is located, have no quantitative noise-limit regulations.

BGAD has developed environmental noise management assessments. Two different sound-level measures of day-night sound level (DNL or L_{dn})[6] are used by the U.S. Army for noise impact assessments: A-weighted DNL (ADNL) and C-weighted DNL (CDNL). ADNL is a descriptor used to evaluate the environmental noise impact on the general population, and CDNL is a descriptor used to evaluate the risk of hearing damage produced by impulsive noise. For the Army's regulatory purposes, these measures are both used to define three land-use classifications. Table 7.8-1 presents these ADNL and CDNL noise-limit criteria for each of three zone classifications (Zones I, II, and III) and the corresponding percent of highly annoyed population (U.S. Army 1997a).

TABLE 7.8-1 Noise Criteria for Noise-Sensitive Land Use Classifications

	Noise Limits[a]		Population
Noise Zone	ADNL (dBA)	CDNL (dBC)	Highly Annoyed (%)
Zone I	< 65	< 62	< 15
Zone II	65–75	62–70	15–39
Zone III	> 75	> 70	> 39

[a] ADNL and CDNL = A-weighted and C-weighted day-night sound levels. dBA and dBC = A-weighted and C-weighted decibels.

Source: U.S. Army (1997a).

[6] L_{dn} is the time-weighted 24-hour average sound level with a 10 decibel (dB) penalty added to the nighttime levels (2200 to 0700 hours).

The EPA has recommended a maximum noise level of 70 dBA[7] as DNL to protect against permanent hearing loss and a maximum noise level of 55 dBA as DNL to protect against outdoor activity interference and annoyance (EPA 1974). These levels are not regulatory goals, but are "intentionally conservative to protect the most sensitive portion of the American population" with "an additional margin of safety." For protection against hearing loss in the general population from nonimpulsive noise, the EPA guideline recommends an L_{eq} of 70 dBA or less over a 40-year period.[8]

7.8.1 Current Environment

BGAD is bordered by U.S. Highway 421/25 (US 421/25) to the west, US 52 to the north, State Route 374 (SR 374) to the east, and SR 499 to the south (Figure 7.1-1). The major off-post noise sources are US 421/25 and the CSX freight railroad, which borders BGAD to the west. The primary noise-producing activity within BGAD is open detonation at the munitions detonation area located in the southeastern part of the depot, approximately 3.7 mi (6 km) directly south of the proposed ACWA facility (Figure 7.8-1). The open detonation generates loud (but sporadic) noise. The area within about 0.5 mi (800 m) of the center of the detonation ground area is classified as Zone III. The area between approximately 0.5 and 1.0 mi (800 and 1,600 m) from the detonation site is classified as Zone II. All other locations within the depot boundary are classified as Zone I. Noise-sensitive land uses, such as housing, schools, and medical facilities, are considered incompatible with noise environments in Zone III, normally incompatible in Zone II, and compatible in Zone I (U.S. Army 1997a). Ambient sound level measurements in the BGAD site are not currently available.

The location of the proposed facility is in the northern section of the depot, in the Zone I area, about 2.5 mi (4 km) from the nearest part of the Zone II area (Figure 7.8-1). This location is in a fairly quiet area (comparable to a wooded subdivision near a small town) where noise levels are typically below 40 dBA (Liebich and Cristoforo 1988). The residence nearest to the site is located about 1.6 mi (2.5 km) north of the site and 5.3 mi (8.5 km) north of munition-detonation ground area. The nearest residential communities are the towns of Reeds Crossing, Moberly, and Speedwell, which are at distances of approximately 2, 2.5, and 4 mi (3, 4, and 6 km),

---

[7] dBA is a unit of weighted sound-pressure level, measured by the use of the metering characteristics and the A-weighting specified in ANSI S1.4-1983 (the American National Standards Institute specification for sound level meters) and in ANSI S1.4A-1985, the amendment to ANSI S1.4-1983 (Acoustical Society of America 1983, 1985).

[8] L_{eq} is the equivalent steady sound level that, if continuous during a specific time period, would contain the same total energy as the actual time-varying sound. For example, L_{eq}(1-h) is the 1-hour equivalent sound level.

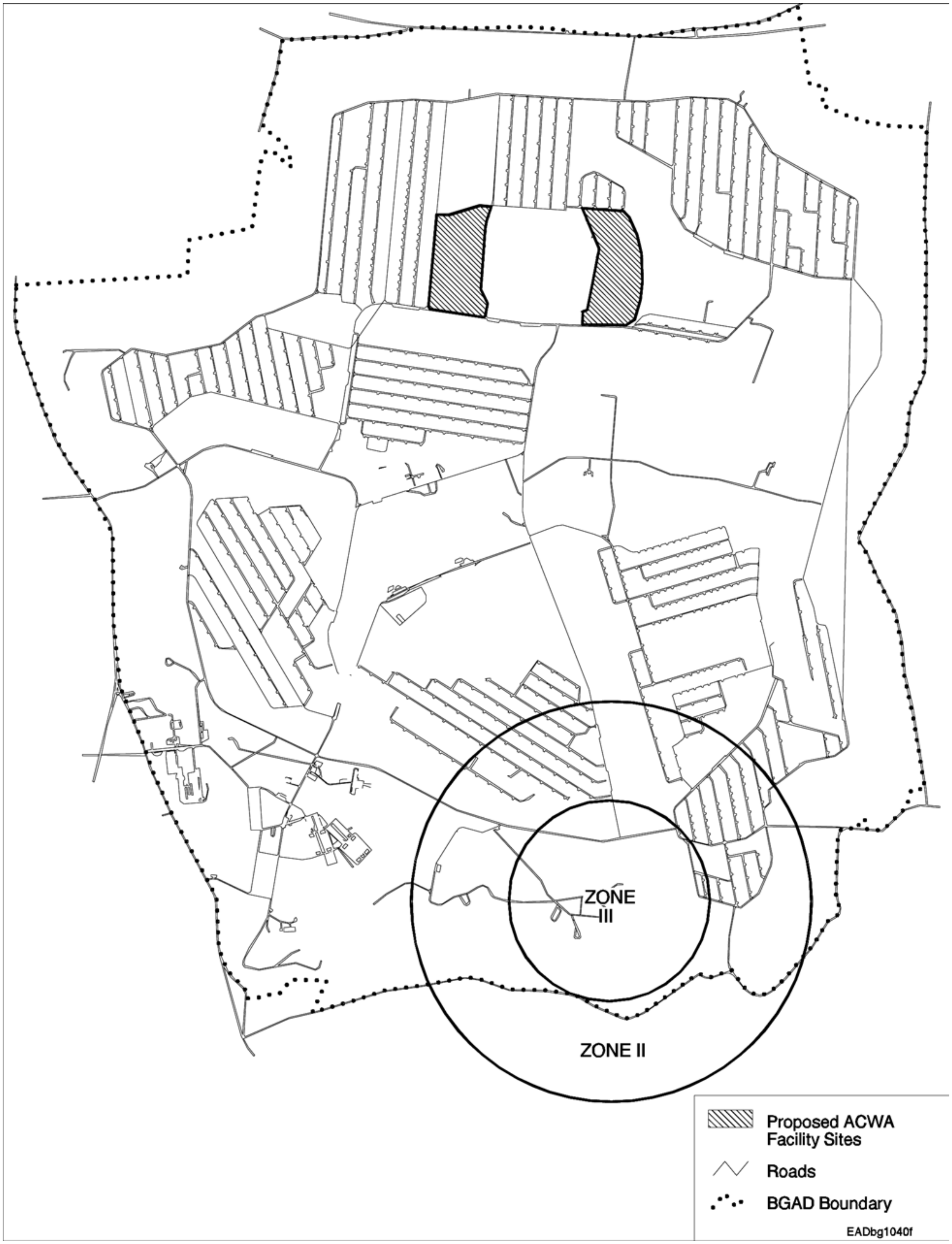

FIGURE 7.8-1 Noise-Sensitive Zones at BGAD (Source: Lexington-Blue Grass Army Depot 1987)

respectively, from the proposed sites for an ACWA facility. The nearest school (Clark Moore Middle School) is more than 3 mi (5 km) to the west-northwest, and the nearest hospital (Pattie A. Clay Memorial Hospital) is located about 5 mi (8 km) west-northwest of the proposed sites. The region has rolling terrain, scattered woods, and a few small lakes both within BGAD and in the surrounding area.

7.8.2 Noise Sources from the ACWA Pilot Test Systems

Standard commercial and industrial practices for moving earth and erecting concrete and steel structures would be followed to construct an ACWA pilot test facility. Noise levels generated from these activities would be comparable to those from any construction site of similar size.

Pilot facility operations would involve a variety of equipment that would generate noise. Some equipment, such as fans and pumps for conveying and handling treatment residues (e.g., pollution abatement systems), heating and air conditioning units, electrical transformers, and in-plant public address systems, might be located outside the buildings. However, most of the equipment used in ACWA pilot testing operations would be housed inside buildings designed to prevent the release of chemical agents and contain potential explosions. The walls, ceiling, and roofing materials used in these buildings would attenuate the noise generated by the activities inside the buildings.

During both construction and operation, the commuter and delivery vehicle traffic in and around the ACWA facility would also generate noise. However, the contribution of noise from these intermittent sources would be minor in comparison to that from the continuous noise sources during construction or operation.

As it was for the air quality modeling presented in Section 7.5, Proposed Area B, which is located closer to the installation boundary and neighboring communities, was selected as the receptor for analysis of potential noise impacts. Regardless of the technology selected, it is assumed that noise levels from both construction and operations would be similar. Detailed information on noise from construction and operational activities associated with an ACWA pilot facility were not available at the time of this analysis.

7.8.3 Impacts of the Proposed Action

7.8.3.1 Impacts of Construction

Operation of equipment and vehicles and associated activities during construction typically generate noise levels in the 77–90 dBA range at a distance of about 50 ft (15 m) from the source (EPA 1979). Noise levels decrease about 6 dB for every doubling of distance from the source because sound spreads over an increasing area. Thus, construction activities at the pilot test facility location would result in maximum estimated noise levels of about 48 dBA at the BGAD boundary closest to Proposed Area B, about 1.2 mi (1.9 km) north of the facility. At residences located further away from the northern site boundary, the noise level would be substantially lower than 48 dBA.

This 48-dBA estimate is likely to be an upper bound because it does not account for other types of attenuation, such as air absorption and ground effects due to terrain and vegetation. This level is below the EPA guidelines of 55 dBA for residential zones (see Section 7.8.1) and is in the range found within a typical residential community at night (Corbitt 1990). If other attenuation mechanisms were considered, noise levels at the nearest residence would decrease to near or below background levels of about 40 dBA (see Section 7.8.1). In particular, tall vegetation between the proposed facility and the site boundary would contribute to additional attenuation. Thus, potential noise impacts from construction activities at the pilot test facility location are expected to be minor to negligible at the nearest residence. The resulting noise levels would be well within the EPA guidelines, which were established to prevent activity interference, annoyance, and hearing impairment.

7.8.3.2 Impacts of Operation

At the baseline incinerator facility in Tooele, Utah, the highest sound levels during operation were measured in the vicinity of the pollution abatement system (Andersen 2000), which is similar in design to pollution abatement systems being considered for use in an ACWA pilot facility. These sound levels were less than 73 dBA within 100 ft (30 m) of the abatement equipment. When the noise attenuation factors discussed in Section 7.8.3.1 are applied, estimated noise levels would be less than 37 dBA at the nearest installation boundary, which is located about 1.2 mi (1.9 km) from the proposed facility. This noise level at the installation boundary is comparable to the ambient background level discussed in Section 7.8.1 and would be hardly distinguishable from the background level. In conclusion, noise levels generated by plant operation would have negligible impacts on the residence located nearest the proposed facility and would be well within the EPA guideline limits for residential areas.

7.8.4 Impacts of No Action

The levels of noise generated by current stockpile maintenance activities are part of the current background noise levels, which reflect the operations of the installation. These levels would not be expected to change under the no action alternative; therefore, the conditions described in Section 7.8.1 (affected environment) would continue to exist.

7.9 VISUAL RESOURCES

7.9.1 Current Environment

BGAD is located in a semiurban area surrounded by a variety of land uses, including agricultural, industrial, residential, and some commercial and public (educational and recreational) areas. There is a steady trend of increased development in the vicinity of the depot.

BGAD is generally characterized by open fields and rolling hills with scattered woodlots (see Section 7.2). The military and industrial nature of the BGAD facility, which contains numerous storage igloos and a relatively limited number of buildings, is, for the most part, hidden from view. With the exception of the main entrance, where the administrative buildings are located, and the guard posts and gates at other entrances, the depot is mostly hidden from view by vegetation and terrain. Also limiting visibility of parts of the facility are earthen-covered storage igloos and large, pastured or wooded buffers between the fence line and the structures.

The industrial and other developed areas on post, including utility corridors, are generally consistent with a Visual Resources Management (VRM) Class IV designation (hosting activities that lead to major modification of the existing character of the landscape). The remainder of the installation fits a VRM Class III or IV designation (hosting activities that, at most, only moderately change the existing character of the landscape) (DOI 1986a,b)

7.9.2 Site-Specific Factors

The general visual aesthetic character of BGAD could be affected by these factors:

1. The appearance of the ACWA facility itself and its supporting components (other facilities, transmission lines, roads, parking areas),

2. The placement of the ACWA facility (its elevation, adjacent land use, resulting view shed, etc.), and

3. Visibility impacts due to fugitive dust emissions from construction or due to steam emissions from the operating stacks.

7.9.3 Impacts of the Proposed Action

7.9.3.1 Impacts of Construction

During construction, the visual character of BGAD would be temporarily disrupted as a result of additional traffic travelling on and off the depot on one of the proposed access roads and the decrease in local visibility from the dust generated by the traffic and construction activities. This disruption would temporarily and intermittently affect the view of BGAD from either US 25 or US 52, depending on which access corridor was chosen. Changes in visual aesthetic character would result from a new entrance gate, a parking area just inside the perimeter fence, and an open corridor along the access route that is currently wooded. Moreover, for a short time during its construction, one might be able to glimpse the ACWA facility. However, the ACWA facility might also be constructed in an area blocked from view by the terrain (i.e., behind a hill or a stand of trees).

7.9.3.2 Impacts of Operations

During operations, the visual elements that would remain constant (once construction was completed and the pilot facility had begun operating) would be the gate, parking area, and access corridor just mentioned in Section 7.9.3.1. Depending on the extent of tree removal during construction and depending on the location chosen, the ACWA facility itself and supporting components (e.g., transmission lines) might be visible from the road as well. There may also be a small steam plume from ACWA operations. However, the industrial appearance of the facility would remain in keeping with the visual character of the surrounding area and with BGAD. The terrain and the scattered woodlots and pasture areas would still hide most of the ACWA facility and its supporting infrastructure from the direct sight of off-post viewers.

7.9.4 Impacts of No Action

Under the no action alternative, there would be no change to the aesthetic character of BGAD.

7.10 GEOLOGY AND SOILS

7.10.1 Current Environment

7.10.1.1 Geology

BGAD is located in the Outer Blue Grass Subdivision of the Blue Grass Physiographic Region. The topography of the Outer Blue Grass Subdivision is characterized by moderately undulating to gently rolling hills that steepen near major streams. The topography of the BGAD facility is generally typical of the Outer Blue Grass physiography (URS 2000). The uppermost units underlying BGAD consist of unconsolidated silts, clays, and loams that resulted from weathering of the underlying bedrock. Bedrock in the vicinity is made up of nearly horizontally bedded dolomite, shale, and limestone units. The uppermost bedrock units across most of BGAD are mapped as belonging to the Ordovician-aged Drakes and Ashlock Formations (Hall and Palmquist 1960; Greene 1968). Fine-grained alluvium is present in the surface water drainages. At the proposed sites for the ACWA pilot facility, the uppermost bedrock unit is the Drakes Formation (Greene 1968). The depth to bedrock across BGAD ranges from 4 to 12 ft (1 to 4 m) on uplands and 0 to 3 ft (0 to 1 m) on hillsides (URS 2000).

No economic mineral deposits have been mapped at BGAD (Anderson and Dever 1998). The nearest economic deposit of Quaternary sand and gravel is approximately 4 mi (6 km) northeast of BGAD. Mineral occurrence has been noted in a core collected about 2 mi (3 km) northeast of the BGAD. In this core, copper and fluorite were present in a sample correlating to the Cambrian-Ordovician-aged Knoxville Group. The possible economic value of these minerals at this location is uncertain. No other exploratory borehole results have been mapped within 7 mi (11 km) of BGAD.

7.10.1.2 Seismicity

BGAD is located in a tectonic domain generally referred to as the Kentucky River Fault System (Weston Geophysical Corporation 1996). In the vicinity of BGAD, a number of older faults have displaced mid-Paleozoic Age (about 400 million years old) formations. However, no faults in the region are known to have displaced geologically younger materials (e.g., of Pleistocene or Holocene Age). In addition, there are no indications of faults that are capable or potentially capable of creating an earthquake.

Those are two other major fault systems in the vicinity of BGAD: the Lexington Fault System and Irvine-Paint Creek Fault System (U.S. Army et al. 1987). The Irvine-Paint Creek Fault System lies closest to the installation, at a distance of about 6 mi (10 km) (McDowell et al. 1981). There are also a number of minor faults in eastern Kentucky. Tate Creek Fault passes about 0.5 mi (1 km) south of the installation, and Moberly Fault passes about 1 mi (2 km) to the northeast. These systems were active during Paleozoic times (about 230 million years ago), but there are no reports of recent seismic activity (Weston Geophysical Corporation 1996).

The epicenter of one of the largest earthquakes in the eastern United States (the Sharpsburg, Kentucky, earthquake of 1980) was about 25 mi (40 km) northeast of BGAD. The focus of this earthquake occurred at a depth of about 10 mi (16 km) and had a maximum Modified Mercalli Intensity of VII in the epicentral region (Mauk et al. 1982). An earthquake of this intensity produces some damage to masonry and causes difficulty in standing. This earthquake was felt over an area of about 260,000 mi^2 (673,000 km^2). Four other earthquakes have been recorded within 50 mi (80 km) of the installation, all of which were smaller than the Sharpsburg, Kentucky, earthquake (U.S. Army et al. 1987).

The estimated peak ground acceleration at BGAD would be generated by an earthquake having an intensity equal to Modified Mercalli Intensity VIII (U.S. Army et al. 1987). Such an earthquake would produce an estimated peak ground acceleration of 0.18 G. It is assumed that the duration of this earthquake would be 15 seconds. An Intensity VIII earthquake would cause damage to masonry and some partial collapse of buildings.

A recent probabilistic analysis was performed for BGAD (Weston Geophysical Corporation 1996). According to this analysis, a seismic event resulting in a peak horizontal acceleration of more than 0.08 G would occur at BGAD once in 1,000 years. An event resulting in a peak horizontal acceleration of more than 0.2 G would occur once in 10,000 years, and an event resulting in a peak horizontal acceleration of more than 0.4 G would occur once in 100,000 years.

According to the nuclear power station seismic hazard curves for the eastern United States, BGAD is located in Seismic Probability Zone 1 (Staub 1991). Within this zone, minor earthquake damage can be expected to occur at least once in 500 years (or a 10% probability of occurring once in 50 years). It is estimated that the peak ground acceleration for this event would be 0.075 G.

7.10.1.3 Soils

Soil types at the BGAD can be grouped into four soil associations on the basis of shared characteristics (USDA 1973) (Table 7.10-1). Scattered throughout the installation are the Lowell-Faywood-Cynthiana, Beasley-Brassfield-Otway, Shelbyville-Mercer-Nicholson, and Lawrence-Mercer-Robertsville Associations. As shown in Figure 7.10-1, the soils present at Proposed Areas A and B are from the Shelbyville-Mercer-Nicholson and Lawrence-Mercer-Robertsville Associations. The engineering properties of these soils are variable and must be accounted for in the design of any facilities built in these areas. The soils within Proposed Areas A and B are largely undisturbed except along the courses of minor roadways.

TABLE 7.10-1 Soil Associations at BGAD

Association	Soil Type	Characteristics
Lowell-Faywood-Cynthiana	Limestone residuum soil: mainly silt loam over clayey subsoil, underlain by limestone	Deep and well-drained Moderate permeability to 24 in. in depth; slow permeability below 24 in. Moderate to high water capacity Moderate to severe erosion hazard
Beasley-Brassfield-Otway	Limestone residuum soil: silty to loamy subsoil, underlain by marl	Deep and well-drained Moderate to slow permeability Low to high water capacity Moderate to severe erosion hazard
Shelbyville-Mercer-Nicholson	Limestone and siltstone residuum soil: silt loam, in some locations underlain by fragipan	Deep and moderately well-drained to well-drained Moderate to slow permeability Moderate to high water capacity Insignificant to high erosion hazard
Lawrence-Mercer-Robertsville	Limestone, alluvium, or colluvium residuum soil: silt loam, in some locations underlain by fragipan	Poorly to moderately well-drained Low to moderate water capacity Slow permeability Insignificant to moderate erosion hazard

Source: USDA (1973).

7.10.2 Site-Specific Factors

Because the proposed action would entail only shallow excavation and require only standard building materials, it would not have impacts on geologic resources at or in the vicinity of BGAD. However, it could have impacts on the soils at BGAD as a result of excavation, erosion, or accidental spills or releases of a variety of hazardous materials, including chemical agents. These potential impacts are discussed in the following sections on impacts of the proposed action. Potential impacts on soils associated with a major accident resulting in catastrophic releases of agent are discussed in Section 7.21.

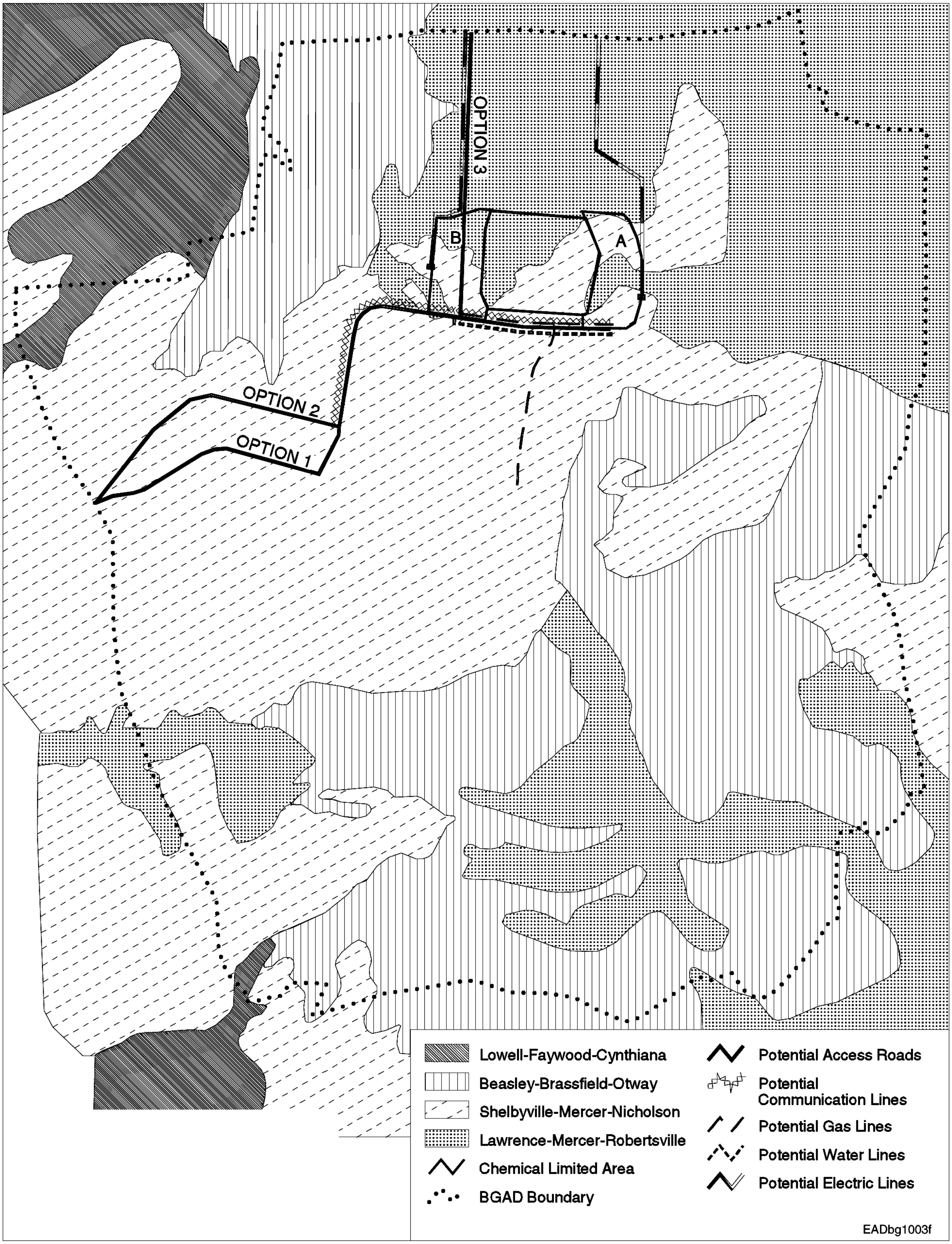

FIGURE 7.10-1 Soil Types at BGAD

7.10.3 Impacts of the Proposed Action

7.10.3.1 Impacts of Construction

Approximately 25 acres (10 ha) of ground could be affected to some degree from construction of the pilot facilities, wastewater treatment plant, and new substations in either Proposed Area A or Proposed Area B (Table 7.3-1). As much as an additional 70 acres (28 ha) of ground could also be disturbed from development of the site infrastructure (e.g., installation of an electric transmission line, communications cables, gas and water pipelines, parking lots, and access roads) for either site. Soil disturbance could result in an increased potential for erosion, which could affect surface water bodies and biological resources. Best management practices (e.g., use of soil fences, berms, and liners; revegetation of disturbed land following construction) would be employed to minimize the potential for soil erosion.

In addition, soils could be affected during construction of a pilot facility if there were an accidental spill or release of a hazardous material. Such accidents would be limited primarily to spills of hazardous materials (e.g., paints, solvents) being transported to the site and used during construction and to leaks of petroleum-based products (e.g., fuel, hydraulic fluid) from construction vehicles. In such an event, actions would be taken to contain the spill or leak to limit its migration. Any contaminated soils would be excavated and disposed of in accordance with applicable requirements.

7.10.3.2 Impacts of Operations

Impacts on soils could result from the operation of a pilot facility if there were an accidental spill or release of a hazardous material. Such accidents could involve spills of any chemical transported to and used in the ACWA pilot facility, spills of chemical agent during transport of an ACW from the storage bunker to the pilot facility, and leaks of petroleum-based products from vehicles. In such an event, actions would be taken to contain the spill or leak to limit its migration. Any contaminated soils would be excavated and disposed of in accordance with the applicable requirements.

Although operations would result in air emissions of a variety of contaminants, the concentrations of these contaminants would be so low (see Sections 7.5 and 7.6) that they would not have a significant impact on surface soils.

7.10.4 Impacts of No Action

Under the no action alternative for BGAD, which is defined as continued storage of ACWs, potential impacts on soils would be limited primarily to leaks of petroleum-based products from vehicles. Releases of other hazardous materials, including chemical agent, would be very unlikely, given the contained nature of stockpile maintenance activities. Impacts associated with future destruction of the ACWs stored at BGAD are discussed as part of the cumulative impact assessment (see Section 7.22.9).

7.11 GROUNDWATER

7.11.1 Current Environment

Groundwater resources are not used at BGAD. The near-surface alluvium layers are not a productive groundwater aquifer because they are too thin. The bedrock layers are also limited groundwater resources.

An important groundwater feature in the region is the possible presence of karstification. Karst features result from the dissolution of carbonate bedrock (limestone and dolomite) and may include caverns, sinkholes, springs, and disappearing streams. Conduit flow (flow in open underground channels) may be present in the groundwater of mature karst zones, and such discrete flow features have a strong control over the flow of groundwater.

At BGAD, the shale-rich Drakes Formation is the predominant uppermost bedrock unit (URS 2000). Observed discharge is at springs or seeps located at the soil/bedrock contact, suggesting that flow within the Drakes Formation is predominantly diffuse flow through the soil and weathered zone rather than conduit flow through dissolution-enlarged pathways (URS 2000). In limited areas of the BGAD, the Ashlock Formation is the uppermost bedrock, and minor karst features are observed.

In the vicinity of Proposed Areas A and B, the Drakes Formation is at the surface. In reconnaissance and field surveys of this portion of BGAD, URS did not discover karst features (URS 2000). The nearest mapped springs are about 1,000 ft (300 m) east of the eastern candidate site, where groundwater discharges into an unnamed tributary of Big Muddy Creek (URS 2000). The existence or future development of karst features on the proposed sites is uncertain. However, mapping by Greene (1968) shows two small water-filled depressions in Proposed Area A. These may be small sinkholes and could therefore represent a potential engineering hazard for any construction activities at the site.

Infiltration of precipitation is fairly low due to the fine-grained residuum soil at BGAD. Springs at BGAD have been observed to be dry during dry periods (URS 2000).

The uplands that dominate the site are described by Hall and Palmquist (1960) as areas where wells will not produce enough water for a dependable domestic supply of 100 gal/d. Water is generally hard and may contain salt or hydrogen sulfide at depths greater than 100 ft (30 m). In low areas along major drainages, wells at depths of less than 100 ft (30 m) will produce 100–500 gal/d. The water in these zones is hard to very hard and may contain salt or hydrogen sulfide, especially at depths greater than 100 ft (30 m). Wells installed in karstified portions of the Ashlock Formation may yield more than 500 gal/d.

Water levels in local aquifers fluctuate considerably as a result of variation in hydrologic factors such as precipitation, transpiration, pumping, and river stage changes (Palmquist and Hall 1961). Insufficient data are available to describe groundwater flow directions and aquifer parameters in the vicinity of the proposed ACWA pilot test facility locations.

A groundwater conceptual model is being developed. Phase I has been completed and reviewed by KDEP. Phase II is underway (URS 2000).

Quarterly groundwater samples were collected from monitoring wells at various BGAD facilities from 1997 to 1999 (IT Corp. 2000). Annual sampling began in FY 2000. The monitored facilities closest to Proposed Areas A and B are the New Landfill, which is about 3,000 ft (1,000 m) east of the eastern site, and the Old TNT Washout Lagoons, which are about 4,000 ft (1,200 m) south of the proposed sites. Samples from the New Landfill were analyzed for VOCs, semivolatile organic compounds (SVOCs), pesticides/PCBs, total metals, dissolved metals, cyanide, and chloride/sulfate. Sampling at 11 wells was planned; however, two of them were dry, and three others yielded insufficient volume for completing all analyses. The results indicated five VOCs present in one of the wells, one SVOC in one well, one pesticide in one well, and arsenic in one well. Samples from the Old TNT Lagoons were analyzed for explosives, total metals, and dissolved metals. Twelve wells were scheduled for sampling, but four were dry. At two other wells, insufficient volume prevented metals analyses. Explosives were detected in three monitoring wells. Lead, arsenic, selenium, and silver were detected in total metals analyses in at least one well.

7.11.2 Site-Specific Factors

The need for groundwater resources would be essentially the same for all four ACWA technologies being considered because none of them would discharge any process wastewater and groundwater resources would not be used for water supply. Wastewater generation would be related to the number of workers, which would be essentially the same for all the technologies being considered.

The foreseeable impacts on groundwater would result from the generation of sanitary sewage. No process water would be released to the local environment, and no groundwater would be used for the water supply. During normal operations, estimated potable water use for an ACWA pilot facility would range from 300,000 to 6.4 million gal/yr (1,000 to 24,000 m^3/yr or 0.9 to 20 acre-ft/yr) (Table 7.3-1). Sanitary sewage generation would range from 400,000 to 7.5 million gal/yr (1,500 to 28,000 m^3/yr) (Table 7.4-4). These numbers are approximations; to be conservative, impacts were calculated on the basis of the assumption that water use would equal the larger wastewater generation estimate (i.e., 7.5 million gal/yr).

7.11.3 Impacts of the Proposed Action

7.11.3.1 Impacts of Construction

Construction-related impacts on groundwater would be none to negligible, and, if such impacts would occur, they would be expected to last for only a short time. During incident-free construction activities, no contamination of groundwater would be expected. Berms and other devices should be in place to restrict surface runoff from the construction site. If spills or leaks would occur, procedures should be in place to quickly remove contaminants before they could be transported to existing groundwater resources.

7.11.3.2 Impacts of Operations

Normal operations would not result in any releases that might affect groundwater resources. There would be a slight increase in flow due to releases from the domestic sewage treatment plant, but the increased flow would not affect groundwater resources. Impacts on groundwater resources would be negligible.

7.11.4 Impacts of No Action

Continued storage of chemical weapons at BGAD would not adversely affect groundwater. Controls are in place to minimize soil erosion, although some erosion would be expected to occur in areas that are kept clear of vegetation for security purposes and in dirt roadways within the storage block. Facilities to handle sanitary waste exist, and procedures are in place to preclude chemical spills and address the spills if they would occur.

7.12 SURFACE WATER

BGAD is within the Kentucky River watershed. Portions of the Green and Cumberland River Basins are within a 50-mi (80-km) radius of BGAD (U.S. Army 1988). The surface water quality in the area is generally good, though there is some degradation in the basin from both point-source and non-point-source pollutants such as agricultural and urban runoff and from municipal and industrial discharges (U.S. Army 1988).

7.12.1 Current Environment

At its closest point in a relatively deep valley, the Kentucky River flows within about 5 mi (8 km) of BGAD (Figure 7.1-1). In this area, a series of locks and dams regulate the flow of the river. U.S. Geological Survey (USGS) Gage Number 03284000 is located at Lock and Dam Number 10 near Boonesboro, north of BGAD. From 1982 through 1999, the average daily mean discharge was 5,600 ft^3/s (cfs), the peak daily mean discharge was 78,000 cfs, and the minimum daily mean discharge was 50 cfs (USGS 2000). BGAD is located above the 100-year flood plain for the Kentucky River.

Water supplies for Richmond, Lexington, and Frankfort, Kentucky, are located on the Kentucky River downstream of BGAD. Most of the potable water supply in Madison County is supplied by surface water.

There are three major lakes or impoundments on BGAD (Figure 7.12-1). Lake Vega is a human-made, 135-acre (55-ha) impoundment located in the central portion of BGAD that has a capacity of about 600 million gal (2,270,000 m^3). Lake Buck and Lake Gem are located in the southwest corner of BGAD. They are not located in the Muddy Creek drainage, which would receive runoff from the proposed ACWA sites. A number of smaller unnamed lakes and ponds also exist at BGAD. Lake Henron (located in the central portion of the facility), Area A Lake (southwest portion of the facility), and Area B Quarry Lake (southeast) are smaller named lakes on the facility.

Major off-post surface water bodies include Wilgreen Lake, located about 5 mi (8 km) west of BGAD, which is used for fishing and contact recreation. Herrington Lake is relatively large and located about 25 mi (40 km) west of BGAD. The Lexington Water Company Reservoir is located about 20 mi (32 km) northwest of BGAD. Neither Herrington Lake nor the Lexington Water Company Reservoir receives any direct runoff from the proposed ACWA sites.

Lake Reba is located near the headwaters of Otter Creek, which is next to the northwestern corner of BGAD. It receives drainage from two unnamed tributaries of Otter Creek and drains the northwest corner of BGAD. Lake Reba is a recreational water source and a source of irrigational water for the Gibson Bay Golf Course. Lake Reba is separate from the Muddy Creek drainage and will not receive drainage from the proposed ACWA sites (URS 2000).

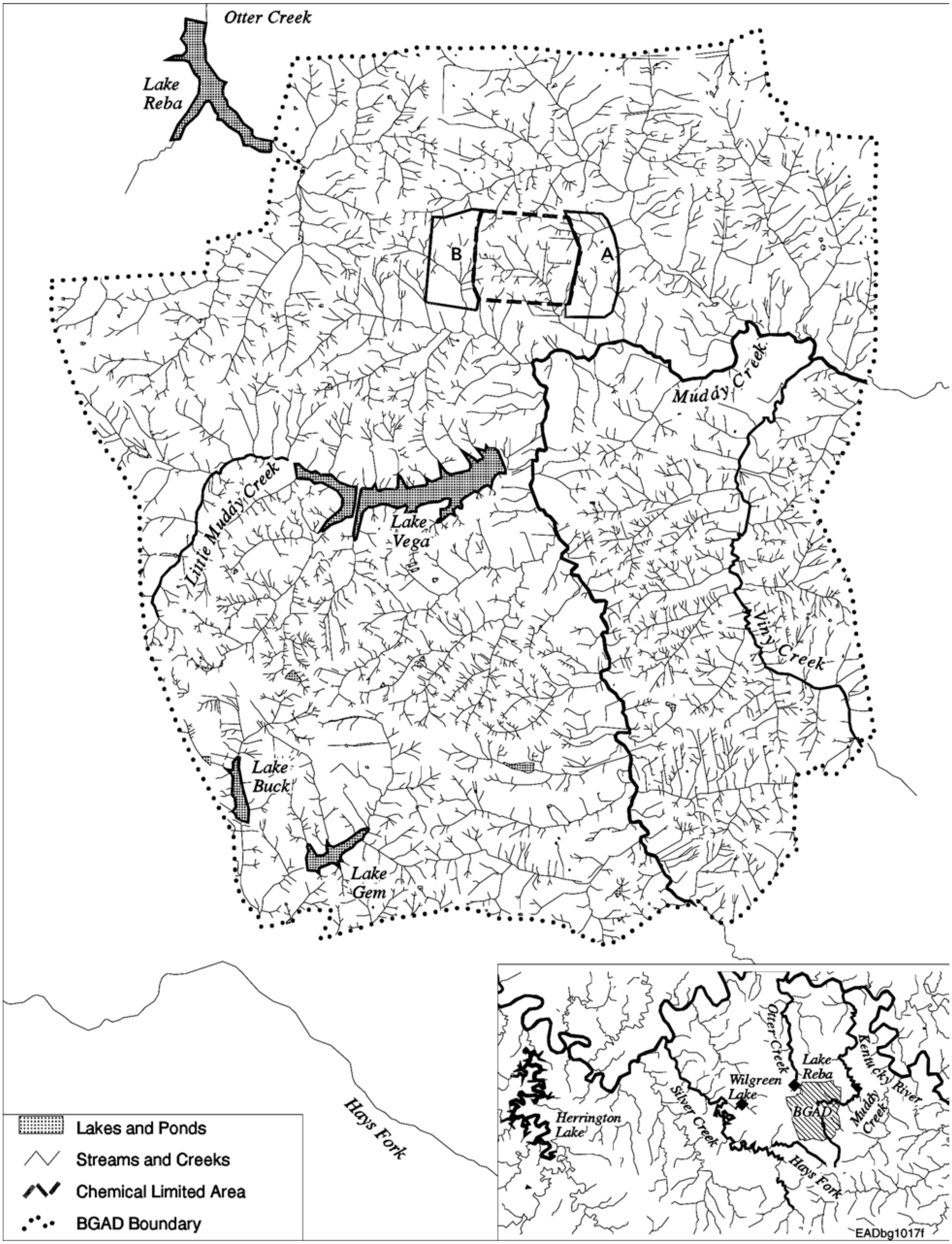

FIGURE 7.12-1 Surface Water Features at BGAD

The BGAD site is traversed by Muddy Creek and the Hays Fork of Silver Creek. All treated wastewater and surface drainage from BGAD leave the site via Muddy Creek, Hays Fork, and an unnamed tributary of Otter Creek, all of which drain into the Kentucky River (U.S. Army 1988). Muddy Creek carries the majority of the runoff.

The proposed ACWA pilot facility sites are bounded on all sides by small unnamed Muddy Creek tributaries. Any surface runoff from the site would enter Muddy Creek along with treated wastewater from the proposed sewage treatment plant. This water would eventually drain into the Kentucky River.

There are two existing sewage plants at BGAD. One discharges to an unnamed tributary of Hays Fork; the other discharges treated water into Muddy Creek. Both of these releases are governed by Kentucky Pollutant Discharge Elimination System (KPDES) Permit KY00270737. The sewage treatment facility that is required to support the proposed ACWA pilot facility would also operate according to a new permit. Treated effluent from the proposed water treatment plant would be discharged into the Muddy Creek drainage.

7.12.2 Site-Specific Factors

Impacts on water resources from water consumption would depend on the technology deployed. All the ACWA technologies being considered do not discharge process water to surface waters; the only outfall to surface waters would be treated domestic sewage. Sanitary sewage generation would range from 400,000 gal/yr for Neut/Bio to 7.5 million gal/yr for the other three technology systems (1,500 to 28,000 m^3/yr) depending on the technology (Table 7.4-4). Treated sanitary wastewater would be discharged to Muddy Creek via a new sewage treatment plant; alternatively, wastewater would be treated by the city of Richmond.

The foreseeable impacts on surface water resources would result from the use of potable water, process water, and water for fire control and from the release of sanitary sewage. No process water would be released to the local environment. During normal operations, estimated potable water use for an ACWA pilot facility would range from 300,000 to 6.4 million gal/yr (1,000 to 24,000 m^3/yr or 0.9 to 20 acre-ft/yr) (Table 7.3-1). During normal operations, estimated process water use for an ACWA pilot facility would range from 1 to 18 million gal/yr (3,800 to 68,000 m^3/yr or 3 to 55 acre-ft/yr). Total water use would range from 1.6 to 24.4 million gal/yr (6,100 to 92,000 m^3/yr).

7.12.3 Impacts of the Proposed Action

7.12.3.1 Impacts of Construction

Water use during construction would be 7 million gal (26,500 m^3 or 21.5 acre-ft) over approximately three years (approximately 7 acre-ft/yr) (Kimmell et al. 2001). This amount represents less than 0.9% of the capacity of the Lake Vega treatment plant and would have a negligible impact on surface waters. Construction activities would generate between about 4.5 and 5.6 million gal (17,000 and 21,000 m^3 or 13.8 and 17.0 acre-ft) of sanitary waste over the same period (Kimmell et al. 2001). This waste would be treated according to regulations and released. It would have a negligible impact on surface water.

Construction-related impacts on overland water flow would be negligible to minor. If impacts occurred, they would last for only a short time. During incident-free construction activities, no contamination of surface water would be expected. Standard precautions would be taken during equipment fueling and maintenance and other activities to prevent spills or leaks. Berms and other devices should be placed to restrict surface runoff from the construction site. If spills or leaks occurred, procedures should exist to quickly remove contaminants before they could be transported to existing surface water resources. Details of hydrologic design would be addressed during detailed site design.

There would be no impacts from construction on off-post surface water.

7.12.3.2 Impacts of Operations

ACWA pilot facility water demands would range from 1.0 to 18 million gal/yr (3,800 to 68,000 m^3/yr or 3 to 55 acre-ft/yr). This amount is approximately 0.4 to 7% of the capacity of the existing water treatment plant, which is 720,000 gal/d or 262.8 million gal/yr (995,000 m^3/yr or 800 acre-ft/yr). The largest estimated additional annual demand of 18 million gal/yr (68,000 m^3/yr or 55 acre-ft/yr) would be approximately 3% of the storage available in Lake Vega, which is 600 million gal (2.3 million m^3 or 1,800 acre-ft). This additional demand would not significantly affect Lake Vega or other surface water bodies.

Sewage would be treated to regulatory-required limits and discharged. The estimated sewage discharge of up to 7.5 million gal/yr (28,000 m^3/yr) or 21,000 gal/d or 0.03 cfs would be small when compared with surface water flows and would not significantly change flow conditions or water quality in the vicinity of the treatment plant.

Impacts from operations on on-post surface water would be negligible.

There would be no impacts on off-post surface water from normal operations. The estimated sewage discharge of 7.5 million gal/yr (28,000 m^3/yr) or 21,000 gal/d or 0.03 cfs would be small when compared with surface water flows and would not significantly change flow conditions.

7.12.4 Impacts of No Action

Continued storage of chemical weapons at BGAD would not adversely affect surface water. Controls are in place to minimize soil erosion, although some erosion would be expected to occur in areas kept clear of vegetation for security purposes and in dirt roadways within the storage block. Facilities exist to handle sanitary waste, and procedures are in place to preclude chemical spills and to address them if they do occur.

7.13 TERRESTRIAL HABITATS AND VEGETATION

7.13.1 Current Environment

Ecological information for BGAD is based largely on data presented in the integrated natural resources management plan (BGAD 2000b). Observations made during a team site visit in July 2000 also provided background information on BGAD and the proposed locations for an ACWA pilot test facility.

BGAD encompasses approximately 14,600 acres (5,900 ha), most of which is maintained as fescue-dominated pasture interspersed with shrubs and trees that are periodically mowed. Vegetation on most of the installation has been adversely affected by cattle grazing. Approximately 75% of forested areas have experienced some damage from cattle grazing and deer browsing (BGAD 2000b). BGAD and the immediate vicinity are within the Outer Blue Grass Subdivision, which is an area of high biodiversity. Eastern Kentucky vegetation is transitional in nature from grassland species to forest trees representative of the Cumberland Mountains.

Forest stands occur on roughly 2,900 acres (1,175 ha) of BGAD. Three general forest types can be distinguished on the basis of local topography and soil conditions: upland forest, riparian forest, and flatwood forest. In general, the forest types are characteristic of soil type, moisture, and aspect at BGAD. Well-drained upland locations include bluegrass mesophytic cane forest, bluegrass savanna woodland, and forests on calcareous soils. Riparian forests occur in bottomlands along Muddy Creek, Viny Creek, tributaries of Little Muddy Creek, and the headwaters of Otter Creek. Flatwood forest (bottomland hardwoods) occurs on poorly drained soils on the northern portion of BGAD. Table 7.13-1 provides a list of the dominant canopy trees

TABLE 7.13-1 Dominant Trees and Common Understory Plant Species of Forests at BGAD

	Dominant/Common Species	
Forest Type	Common Name	Scientific Name
Upland forest	Black walnut	*Juglans nigra*
	Ohio buckeye	*Aesculus glabra*
	Bur oak	*Quercus macrocarpa*
	Chinkapin oak	*Quercus muhlenbergii*
	Shumard oak	*Quercus shumardii*
	White oak	*Quercus alba*
	Pignut hickory	*Carya glabra*
	Shagbark hickory	*Carya ovata*
	Hackberry	*Celtis occidentalis*
	Honey locust	*Gleditsia triacanthos*
	Sugar maple	*Acer saccharum*
	White ash	*Fraxinus americana*
	Coralberry	*Symphoricarpos orbiculatus*
	Scorpion grass	*Microstegium vimineum*
Riparian forest	American elm	*Ulmus americana*
	Green ash	*Fraxinus pennsylvanica*
	Hackberry	*Celtis occidentalis*
	Boxelder	*Acer negundo*
	American sycamore	*Plantanus occidentalis*
	Wingstem	*Verbesina alternifolia*
	Crownbeard	*Verbesina occidentalis*
	Scorpion grass	*Microstegium vimineum*
Flatwood forest	Southern red oak	*Quercus falcata*
	Post oak	*Quercus stellata*
	Shingle oak	*Quercus imbricaria*
	Red maple	*Acer rubrum*

Source: BGAD (2000b).

and common understory species at BGAD. The major vegetative types occurring at BGAD are shown in Figure 7.13-1.

The ongoing forest management program is described in the integrated natural resources management plan and environmental assessment for BGAD (BGAD 2000b). Oak trees are planted to provide valuable food and cover for many wildlife species. Between 1968 and 1974, timber was harvested at BGAD. Forest management activities are designed to improve forest stand quality and wildlife habitat. They include reforestation, tree thinning, and timber stand

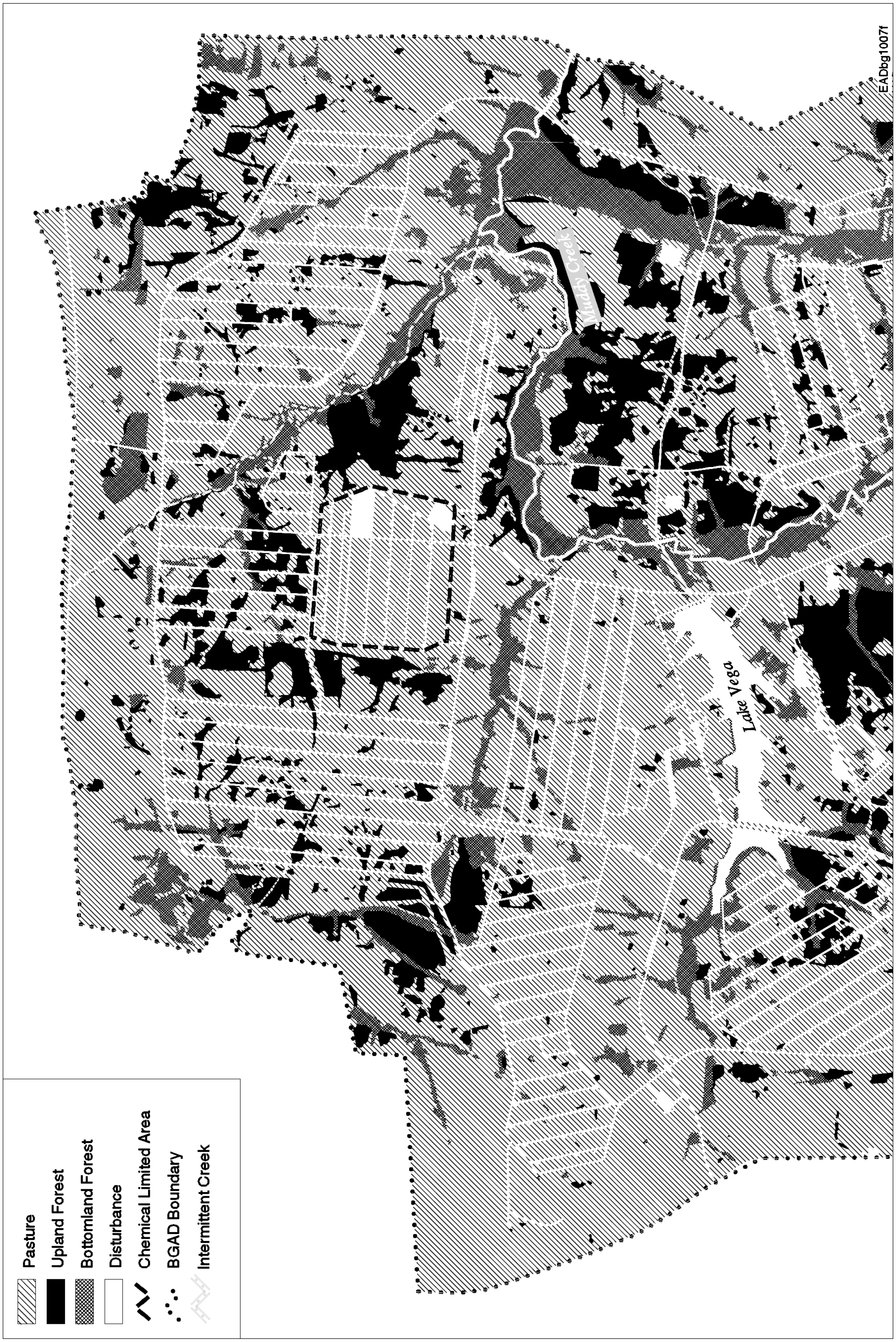

FIGURE 7.13-1 Vegetation at BGAD

improvement. Timber stand improvement involves the selective removal of certain trees and the enhancement of openings for tree regeneration, thus benefiting stand species composition and overall quality.

Prescribed burning is being used in grassland areas to maintain or improve the quality of warm-season grasses and prevent the invasion of undesirable species. Burning is planned as a tool to maintain prairie savanna habitat at BGAD (BGAD 2000b).

Ongoing surveys at BGAD have identified several natural areas that should be protected from further disturbance (BGAD 2000b). These areas vary in size from less than one acre to several hundred acres. They represent plant communities that are either rare in the Blue Grass Physiographic Region of Kentucky or are in a relatively undisturbed condition when compared with other similar areas in the region.

Vegetation in Proposed Area A located east of the Chemical Limited Area is composed of a mixture of grasses and forbs. A few American sycamore trees occur along the western perimeter of the area and along the southern end of the area. Upland forest occurs east and southeast of Proposed Area A, and forested wetlands are located immediately southeast of the area (see Figure 7.13-1). Upland forest is also present north of Proposed Area A and north of the Chemical Limited Area. Proposed Area B is grass-covered in the eastern portions and tree-covered in the western half. Upland forest covers the western portion of Proposed Area B. No quantitative data were available on vegetation or wildlife in either Proposed Area A or B.

7.13.2 Site-Specific Factors

It is expected that impacts from construction on vegetation would be the same regardless of the technology evaluated, given the similarity in space requirements, construction activities, and time requirements for constructing any of the pilot test facilities. Routine pilot testing during operations would generate emissions that would be deposited on vegetation downwind of the facility.

Factors associated with an ACWA pilot test facility that would affect vegetation would include construction activities, releases and spills, and accidents. These factors could occur during construction of the test facility complex itself and during the installation of utilities, communication cables, and other support areas (such as parking lots and material lay-down areas). The transportation of workers and building materials to the site would also be a factor during both construction and operations.

7.13.3 Impacts of the Proposed Action

The locations of the potential sites and utility corridors are described in Section 7.1.1, shown in Figure 7.3-1, and summarized in Table 7.3-2.

7.13.3.1 Impacts of Construction

The construction of an ACWA pilot test facility would disturb about 25 acres (10 ha) for the site complex and another 70 acres (28 ha) for the site infrastructure. The total area likely to be disturbed during construction is shown in Table 7.3-2.

The impacts from construction on vegetation would probably be the same for the four technology alternatives. The land requirements for the ACWA facilities and infrastructure requirements were assumed to be the same for all technologies.

If Proposed Area A were chosen as the preferred location, 25 acres (10 ha) of a fescue-dominated grassland community would be affected. A few shrubs and isolated trees would be cleared if the facilities were constructed along the eastern or southeastern portions of Proposed Area A. Proper design and placement of the 1.4-acre (0.6-ha) sedimentation pond would avoid impacts on vegetation from soil erosion and runoff during construction.

Construction at Proposed Area B would remove 25 acres (10 ha) of upland forest and grassland communities just beyond the west boundary of the Chemical Limited Area. Grassland vegetation would also have to be removed to allow for a 60-ft-wide (18-m-wide) access road that would extend from the north side of BGAD (see Figure 7.3-1). This road would disturb an area of about 7 acres (2.8 ha).

Some clearing or trimming of trees would be required to install the 69-kV transmission line along a right-of-way to either Proposed Area A or Proposed Area B. The installation of gas and water supply lines would likely disturb vegetation along road rights-of-way, but this vegetation would have already been disturbed during roadway construction. Grass cover along some rights-of-way near Proposed Areas A and B would continue to be maintained by periodic mowing.

7.13.3.2 Impacts of Operations

During routine operations, a portion of the materials released from the pilot facility stacks would be deposited on the soils surrounding the site. Deposition from atmospheric emissions would result in very low concentrations of trace metals and organic compounds. A soil screening-level ecological risk assessment was conducted to evaluate the potential impacts of air emissions expected from the four ACWA technologies. This assessment showed that impacts to ecological receptors would be unlikely (see Section 7.14.3.2).

7.13.4 Impacts of No Action

Continuing to store chemical agent at BGAD would not adversely affect plant communities in the Chemical Limited Area during normal maintenance and monitoring of the storage bunkers, vegetated areas, and cleared areas. Periodic mowing of vegetation between the bunkers has precluded establishment of shrub species. This type of vegetative control would likely continue in the future.

7.14 WILDLIFE

7.14.1 Current Environment

Wildlife habitat at BGAD has been adversely affected by livestock grazing. The diversity of ground nesting birds, amphibians, and reptiles is relatively low when BGAD habitat is compared with similar, undisturbed habitats of eastern Kentucky. The wildlife species that occur in grazed areas are those that are generally tolerant of disturbed areas (BGAD 2000b).

7.14.1.1 Amphibians and Reptiles

Many herpetofaunal species occur in the BGAD region because of the overlap of many northern, southern, and southeastern species that reach distributional limits in eastern Kentucky (Barbour 1971). No quantitative data have been collected on amphibians and reptiles at BGAD. Fifteen reptile and 20 amphibian species are known to occur on BGAD (BGAD 2000b). Amphibians of mesic, forested habitats include the Jefferson's salamander (*Ambystoma jeffersonianum*), marbled salamander (*A. opacum*), and spotted salamander (*A. maculatum*). Common frogs and toads include the Fowler's toad (*Bufo woodhousii fowleri*), green frog (*Rana clamitans*), bullfrog (*R. catesbeiana*), spring peeper (*Pseudacris crucifer*), upland chorus frog (*Pseudacris triseriata*), and cricket frog (*Acris crepitans*). Salamanders occurring in stream habitats and rock outcrops in riparian areas include the southern two-lined salamander (*Eurycea cirrgeria*), cave salamander (*E. lucifuga*), and longtail salamander (*E. longicauda*).

Reptiles of forested habitats at BGAD include the rough green snake (*Opheodrys aestivus*), black rat snake (*Elaphe o. obsoleta*), milk snake (*Lampropeltis triangulum*), and black kingsnake (*Lampropeltis getulus niger*). Aquatic habitats support four turtle species. The most common species are the common snapping turtle (*Chelydra serpentina*) and red-eared slider

(*Trachemys scripta elegans*). The eastern garter snake (*Thamnophis sirtalis*) and black racer (*Coluber constrictor*) are the most frequently observed snake species in grassland habitats and pastures at BGAD. Although not included in the species list for BGAD (BGAD 2000b), the timber rattlesnake (*Crotalus horridus*), northern copperhead (*Agkistrodon contortrix*), and several lizard species may occur in upland forest habitats at BGAD (BGAD 1984; Conant and Collins 1998).

7.14.1.2 Birds

Eastern Kentucky University researchers observed 170 bird species over several decades of monitoring at BGAD (BGAD 2000a). Numerous waterfowl, shorebird, and warbler species visit BGAD only during the spring and fall migration periods. A survey of nongame resident and migratory bird species conducted during 1993 and 1994 documented the presence of 52 species in a variety of habitats (Duguay and Elliott 1994). Bird species frequently observed in upland forests and forest edge habitat during the summer breeding season were the indigo bunting (*Passerina cyanea*), eastern wood pewee (*Contopus virens*), common grackle (*Quiscalus quiscula*), blue jay (*Cyanocitta cristata*), and common yellowthroat (*Geothlypis trichas*). The most common species found in bottomland hardwood forests included the blue jay (*Cyanocitta cristata*), northern cardinal (*Cardinalis cardinalis*), indigo bunting (*Passerina cyanea*), and common yellowthroat (*Geothlypis trichas*). The red-winged blackbird (*Agelaius phoeniceus*), eastern meadowlark (*Sturnella magna*), common yellowthroat (*Geothlypis trichas*), American robin (*Turdus migratorius*), field sparrow (*Spizella pusilla*), and European starling (*Sturnus vulgaris*) were the most frequently observed species in grassland/pasture habitats. Resident birds of prey at BGAD that hunt in grassland areas included the red-tailed hawk (*Buteo jamaicensis*), northern harrier (*Circus cyaneus*), and kestrel (*Falco sparverius*). Game species important in this region of Kentucky that were observed at BGAD included wild turkey (*Meleagris gallopavo*), northern bobwhite (*Colinus virginianus*), and mourning dove (*Zenaida macroura*) (BGAD 2000b).

7.14.1.3 Mammals

Terrestrial vertebrate surveys have documented the presence of 33 mammalian species at BGAD (Table 7.14-1). The most important game species on BGAD is the white-tailed deer. Deer populations vary between 700 and 800 individuals in any given year (BGAD 2000b) and are being maintained at that level by setting annual harvest limits for hunters. Both deer hunting and small game hunting are allowed on BGAD. Furbearers are not trapped or hunted on BGAD. Ongoing monitoring studies during the period of 1999–2004 will assist land management personnel in determining whether carrying capacities are being exceeded to the point of warranting the establishment of a trapping season.

TABLE 7.14-1 Mammalian Species Occurring at BGAD[a]

	Habitat[b]			
Species	Grass-land	Upland Forest	Bottomland Forest	Marsh
Eastern fox squirrel (*Sciurus niger*)		X	X	
Gray squirrel (*Sciurus carolinensis*)		X	X	
Southern flying squirrel (*Glaucomys volans*)		X	X	
White-tailed deer (*Odocoileus virginianus*)	X	X	X	
Raccoon (*Procyon lotor*)		X	X	
Red fox (*Vulpes vulpes*)	X	X		
Gray fox (*Urocyon cinereoargenteus*)		X		
Coyote (*Canis latrans*)	X			
Woodchuck (*Marmota monax*)	X	X		
Striped-skunk (*Mephitis mephitis*)	X	X	X	
Muskrat (*Ondatra zibethicus*)				X
Mink (*Mustela vison*)				X
Beaver (*Castor canadensis*)			X	X
Bobcat (*Lynx rufus*)		X	X	
Eastern chipmunk (*Tamias striatus*)		X	X	
Eastern cottontail (*Sylvilagus floridanus*)	X			
Opossum (*Didelphis virginiana*)		X	X	
Meadow vole (*Microtus pennsylvanicus*)	X			
Prairie vole (*Microtus ochrogaster*)	X			
Woodland vole (*Microtus pinetorum*)	X	X		
Southeastern shrew (*Sorex longirostris*)	X	X	X	
Short-tailed shrew (*Blarina carolinensis*)	X	X	X	
Least shrew (*Cryptotis parva*)	X			X
White-footed mouse (*Peromyscus leucopus*)		X	X	
House mouse (*Mus musculus*)	X	X		
Eastern harvest mouse (*Reithrodontomys humulis*)	X			
Meadow jumping mouse (*Zapus hudsonius*)	X		X	
Eastern mole (*Scalopus aquaticus*)	X			
Southern bog lemming (*Synaptomys cooperi*)	X		X	
Big brown bat (*Eptesicus fuscus*)		X	X	
Red bat (*Lasiurus borealis*)		X	X	
Northern long-eared bat (*Myotis septentrionalis*)		X	X	
Eastern pipistrelle (*Pipistrellus subflavus*)		X	X	

[a] BGAD (2000b).

[b] Brown (1997).

Common species found in forested habitats include the eastern chipmunk, eastern fox squirrel, gray squirrel, and raccoon. The meadow vole, prairie vole, and several shrew species are the most representative small mammals occurring in a variety of habitats. The eastern cottontail occurs in grasslands throughout BGAD. Muskrat, beaver, and mink occur in various wetlands throughout the installation.

7.14.2 Site-Specific Factors

It is expected that impacts from construction on wildlife would be the same regardless of the technology evaluated, given the similarity in space requirements, construction activities, and time requirements for constructing the pilot test facilities. Operational impacts on wildlife would be related to emissions from routine operations, noise, and the presence of the work force.

During construction, impacts on wildlife might result from clearing vegetation for an ACWA pilot test facility and associated infrastructure. Increased activity from the presence of workers and increases in vehicle traffic might also affect wildlife.

7.14.3 Impacts of the Proposed Action

7.14.3.1 Impacts of Construction

Loss of habitat, increased human activity in the Chemical Limited Area, increased traffic on local roads, and noise would be the most important factors that would affect wildlife species. The presence of construction crews and increased traffic would cause some wildlife species to avoid areas next to the construction site during the 30-month construction period. Wildlife inhabiting both Proposed Areas A and B rely on native shrubs and grasses for food, cover, and nesting and would be affected by vegetation clearing. Burrowing and less mobile species such as amphibians, some reptiles, and small mammals would be killed during vegetation clearing and other site preparation activities. The loss of grassland and forest habitat would displace small mammals and songbirds from the construction areas. The loss of about 95 acres (38 ha) of shrub, upland forest, and grassland habitat during construction in Proposed Area A would not be expected to eliminate any wildlife species from BGAD since similar habitat is relatively common near the Chemical Limited Area and elsewhere on the installation. Mammalian species that would be likely to be affected by loss of grassland and shrub habitat would include the meadow vole, the white-footed mouse, three shrew species, and the eastern cottontail.

The wildlife species that would be most affected by construction in Proposed Area B would be the mammals and birds that are typical of the upland forest, forest edge and shrub habitats at BGAD. Some impact on wildlife habitat might occur along an intermittent stream that traverses the southern portion of Proposed Area B. Species typical of riparian habitat at BGAD include the green frog, chorus frog, cricket frog, and the three salamander species that inhabit rock outcrops and rocky stream beds. The 69-kV transmission line should be built to span sensitive riparian habitats and highly erodible slopes, and construction vehicles should not be used in such areas whenever possible. The tributaries to Muddy Creek along the proposed transmission line and portions of Proposed Area B should not be disturbed to protect a relatively rich herbaceous layer (Bloom et al. 1995) in the floodplain riparian community that provides habitat for amphibians and reptiles.

Noise levels generated by construction equipment would be expected to range from 77 to 90 dBA at a proposed ACWA facility (see Section 7.8.3.1). Levels would diminish to background levels at the northern and northeast boundaries of BGAD. Published results from numerous studies indicate that small mammals might be adversely affected by the maximum noise levels produced by construction equipment (Manci et al. 1988; Luz and Smith 1976; Brattstrom and Bondello 1983). In Manci et al. (1988), an article on the effects of noise on wildlife and domestic animals, it is reported that sudden sonic booms of 80–90 dB startled seabirds, causing them to temporarily abandon nest locations. The startle response of birds to abrupt noise and continuous noise and ability to acclimate seems to vary with species (Manci et al. 1988). Some songbirds within about 330 ft (100 m) of construction equipment might abandon existing habitat because of episodic or continuous noise levels. Also, white-tailed deer and other larger mammals would not use areas near the ACWA site during construction because of noise and the presence of workers. No long-term impacts on the hearing ability of wildlife species would be expected from construction-generated noise.

Some unavoidable impacts on wildlife would occur as a result of increased vehicular traffic. Construction traffic along the new access road and existing roads from the west entrance of BGAD to Proposed Area B would increase the potential for roadkills for species such as the eastern cottontail, gray and eastern fox squirrels, opossum, and eastern chipmunk.

Birds of prey at BGAD would probably not be adversely affected by the loss of prey base that would be associated with the clearing of about 95 acres (38 ha) of vegetation, but they might not forage in areas next to construction sites because of increased human activity. Species such as the red-tailed hawk and kestrel might benefit from using the single wooden poles built for the transmission line as perch sites.

Electrocution of raptors from simultaneous wing contact with two conductors or a conductor and ground wire on a 69-kV transmission line would not be expected if appropriate design features were incorporated into the system. The red-tailed hawk, the largest raptor occurring at BGAD, has a maximum wing span of 54 in. (132 cm). If conductors were not properly shielded and if the wings of a red-tailed hawk made simultaneous contact with two conductors or with a conductor and ground wire as the bird attempted to land, it would be electrocuted. Electrocution could occur at a transmission pole regardless of whether a crossarm design or a single-pole design without a crossarm was used. Also, cases have been reported in which a single-pole structure was built to support 69-kV conductors, and raptors were electrocuted when they landed on an insulator and made simultaneous contact with a conductor and ground wire (Avian Power Line Interaction Committee 1996). To avoid raptor electrocution, suggested practices for raptor protection would be followed in designing the 69-kV transmission line (Avian Power Line Interaction Committee 1996).

7.14.3.2 Impacts of Operations

The impacts of routine operations on wildlife would be the same for the four technology alternatives. Operation of the test facility would increase human activity in the north central portion of BGAD. An increase in traffic along access roads from worker vehicles and periodic delivery of chemicals and other supplies would increase the number of roadkills of rodents and reptiles.

The maximum noise next to facilities would probably be 72 dBA and decrease to about 50 dBA at a distance of 1,000 ft (305 m). Anticipated noise levels of 55–60 dBA near the facility boundary would have only minor impacts on birds and mammals. Any abrupt noise levels would startle birds and might cause temporary nest abandonment. These levels would not be likely to interfere with the auditory function of birds and mammals next to the ACWA site.

A soil screening-level ecological risk assessment was conducted to illustrate potential impacts of air emissions for each of the four ACWA technologies being considered for pilot testing at BGAD. The overall approach for the risk assessment was the same as that used at PCD (see Section 6.13.3.2). Details of the risk assessment are provided elsewhere (Tsao 2001). Table 7.14-1 lists the number of chemicals evaluated from the air emissions for each ACWA technology and provides a list of chemicals that resulted in an HQ of >1. The only group of chemicals in stack emissions having an HQ of >1 was isomers of xylene.

TABLE 7.14-1 Chemical Emissions of Potential Concern Based on a Screening-Level Ecological Risk Assessment of Air Emissions from Routine Operation of an ACWA Pilot Facility at BGAD

Technology	No. of Chemicals Evaluated	Chemicals of Potential Concern from Stack Emissions[a]
Neut/Bio	64	Xylenes
Neut/SCWO	44	None
Neut/GPCR/TW-SCWO	72	None
Elchem Ox	51	None

[a] Chemical emitted for destruction of GB, VX, and mustard with an HQ of >1 based on 12-h/d, 6-d/wk operation.

Xylene isomers are the only toxic air pollutants that would be released during the normal operation of a BGAD ACWA pilot facility using Neut/Bio technology that would exceed the soil screening benchmark value (HQ = 6.3). Xylene would likely be dispersed over a large geographical region and would probably not be deposited on soil because of its volatility and low solubility in water. With a vapor pressure of 7.99 mm Hg and a melting point of −50°C, most xylenes would remain in a gaseous state and ultimately be degraded by hydroxyl radicals in the atmosphere. Because xylene would be released as a gas from the emission stacks, the primary route of exposure to agricultural and ecological receptors would be via inhalation. Inhalation toxicity studies on pregnant rats at exposures of 230, 1,900, or 3,360 mg/m^3 for 24 h/d during a 7- to 14-d period showed increased bone malformation to fetuses and increased fetal loss (Hazardous Substances Data Bank 2001). In addition, it is estimated that the release of xylenes (and other organics) from the emission stacks would amount to 1.1×10^{-5} mg/m^3, a minute fraction of the concentrations tested in these laboratory studies. On the basis of these studies and projected emissions of xylenes, it is highly unlikely that stack emissions from the Neut/Bio would adversely affect wildlife species at BGAD.

Although xylene would be likely to remain as a gas, some small amount would be deposited onto soil in liquid form through physical mixing with precipitation. Soil toxicity studies on xylene solution have demonstrated potential effects on vegetation and crops. A toxicity study on sugar beets indicated that the concentration that reduced the root lengths grown in solution was 100 mg/L. Xylene was also tested for effects on respiration of native soil microflora; no effects were found at the highest soil concentration of 1,000 mg/kg (Efroymson et al. 1997). During ACWA pilot testing, the highest soil concentration of xylene, up to 0.31 mg/kg, would be expected to occur in the northeast quadrant (Tsao 2001). This value is significantly lower than available toxicity testing results but higher than a soil benchmark value of 0.05 mg/kg (EPA 2001b).

Food-chain transfer via plants is unlikely. Using the most recent biouptake model developed by the EPA (modeled bioaccumulation factor is 0.11), researchers found that the potential for xylenes to bioaccumulate in terrestrial food chains is low. Additionally, the half-life of xylenes in air of 1–2 days (Hazardous Substances Data Bank 2001) suggests that xylene would be quickly degraded in the air by hydroxyl radicals; and if xylene was deposited onto soil, it would quickly lose its toxicity to soil microorganisms or plants. Use of a heating, ventilation, and air conditioning (HVAC) carbon/HEPA filter (see Appendix C) on the biotreatment vent would aid in reducing xylene emissions.

In conclusion, it is unlikely that stack emissions of xylenes would be present at concentrations that would be harmful to wildlife or cause soil contamination that would result in bioaccumulation in terrestrial biota at BGAD.

7.14.4 Impacts of No Action

No impacts on wildlife species would occur from continued storage of chemical weapons at BGAD. Maintaining the grass cover in the Chemical Limited Area would provide habitat for small mammals and birds that are typical in grassland communities of the Blue Grass Physiographic Province.

7.15 AQUATIC HABITATS AND FISH

7.15.1 Current Environment

The eastern region of Kentucky that encompasses a 30-mi (50-km) radius around BGAD is rich in surface water resources. Although natural lakes are relatively uncommon, several human-made impoundments are present within the project area. Rivers and streams in the project area provide habitat for several warm-water fish species that could be attractive to recreational anglers. Some cold-water streams in the project area provide cold-water fisheries. The most common gamefish in rivers and streams within the 30-mi (50-km) radius of BGAD are largemouth bass, walleye, sauger, rock bass, bluegill, sunfish, and catfish (Commonwealth of Kentucky, Department of Fish and Wildlife Resources 1983, 1996).

Twenty-four fish species are reported from four BGAD reservoirs and Muddy Creek located immediately outside BGAD (Bloom et al. 1995). Black bullhead, yellow bullhead, channel catfish, bluegill, red-ear sunfish, largemouth bass, and white crappie are known to occur in BGAD reservoirs from surveys conducted in 1992 and 1993 at BGAD (Bloom et al. 1995). The most common fish species in the three streams on BGAD are as follows: creek chub (*Semotilus atromaculatus*), bluntnose minnow (*Pimephales notatus*), central stoneroller (*Campostoma anomalum*), and striped shiner (*Luxilus chrysocephalus*) in Muddy Creek; creek chub, fathead minnow (*P. pomelas*), mosquitofish (*Gambusia affinis*), and green sunfish (*Lepomis cyanellus*) in Otter Creek tributaires; and bluegill (*L. machrochirus*), mosquitofish, bluntnose minnow, and central stoneroller in Silver Creek tributaries.

Three mussel species, four fingernail clam species, two snail species, and three crustacean (crayfish) species were detected in surveys of BGAD streams and areas around the reservoirs. Freshwater clams, snails, crayfish, and fish species occurring on BGAD are common in streams of the Kentucky River drainage and regionally in eastern Kentucky (Bloom et al. 1995).

7.15.2 Site-Specific Factors

It is expected that impacts from construction on aquatic habitats and fish would be the same regardless of the technology evaluated, given the similarity in space requirements, construction activities, and time requirements for constructing the pilot test facilities. Construction activities that would release sediments to on-post tributaries of streams could affect stream water quality and fish species. Any impacts from routine operations would be a result of emissions that were deposited in water bodies downwind of the pilot test facility.

7.15.3 Impacts of the Proposed Action

7.15.3.1 Impacts of Construction

Aquatic habitats and fish species would not be likely to be affected by construction activities. A sedimentation pond designed to control runoff from the ACWA facility would contain runoff during construction and eliminate potential impacts from sediment input to tributaries of Muddy Creek. Siltation fencing or other mechanical erosion control measures would be used during construction of water and gas pipelines and communication cables to control runoff at points where surface disturbance could affect aquatic habitats.

7.15.3.2 Impacts of Operations

Routine operations of an ACWA pilot test facility would not affect aquatic habitats and fish species at BGAD. No effluents from ACWA processes would be released to streams because all process liquids would be recycled. However, treated sanitary wastes would be discharged to Muddy Creek through a new sewage treatment plant or WWTP #1 or discharged to the city of Richmond wastewater treatment system. Such discharges would be within existing permit limitations, and no additional impacts on aquatic habitats or fish species would occur.

7.15.4 Impacts of No Action

No impacts on aquatic habitats or fish species would result from the continued storage of chemical weapons at BGAD.

7.16 PROTECTED SPECIES

7.16.1 Current Environment

The U.S. Fish and Wildlife Service (USFWS) has identified seven federal listed endangered species (Barclay 2000) as occurring within 30 mi (50 km) of BGAD (see Table 7.16-1): three mussel species, three bat species, and one plant species. Another endangered species, Kirtland's warbler (*Dendroica kirtlandii*), might visit the installation during migration between its wintering grounds in the Bahamas and its summer breeding area in Michigan. Five

TABLE 7.16-1 Federal Listed Threatened, Endangered, and Candidate Species Occurring within 30 Miles (50 Kilometers) of BGAD

Species	Status[a]
Mammals	
Gray bat (*Myotis grisescens)*	E
Indiana bat (*Myotis sodalis*)	E
Virginia big-eared bat (*Corynorhinus townsendii virginianus*)	E
Birds	
Kirtland's warbler (*Dendroica kirtlandii*)	E
Bald eagle (*Hilaeetus leucocephalus*)	T
Fish	
Blackside dace (*Phoxinus cumberlandensis*)	T
Mussels	
Cumberland bean (*Villosa trabalis*)	E
Cumberland elktoe (*Alasmidonta atropurpurea*)	E
Little-wing pearly mussel (*Pegias fabula*)	E
Fluted kidneyshell (*Ptychobranchus subtentum*)	C
Plants	
Running buffalo clover (*Trifolium stoloniferum*)	E
Virginia spirea (*Spiraea virginiana*)	T
Eggert's sunflower (*Helianthus eggertii*)	T
White-haired goldenrod (*Solidago albopilosai*)	T
Short's badderpod (*Lesquerella globosa*)	C
White fringeless orchid (*Plantathera integrilabia*)	C

[a] E = endangered, T = threatened, C = candidate.

Sources: Barclay (2001); USFWS (2001).

federal-listed threatened species and three candidate species for listing are also known to occur within this area. All federal-listed species are afforded protection under the *Endangered Species Act of 1974*.

Of the listed species, only the bald eagle (*Hilaeetus leucocephalus*) and running buffalo clover (*Trifolium stoloniferum*) are known to occur at BGAD. The bald eagle probably occurs only as a winter migrant, being attracted to Lake Vega and other water bodies on post and in the region. Researchers have identified 145 patches of running buffalo clover (RBC) on BGAD. Locations of known patches of RBC are shown in Figure 4 of Appendix E. The clover occurs most commonly on rich soils in open woodlands, savannas, floodplains, and mesic stream terraces on well-drained sites (BGAD 2000a). It typically grows on sites periodically disturbed by mowing, grazing, or trampling. A complete treatment of running buffalo clover is included in the biological assessment presented in Appendix E. Mist net surveys for bats at caves on BGAD and along Muddy Creek in 1993 failed to document the presence of any endangered bat species on BGAD (Bloom et al. 1995). No suitable riverine habitat occurs at BGAD to support any of the endangered mussel species.

The Commonwealth of Kentucky has not developed a list of state-protected endangered or threatened species. However, the Kentucky State Nature Preserves Commission (KSNPC), in conjunction with the Kentucky Natural Heritage Program (KYNHP), does maintain a database of species considered to be endangered, threatened, or of special concern on the basis of their rarity of occurrence or a lack of recent records documenting their occurrence (KSNPC 2001). A search on this database of the 20 counties located either totally or partially within a 30-mi (50-km) radius of BGAD showed that there are 65 endangered species, 77 threatened species, and 61 species of special concern. Also, 18 sensitive plant communities occur within this area. These communities typically occupy a limited area of habitat because of factors such as past human disturbance, topography, aspect, or soil conditions. Remnants of two sensitive plant communities, the bluegrass mesophytic cane forest and the calcareous mesophytic forest, occur on BGAD, as does a plant species of special concern, the spinulose wood fern (*Dryopteris carthusiana*).

7.16.2 Site-Specific Factors

It is expected that impacts from construction on protected species would be the same regardless of the technology evaluated, given the similarity in space requirements, construction activities, and time requirements for constructing the pilot test facilities. Impacts on protected species might result from the clearing of vegetation during construction of an ACWA pilot test facility and associated infrastructure. Increased human activity from the presence of the on-post work force during both construction and operations and increases in vehicular traffic might also affect federal and state protected or sensitive species.

7.16.3 Impacts of the Proposed Action

7.16.3.1 Impacts of Construction

Construction of an ACWA facility in either Proposed Area A or B could adversely affect RBC, a federal listed endangered species known to occur at 145 locations on BGAD. There is potential habitat for RBC near both proposed areas and along possible construction transportation routes, and, in fact, about 8–10 RBC patches are already known to occur there. Direct disturbance or loss of individual plants in patches along the proposed 69-kV transmission line could occur unless concerted efforts to protect them are made by conducting clearance surveys, marking patches that are discovered, and avoiding patches when placing towers and erecting conductors. A detailed evaluation of the impacts associated with the construction and operation of an ACWA facility is provided in the biological assessment for the project (see Appendix E). No other federal endangered species are known to inhabit or visit BGAD.

The bald eagle (*Haliaeetus leucocephalus*), a federal listed threatened species, has been observed as a winter visitor at BGAD. Construction activities and increased human presence could have a minor impact on individual bald eagles feeding on fish in Lake Vega, located about 0.8 mi (1.2 km) south of the Chemical Limited Area. This route would receive increased traffic during construction. At peak construction periods, eagles would be likely to abandon foraging areas in and around Lake Vega and move to other water bodies in the BGAD area.

7.16.3.2 Impacts of Operations

Routine operations of an ACWA pilot test facility would not affect federally protected species at BGAD. A detailed evaluation of the impacts associated with operation of an ACWA facility is provided in the biological assessment for the project (see Appendix E).

7.16.4 Impacts of No Action

No impacts on protected species would occur from continued storage of chemical weapons at BGAD. Ongoing surveys for RBC (*Trifolium stoloniferum*) at BGAD would identify any patches within the Chemical Limited Area. These patches would be marked with signs to prevent disturbance during mowing or other surface activity between the bunkers.

7.17 WETLANDS

7.17.1 Current Environment

One of the goals of the integrated natural resources management plan (BGAD 2000b) is to map the wetlands and compare their extent with national wetland inventory maps prepared by the USFWS. A wetland inventory of BGAD was conducted in 1999 and 2000 (USFWS 2001).

Wetlands on BGAD occur around streams and large surface water bodies. In general, they are scattered throughout the installation. Some of the intermittent streams support limited stands of emergent vegetation, including cattail, bullrush, sedges, and duckweed. Small tracts of forested wetlands are dominated by boxelder, American sycamore, and green ash in the canopy and by various sedges, forbs, and emergent aquatic vegetation (Libby 1995). A map showing wetlands identified on the USFWS National Wetland Inventory maps is included as Figure 7.17-1. East of Lake Vega and about 1 mi (2 km) south of the Chemical Limited Area at BGAD (BGAD 2000b), wetlands were created by a dam improvement project. It resulted in the establishment of semipermanently flooded, emergent, herbaceous vegetation. Wetlands also occur along a tributary to Big Muddy Creek located about 0.5 mi (1 km) south of Proposed Area A. Minor wetland areas occur along an intermittent drainage way located west and southwest of the Chemical Limited Area in Proposed Area B.

7.17.2 Site-Specific Factors

It is expected that impacts to wetlands resulting from construction activities would be the same regardless of the technology evaluated, given the similarity in space requirements, construction activities, and time requirements for constructing the pilot test facilities. Factors associated with an ACWA pilot test facility that would affect wetlands include construction activities, releases, and spills. These factors could occur during the construction of the proposed test facility on about 25 acres (10 ha) and during installation of the infrastructure and parking lots on an additional 70 acres (28 ha). The transportation of workers and building materials to the site and vehicle traffic during facility operations would also be factors.

7.17.3 Impacts of the Proposed Action

7.17.3.1 Impacts of Construction

Areas likely to be disturbed by construction of an ACWA pilot test facility and associated infrastructure were compared with known wetland locations identified in USFWS national

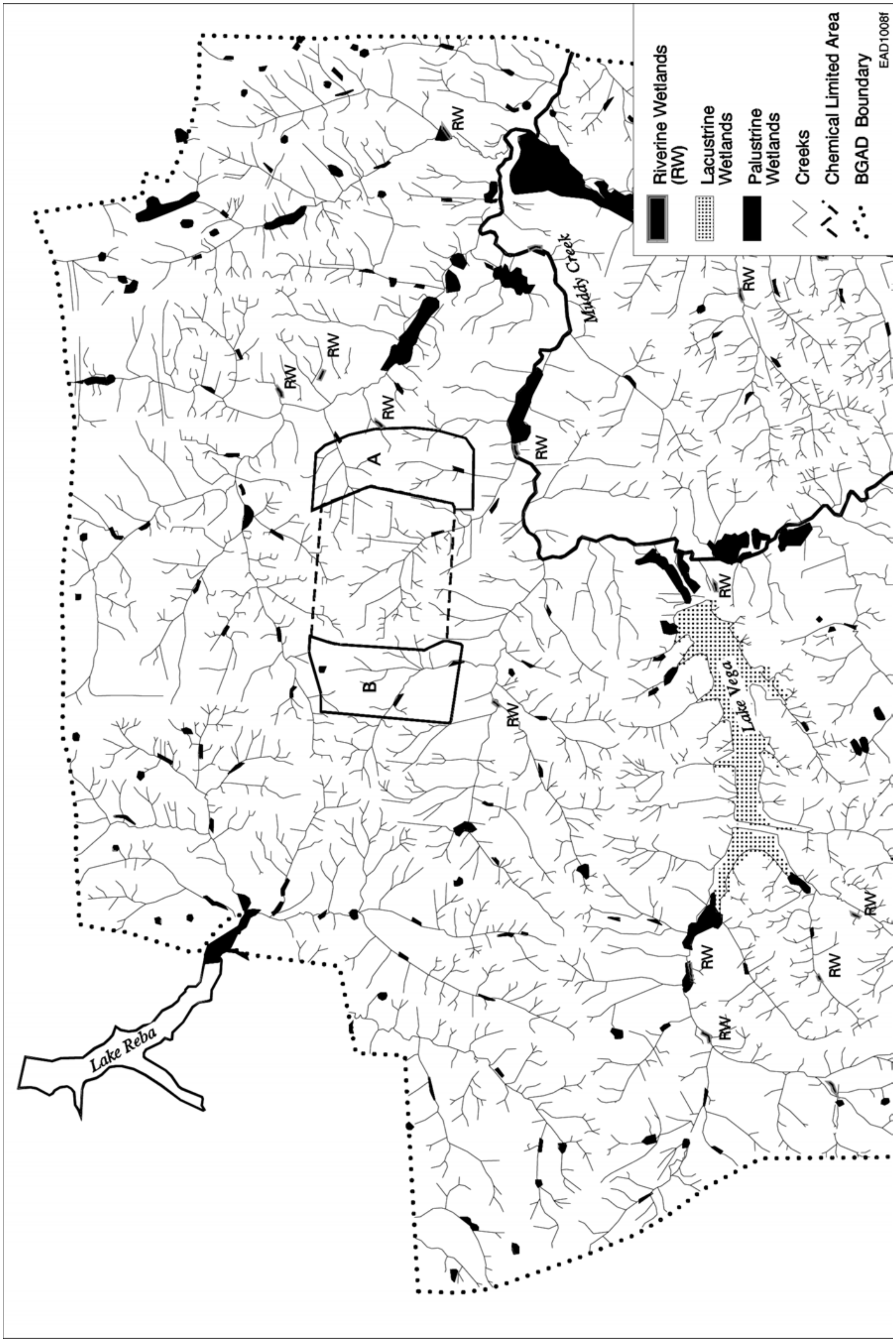

FIGURE 7.17-1 Wetlands at BGAD as Identified in U.S. Fish and Wildlife Service National Wetland Inventory Maps

wetland inventory maps. Potential impacts on wetlands were determined on the basis of this comparison and observations made during a site visit in June 2000. Figure 7.17-2 shows locations of wetlands and potential routes for access roads and gas, water, communications, and electric power lines. Construction of an ACWA pilot test facility could affect five small plaustrine wetlands (i.e., wetlands associated with intermittent and ephemeral streams) located in the project area. No wetlands would be directly affected by construction within the 25-acre (10 ha) site needed for pilot test facilities in Proposed Area A. Proposed Area B includes three small (less than 0.5 acre or 0.2 ha) wetlands that could be adversely affected by construction of the access road and pilot test facilities. Runoff from the construction sites would be directed to a sedimentation pond, thereby reducing the potential for impacts on wetlands located along tributaries to Muddy Creek.

There are three options for access roads to be used to deliver construction materials and workers. Some road widening would be needed if existing roads were selected as access roads. Option 2 would require new road construction for a distance of about 4,500 ft (1,400 m) north of the west entrance to BGAD before turning east and connecting with Route 2. A wetland of 1.5 to 2 acres (0.6 to 0.8 ha) in size located immediately north of Route 2 could be affected if road widening was necessary. The wetland area that would be affected cannot be determined until final road design plans are developed.

Fiber-optic communication cables would probably be buried by using a truck-mounted trenching device. A right-of-way up to 15 ft (5 m) wide would probably be added along previously disturbed road rights-of-way. Avoidance of wetlands should be possible by limiting cable placement to road rights-of-way and by using siltation fences or straw bales at sensitive areas next to wetland vegetation.

The poles for the 69-kV power line should be able to be placed to avoid disturbing three small wetlands east and northeast of Proposed Area A. Impacts of the power line on wetlands near Proposed Area A or Proposed Area B would be minimal if appropriate locations for poles and conductor strings were chosen prior to construction.

The following mitigation measures would reduce or eliminate construction-related impacts on wetlands:

- Routing of pipelines and power lines to avoid existing wetlands,
- Use of siltation fences or straw bales in areas where runoff is likely,
- Revegetation of disturbed areas as soon as possible after construction, and
- Proper design of a sedimentation pond on the 25-acre (10-ha) ACWA facility site.

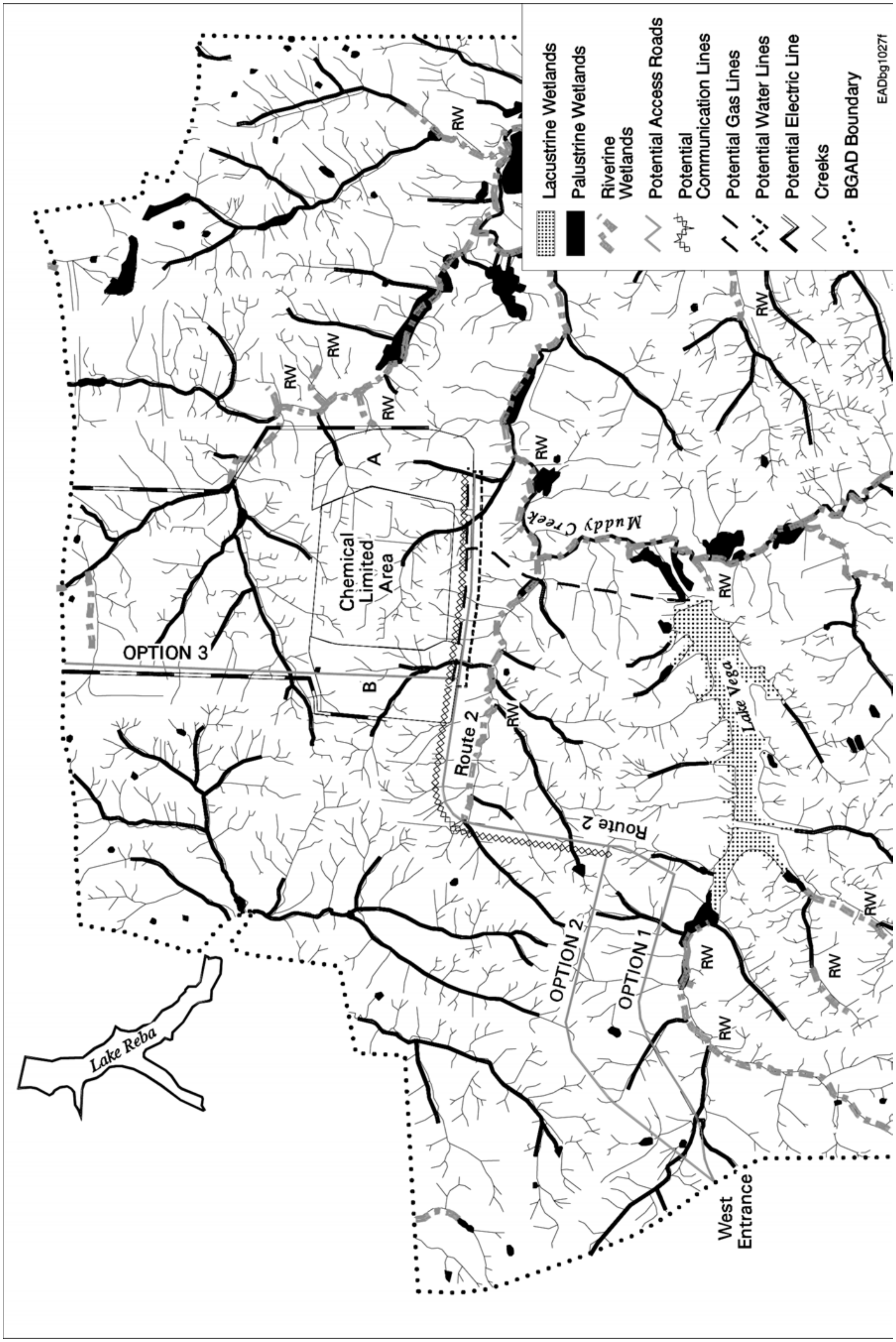

FIGURE 7.17-2 Wetlands and Potential Routes for Utility Corridors and Access Roads at BGAD

7.17.3.2 Impacts of Operations

The impacts of routine operations on wetlands would be the same for the four technology alternatives. Routine operations of an ACWA pilot test facility would not adversely affect wetlands. Some new wetland habitat could be created below the outfall from the sanitary waste treatment facility. Discharge from the facility would be approximately 7.5 million gal/yr (28,000 m^3/yr). Discharge flow rates would be less than 0.1 cfs but could result in continually wet substrate that would support the establishment of new wetland vegetation in an area of a few square feet below the outfall.

7.17.4 Impacts of No Action

No impacts on wetlands would occur from continued storage of ACWs at BGAD.

7.18 CULTURAL RESOURCES

7.18.1 Current Environment

7.18.1.1 Archaeological Resources

Of the two alternative facility locations (Proposed Areas A and B), only the southwestern portion of Proposed Area A was surveyed for archaeological resources (Geo-Marine, Inc. 1996) (Figure 7.18-1). No sites or isolated finds[9] were recorded during that survey (Ball 1983). However, in the vicinity of the project area, which includes the locations of proposed right-of-way corridors for access roads and utility lines, nine sites and three isolated finds were recorded. Eighteen historic site locations (e.g., farmsteads, cemeteries, schools) were also identified in or near the project area during a review of old atlas maps. Estill’s Station, the site of the “last reported battle between the settlers and Native Americans in the Kentucky River valley area,” may have been located just southwest of the Chemical Limited Area (Geo-Marine, Inc. 1996). In a pedestrian survey of an area north of the Chemical Limited Area by Geo-Marine, Inc., two sites (15Ma163 and 15Ma166) and one isolated find near the Option 3 access road corridor were recorded (Figures 7.18-1 and 7.3-1). Another site, 15Ma184, was recorded near a right-of-way for one of the proposed transmission lines. The eligibility of these archaeological sites for listing on the National Register of Historic Places has not yet been determined (Geo-Marine, Inc. 1996).

---

[9] An isolated find is defined as one stone tool, five or fewer pieces of lithic debris, a single historic artifact type (e.g., glass, ceramic), or a scatter of glass or ceramics where all the sherds appear to be from the same vessel.

FIGURE 7.18-1 Survyed Areas and Areas with a High Potential for Archaeological Sites at BGAD

Therefore, the sites must be treated as if they are eligible until their status has been evaluated and the Kentucky State Historic Preservation Officer (SHPO) has concurred with the evaluation results. (Refer to Appendix F for additional details on the cultural resource surveys, recorded sites, and prehistoric and historic context for BGAD.)

Because the remainder of Proposed Areas A and B has not been surveyed, an archaeological survey of these areas is required in order to accurately assess the potential for impacts on significant resources. The southern portion of Proposed Area B has been designated an area of high potential for containing archaeological resources (Geo-Marine, Inc.) (Figure 7.17-1).

7.18.1.2 Traditional Cultural Properties

A traditional cultural property is defined as a property "eligible for inclusion in the National Register because of its association with the cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community" (Parker 1995). No traditional cultural properties are known to occur within the proposed construction areas. Interested Native American governments have been consulted about the proposed action. Copies of the consultation letters and any responses received are presented in Appendix F.

7.18.1.3 Historic Structures

BGAD is considered historically significant because of its contributions during World War II as an important supply and storage depot for ammunition, combat and automotive parts and equipment, and, by 1944, chemical warfare ammunition. The storage igloos within the Chemical Limited Area have been recommended as potentially eligible historic structures (Geo-Marine, Inc. 1996). The igloos are used to store the weapons stockpile that will be removed during operation of the proposed pilot facilities.

7.18.2 Site-Specific Factors

Factors that need to be considered with regard to significant archaeological sites, traditional cultural properties, and historic structures under the ACWA program include these:

1. Destruction or disturbance of cultural resources could occur during construction activities.

2. Contamination of cultural resources could occur during an accidental chemical release or spill. This might lead to the establishment of temporary restrictions on access to the property or possibly to the destruction or disturbance of cultural resources if soils would need to be removed during cleanup.

3. Secondary impacts could be associated with the construction or operation of a proposed facility, such as these:

   a. Increased pedestrian or vehicular traffic in the area could increase the potential for inadvertent or intentional damage to cultural resources by casual passerbys or amateur collectors and/or

   b. Increased erosion potential as a result of construction activities could disturb archaeological sites next to the construction area.

7.18.3 Impacts of the Proposed Action

7.18.3.1 Impacts of Construction

Archaeological Resources. The areas east and west of the Chemical Limited Area, which are potential locations for ACWA pilot facilities, have not been fully surveyed for archaeological resources. Moreover, surveys have not been conducted along proposed utility and access road corridors or at other proposed areas of ground disturbance associated with an ACWA pilot facility. Archaeological surveys of the selected construction site, the selected utility and access road corridors, and other areas of ground disturbance are required before the start of any of the proposed activities. Upon completion of these surveys, the SHPO must concur with a determination of "no adverse effect" before construction can begin. If sites that are eligible for listing on the National Register of Historic Places are found, mitigation of the effects to those sites (e.g., avoidance, protection, data recovery), determined in consultation with the SHPO, must be completed before ground is disturbed.

A large section of Proposed Area A was surveyed, and no sites were recorded (Ball 1983). No impacts on archaeological resources would be expected within the surveyed portion of Proposed Area A. The northern and eastern portions of Area A and the northern portion of Proposed Area B have not been surveyed. For the most part, they have a low potential for containing significant archaeological sites; there are some small, scattered locations within Proposed Area A designated as having a high potential. Despite not being designated as areas with high potential, all undisturbed and unsurveyed areas of Proposed Areas A and B and locations for associated support facilities and utility corridors have some potential for containing archaeological resources. These areas must be surveyed in order to accurately assess the potential impacts of the proposed project. The southern half of Proposed Area B has a high potential for containing archaeological sites, so the potential for adverse effects on archaeological resources at BGAD is highest at this location (see Figure 7.17-2).

Because the locations for proposed utility corridors were chosen to try to follow existing rights-of-way, little impact on archaeological resources would be expected at these locations. However, if cultural material were unexpectedly encountered during ground-disturbing activities at previously disturbed or surveyed areas of the depot, construction would have to stop immediately, and the Kentucky SHPO and a qualified archaeologist would have to be consulted to evaluate the significance of the cultural artifacts.

Traditional Cultural Properties. No traditional cultural properties are known to occur within the proposed construction areas for the ACWA facilities; therefore, no impacts on traditional cultural properties are expected. However, interested Native American tribes have been consulted about the proposed action. Copies of the consultation letters and any responses received are presented in Appendix F.

Historic Structures. The structures within the chemical storage area at BGAD are potentially eligible as part of a BGAD historic district. None of these structures will be demolished or modified during construction of an ACWA pilot facility at BGAD. Therefore, no adverse impacts on these structures are anticipated.

7.18.3.2 Impacts of Operations

Archaeological Resources. Routine operation of a pilot facility would have no impact on eligible archaeological resources at BGAD. No known significant resources that could be affected by increased use of the area are located near the proposed ACWA facility locations, and no ground-disturbing activities would be involved in operating the facilities.

Traditional Cultural Properties. No traditional cultural properties are known to occur within the operational areas for the ACWA facilities; therefore, no impacts on traditional cultural properties would be expected. However, interested Native American tribes have been consulted about the proposed action. Copies of the consultation letters and any responses received are presented in Appendix F.

Historic Structures. The structures within the chemical storage area are potentially eligible to be part of a BGAD historic district. These structures are used to store the weapons stockpile from which munitions would be removed during operation of the proposed ACWA pilot facility. Routine removal of the munitions from these structures would not affect the integrity of the structures; therefore, no adverse effect from operations would be expected.

7.18.4 Impacts of No Action

7.18.4.1 Archaeological Resources

The no action alternative (i.e., continued storage of chemical weapons that might otherwise be destroyed by pilot testing) would not directly affect archaeological resources; no ground-disturbing activities are currently planned for the area should an ACWA facility not be constructed at BGAD. Archaeological resources might be affected in the event of an accident while munitions are in storage (see Section 7.21.2.8 and 7.21.3.8).

7.18.4.2 Traditional Cultural Properties

No known traditional cultural properties are known to occur within BGAD; therefore, the no action alternative would have no impact on such properties. Nearby resources might be affected in the event of an accident while munitions are in storage (see Sections 7.21.2.8 and 7.21.3.8).

7.18.4.3 Historic Structures

The no action alternative would not directly affect historic structures. Chemical munitions that might otherwise be removed and destroyed during pilot testing would continue to be stored in the designated structures. Such use is compatible with the history and the origin of the storage bunkers. These structures might be affected in the event of an accident while munitions are in storage (see Sections 7.21.2.7 and 7.21.3.5).

7.19 SOCIOECONOMICS

7.19.1 Current Environment

Socioeconomic data for BGAD describe a region of influence (ROI) surrounding the installation that is composed of five counties: Clark County, Estill County, Fayette County, Jackson County, and Madison County (Figure 7.19-1). The ROI is based on the current residential locations of government workers directly connected to BGAD activities and captures the area in which these workers spend their wages and salaries. Almost 80% of BGAD workers currently reside in these counties (Elliot 2001). The following sections present data on each of the counties in the ROI. However, since the majority of BGAD workers live in Madison County and in the city of Richmond, the majority of impacts from an ACWA facility would be expected to occur in these locations. Consequently, more emphasis is placed on describing these two areas.

7.19.1.1 Population

The population of the ROI in 2000 stood at 393,330 (U.S. Bureau of the Census 2001b), and it was expected to reach 399,000 by 2001 (Table 7.19-1). In 2000, 70,872 people (18% of the ROI total) resided in Madison County; 21,152 of Madison County's population lived in the city of Richmond and 9,851 lived in Berea. During the 1980s, each of the counties in the ROI experienced a small increase in population, with an ROI annual average growth rate of 0.8%. In Berea the growth rate was 0.6%, whereas Richmond experienced a decline in growth of –0.3%. Over the period 1990–2000, population in the ROI continued to grow slightly, at an annual average growth rate of 1.5%, while the annual rate for Richmond was 2.5% and that for Berea was 0.8%. Over the same period, the population in the state grew at an annual rate of 0.9%.

7.19.1.2 Employment

In 1999, total employment in Madison County stood at 25,430 (U.S. Bureau of the Census 2001b), and it was expected to reach 27,000 by 2001 (Allison 2001). The economy of the county is dominated by the trade and service industries, with employment in these activities contributing more than 55% to total employment in the county (see Table 7.19-2). The manufacturing sector provided 25% of all jobs in the county in 1999. Annual average employment growth in Madison County was 3.1% during the 1990s (U.S. Bureau of the Census 1992b, 2001).

FIGURE 7.19-1 BGAD Region of Influence

TABLE 7.19-1 Population in the BGAD Region of Influence and Kentucky in Selected Years

Location	1980[a]	1990[a]	Average Annual Growth Rate (%) 1980–1990	2000[b]	Average Annual Growth Rate (%) 1990–2000	2001[c] (Projected)
City of Richmond	21,708	21,155	–0.2	27,152	2.5	27,800
City of Berea[c]	8,602	9,126	0.5	9,851	0.8	9,930
Madison County	53,352	57,508	0.7	70,872	2.1	72,400
Clark County	28,322	29,496	0.4	33,144	1.2	33,500
Estill County	14,495	14,614	0.1	15,307	0.5	15,400
Fayette County	204,165	225,366	0.9	260,512	1.5	264,000
Jackson County	11,996	11,955	0.0	13,495	1.2	13,700
ROI total	313,330	338,939	0.7	393,330	1.5	399,000
Kentucky	3,660,324	3,685,296	0.1	4,041,769	0.9	4,080,000

[a] U.S. Bureau of the Census (1994).

[b] U.S. Bureau of the Census (2001b).

[c] Allison (2001).

TABLE 7.19-2 Employment in Madison County by Industry in 1999

Employment Sector	Number Employed	% of County Total
Agriculture	3,313[a]	13.0
Mining	60	0.2
Construction	813	3.2
Manufacturing	6,331	24.9
Transportation and public utilities	245	1.0
Trade	4,545	17.9
Finance, insurance, and real estate	660	2.6
Services	9,463	37.2
Total	25,430	

[a] 1997 data.

Sources: U.S. Bureau of the Census (2001a); USDA (1999).

In 1999, total employment in the ROI stood at 192,684 (U.S. Bureau of the Census 2001a), and it was expected to reach 200,000 by 2001 (Allison 2001). The economy of the ROI is dominated by the trade and service industries, with employment in these sectors currently contributing 66% to total employment in the ROI (see Table 7.19-3). The annual average employment growth rate in the ROI was almost 1.8% during the 1990s (U.S. Bureau of the Census 1992b, 2001a).

Employment at BGAD stands at approximately 400, including approximately 50 employees working at the BGCA. Since base realignment in the 1990s, a number of commercial and industrial tenants have occupied land and buildings formerly used by the military. Commercial and industrial activities employ approximately 300 civilians (Elliot 2001).

Unemployment in Richmond declined during the 1990s, from a peak annual rate of 9.0% in 1990 to the current rate of 4.9% (Table 7.19-4) (U.S. Bureau of Labor Statistics 2001). Unemployment in the ROI currently stands at 3.4%, compared with 4.7% for the state of Kentucky.

7.19.1.3 Personal Income

Personal income in Madison County stood at almost $1.4 billion in 1999 and was expected to reach $1.6 billion in 2001, based on an annual average rate of growth of 7.5% over

TABLE 7.19-3 Employment in the BGAD Region of Influence by Industry in 1999

Employment Sector	Number Employed	% of County Total
Agriculture	11,077[a]	5.7
Mining	286	0.1
Construction	11,133	5.8
Manufacturing	29,339	15.2
Transportation and public utilities	5,282	2.7
Trade	35,354	18.3
Finance, insurance, and real estate	9,327	4.8
Services	90,886	47.2
Total	192,684	

[a] 1997 data.

Sources: U.S. Bureau of the Census (2001a); USDA (1999).

TABLE 7.19-4 Unemployment Rates in Richmond, BGAD Region of Influence, and Kentucky

Location and Period	Rate (%)
Richmond	
1990–2000 average	5.9
2001 (current rate)	4.9
ROI	
1990–2000 average	3.5
2001 (current rate)	3.4
Kentucky	
1990–2000 average	5.6
2001 (current rate)	4.7

Source: U.S. Bureau of Labor Statistics (2001).

the period 1990–1999 (Table 7.19-5). Per capita income also rose in the 1990s and was expected to reach $22,500 in 2001, compared with $12,732 at the beginning of the period.

Growth rates in personal income were lower in the ROI than in Madison County. Total personal income grew at an annual rate of 6.7% over the period 1990–1999 and was expected to reach $11.8 billion by 2001. ROI per capita income was expected to rise from $17,095 in 1990 to $29,500 in 2001, representing an average annual growth rate of 5.1%.

7.19.1.4 Housing

Housing stock in Madison County grew at an annual rate of 3.3% over the period 1990–2000 (Table 7.19-6), with the total number of housing units expected to reach 30,600 in 2001. Housing growth in Richmond was slower, at 0.5% over the same period. More than 8,140 new units were added to the existing housing stock in Madison County during this period, with 575 of these constructed in Richmond. Vacancy rates currently stand at 8.3% in Madison County and 9.0% in Richmond for all types of housing. On the basis of annual average growth rates between 1990 and 2000, there would be 2,600 vacant housing units in Madison County in 2001, of which 1,180 would be rental units available to construction workers at the proposed facility.

TABLE 7.19-5 Personal Income in Madison County and BGAD Region of Influence

Location and Personal Income	1990[a]	1999[b]	Average Annual Growth Rate (%) 1990–1997	2001[ac] (Projected)
Madison County				
Total (millions of $)	732	1,408	7.5	1,630
Per capita ($)	12,732	20,286	5.3	22,500
Total ROI				
Total (millions of $)	5,794	10,348	6.7	11,800
Per capita ($)	17,095	26,705	5.1	29,500

[a] U.S. Bureau of the Census (1994).

[b] U.S. Department of Commerce (2001).

[c] Allison (2001).

Housing grew at a lower rate in the ROI than in Madison County during the 1990s; the overall annual growth rate was 2.0%. The total number of housing units was expected to reach 176,000 by 2001, with more than 30,800 housing units added in the 1990s. Vacancy rates currently stand at 7.3% for all types of housing, meaning that 6,200 vacant rental units would be available to construction workers at the proposed facility.

7.19.1.5 Community Resources

Community Fiscal Conditions. Construction and operation of the proposed facility might result in increased revenues and expenditures for local government jurisdictions, including counties, cities and school districts. Revenues would come primarily from state sales taxes, state and local income taxes, personal property taxes, and real estate taxes associated with employee spending during construction and operation. The money would be used to support additional local community services currently provided by each jurisdiction. Appendix G presents information on revenues and expenditures by the various local government jurisdictions in the ROI.

TABLE 7.19-6 Housing Characteristics in Richmond, Madison County, and BGAD Region of Influence

Location and Type of Housing	1990[a]	2000[b]	2001[c] (Projected)
City of Richmond			
Owner occupied	5,475	3,803	3,670
Rental	5,003	6,993	7,230
Total unoccupied units	804	1,062	1,090
Total units	11,282	11,857	11,900
Madison County			
Owner occupied	12,422	16,219	16,700
Rental	7,590	10,933	11,300
Total unoccupied units	1,444	2,443	2,570
Total units	21,456	29,595	30,600
ROI total			
Owner occupied	74,746	93,820	96,000
Rental	55,506	66,050	67,200
Total unoccupied units	11,339	12,530	12,700
Total units	141,591	172,400	176,000

[a] U.S. Bureau of the Census (1994).

[b] U.S. Bureau of the Census (2001b).

[c] Allison (2001)

Community Public Services. Construction and operation of the proposed facility would result in increased demand for community services in the counties, cities, and school districts likely to host relocating construction workers and operations employees. Additional demands would also be placed on local medical facilities and physician services. Table 7.19-7 presents data on employment and levels of service (number of employees per 1,000 population) for public safety and general local government services. Tables 7.19-8 and 7.19-9 provide staffing data for school districts and hospitals. Table 7.19-10 presents data on employment and levels of service for physicians.

7.19.1.6 Traffic

Vehicular access to BGAD is afforded from US 421/25, which runs south from Richmond toward Berea along the western perimeter of the installation. The entrance to the installation is located approximately 6 mi (10 km) from downtown Richmond. Other roads in the immediate vicinity of the BGAD used by employees working on the installation include US 52,

TABLE 7.19-7 Public Service Employment in Madison County, Richmond, Berea, and Kentucky

	Madison County[a]		Richmond[a]		Berea[a]		Kentucky[b]
Employment Category	Number Employed	Level of Service[c]	Number Employed	Level of Service[c]	Number Employed	Level of Service[c]	Level of Service[c]
Police protection	20[d]	0.6	57[f]	2.3	26[f]	2.7	1.7
Fire protection[e]	17[d]	0.5	52[g]	2.1	15[g]	1.6	0.7
General services	145[d]	4.5	104[h]	3.8	49[i]	5.0	32.1
Total	182	5.6	213	7.8	90	9.1	34.5

[a] Source of population data is U.S. Bureau of the Census (2001b).

[b] U.S. Bureau of the Census (2000).

[c] Level of service represents the number of employees per 1,000 persons in each jurisdiction.

[d] Baldwin (2000).

[e] Does not include volunteers.

[f] 1996 data in Madison County Rescue Squad (2000a).

[g] 1996 data in Madison County Rescue Squad (2000b).

[h] Fritz (2000).

[i] Moore (2000).

TABLE 7.19-8 School District Data for Madison County and Kentucky in 2000

	Madison County		Kentucky
Employment Category	Number Employed	Student to Teacher Ratio[a]	Student to Teacher Ratio[a]
Teachers	655	15.6	15.8

[a] Student to teacher ratio represents the number of students per teacher in each school district.

Source: Kentucky Department of Education (2000).

TABLE 7.19-9 Medical Facility Information for Madison County in 1999

Hospital	Number of Staffed Beds	Occupancy Rate (%)
Berea Hospital	138[b]	35[b]
Pattie A. Clay Hospital	115[b]	40[b]
County total	253	-

[a] Percent of staffed beds occupied.

[b] Data source, by permission: SMG Marketing Group, Inc.,© copyright 2001.

TABLE 7.19-10 Employment of Physicians in Madison County and Kentucky in 1997

	Madison County		Kentucky
Employment Category	Number Employed	Level of Service[a]	Level of Service[a]
Physicians	98	1.5	2.2

[a] Level of service represents the number of employees per 1,000 persons in each jurisdiction.

Sources: American Medical Association (1999); U.S. Bureau of the Census (2001b).

which runs in an easterly direction from Richmond toward Irvine along the northern perimeter of BGAD; SR 876, a bypass around Richmond; SR 374/499, which connects US 421 with US 52 around the southern and eastern perimeters of the installation; and Interstate (I) 75, which connects Berea and Richmond with Lexington to the north.

Table 7.19-11 shows average annual daily traffic flows over these road segments, together with designations for the congestion levels (level-of-service designations) developed by the Transportation Research Board (1985). The designations range from A to F; A through C represent good traffic operating conditions with some minor delays experienced by motorists, and F represents jammed roadway conditions. The ongoing land-use changes from farmland to residential and light industrial may create additional roadway congestion.

TABLE 7.19-11 Average Annual Daily Traffic (AADT) in the Vicinity of BGAD

Road Segment	Traffic Volume (AADT)	Level of Service[a]
US 421/25 at State Route (SR) 876	27,300	C
US 421/25 at Duncannon Lane	15,400	B
US 421 at Menelaus Road	8,050	B
US 52 between SR 876 and Reba Road	18,600	A
SR 876 between Porter Drive and US 52	23,600	C
SR 876 between US 25 and Boggs Lane	30,000	C
Interstate 75 between Exit 87 and Exit 90	50,000	A

[a] Allison (2001).

Source: Jackson (2000).

7.19.2 Site-Specific Factors

The socioeconomic analysis covers the effects on population, employment, income, housing, community resources, and traffic from the proposed and no action alternatives.

7.19.3 Impacts of the Proposed Action

This section presents the potential environmental impacts from constructing and operating an ACWA pilot test facility on socioeconomic factors. The socioeconomic analysis covers the impacts on population, employment, income, regional growth, housing, community resources, and transportation. Impacts of construction and operations are summarized in Table 7.19-12. The impacts of no action are provided as well for comparison.

7.19.3.1 Impacts of Construction

Neutralization/Biotreatment. The potential socioeconomic impacts from constructing a Neut/Bio facility at BGAD would be relatively small. Construction activities would create direct employment of about 570 people in the peak construction year and an additional 530 indirect jobs in the ROI. Total peak-year construction activities would increase the annual average employment growth rate by less than 0.1% over the duration of construction. A Neut/Bio facility would produce approximately $35 million of income in the peak year of construction.

TABLE 7.19-12 Effects of Construction, Operations, and No Action at BGAD on Socioeconomics[a,b]

Impact Category	Neut/Bio Construction	Neut/Bio Operation	Neut/SCWO Construction	Neut/SCWO Operation	Neut/GPCR/TW-SCWO Construction	Neut/GPCR/TW-SCWO Operation	Elchem Ox Construction	Elchem Ox Operation	No Action
Employment (number of jobs in ROI)[c]									
Direct	570	720	670	720	710	720	800	720	50
Indirect	530	570	510	610	550	560	610	600	40
Total	1,100	1,290	1,180	1,330	1,260	1,280	1,410	1,320	91
Income (millions of $ 2000 in ROI)									
Direct	20.2	34.7	23.1	34.7	24.3	34.7	27.4	34.7	3.0
Indirect	14.7	14.4	13.7	15.8	14.9	14.4	16.7	15.6	0.9
Total	34.9	49.1	36.8	50.5	39.2	49.1	44.1	50.3	3.9
Population (number of new residents in ROI)	310	680	490	720	570	680	740	710	0
Housing (number of units required in ROI)	110	250	180	260	210	250	270	260	0
Public finances (% impact on fiscal balance)									0
City of Richmond	<1	1	1	1	1	1	1	1	0
Madison County (excluding Richmond)	<1	<1	<1	<1	<1	<1	<1	<1	0
Madison County schools	<1	<1	<1	<1	<1	<1	<1	<1	0
Public service employment (number of new employees in Madison County)[d]									
Police officers	0	1	1	1	1	1	1	1	0
Firefighters	0	1	0	1	1	1	1	1	0
General	1	2	1	2	1	2	2	2	0
Teachers	2	4	3	4	3	4	4	4	0
Physicians	0	1	0	1	0	1	1	1	0
Number of new staffed hospital beds in Madison County	1	1	1	2	1	1	2	1	0
Traffic (impact on current levels of service in Madison County)	None	None	None	None	None	None	None	None	None

[a] Impacts are shown for the peak year of construction (2004) and the first year of operations (2009).

[b] The sum of individual row entries and column totals may not correspond because of independent rounding.

[c] Numbers represent FTEs.

[d] Includes impacts that would occur in the City of Richmond, Madison County, and the Madison County School District.

During construction, about 310 people would in-migrate to the ROI. However, in-migration would have only a marginal effect on population growth and would require only 2% of vacant rental housing in the peak year. No significant impact on public finances would occur as a result of in-migration, and fewer than 10 local public service employees would be required to maintain existing levels of service in the four local community jurisdictions in Madison County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding the installation.

Neutralization/SCWO. The potential socioeconomic impacts from constructing a Neut/SCWO facility at BGAD would be relatively small. Construction activities would create direct employment of approximately 670 people in the peak construction year and an additional 510 indirect jobs in the ROI. Total peak-year construction activities would increase the annual average employment growth rate by 0.1% over the duration of construction. Direct Neut/SCWO-related employment and related wages and salaries at BGAD would also produce about $37 million of income in the peak year of construction.

In the peak year of construction, about 490 people would in-migrate to the ROI, both as a result of SCWO employment on site and as a result of the overall growth in the ROI economy through the local procurement of materials and services and through employee spending. However, in-migration would have only a marginal effect on population growth and would require only 3% of vacant rental housing during the peak year. No significant impact on public finances would occur as a result of in-migration, and fewer than 10 local public service employees would be required to maintain existing levels of service in the four local community jurisdictions in Madison County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding the installation.

Neutralization/GPCR/TW-SCWO. The potential socioeconomic impacts from constructing a Neut/GPCR/TW-SCWO facility at BGAD would be relatively small. Construction activities would create direct employment of about 710 people in the peak construction year and an additional 550 indirect jobs in the ROI. Total peak-year construction activities would increase the annual average employment growth rate by 0.1% over the duration of construction. A Neut/GPCR/TW-SCWO facility would produce approximately $39 million of income in the peak year of construction.

During construction, about 570 people would in-migrate to the ROI. However, in-migration would have only a marginal effect on population growth and would require 3% of vacant rental housing in the peak year. No significant impact on public finances would occur as a result of in-migration, and 10 local public service employees would be required to maintain existing levels of service in the four local community jurisdictions in Madison County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding the installation.

Electrochemical Oxidation. The potential socioeconomic impacts from constructing an Elchem Ox facility at BGAD would be relatively small. Construction activities would create direct employment of about 800 people in the peak construction year and an additional 610 indirect jobs in the ROI. Total peak-year construction activities would increase the annual average employment growth rate by 0.1% over the duration of construction. An Elchem Ox facility would produce approximately $44 million of income in the peak year of construction.

During construction, about 740 people would in-migrate to the ROI. However, in-migration would have only a marginal effect on population growth and would require 4% of vacant rental housing in the peak year. No significant impact on public finances would occur as a result of in-migration, and less than 10 local public service employees would be required to maintain existing levels of service in the four local community jurisdictions in Madison County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding the installation.

7.19.3.2 Impacts of Operations

Neutralization/Biotreatment. The potential socioeconomic impacts from operating a Neut/Bio facility at BGAD would be relatively small. Operational activities would create about 720 direct jobs annually and an additional 570 indirect jobs in the ROI. A Neut/Bio facility would produce about $49 million annually during operations.

About 680 people would move to the area at the beginning of operations. However, in-migration would have only a marginal effect on population growth and would require 15% of vacant owner-occupied housing during facility operations. No significant impact on public finances would occur as a result of in-migration, and fewer than 10 local public service employees would be required to maintain existing levels of service in the four local community jurisdictions in Madison County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding the installation.

Neutralization/SCWO. The potential socioeconomic impacts from operating a Neut/SCWO facility at BGAD would be relatively small. Operational activities would create about 720 direct jobs annually and an additional 610 indirect jobs in the ROI. Direct Neut/SCWO-related employment and related wages and salaries at BGAD would also produce about $51 million annually during operations.

About 720 people would move to the area at the beginning of Neut/SCWO facility operation. However, in-migration would have only a marginal effect on population growth and would require 16% of vacant owner-occupied housing during facility operations. No significant impact on public finances would occur as a result of in-migration migration, and fewer than

10 local public service employees would be required to maintain existing levels of service in the four local community jurisdictions in Madison County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding the installation.

Neutralization/GPCR/TW-SCWO. The potential socioeconomic impacts from operating a Neut/GPCR/TW-SCWO facility at BGAD would be relatively small. Operational activities would create about 720 direct jobs annually and an additional 560 indirect jobs in the ROI. A Neut/GPCR/TW-SCWO facility would produce about $49 million annually during operations.

About 680 people would move to the area at the beginning of operations. However, in-migration would have only a marginal effect on population growth and would require 15% of vacant owner-occupied housing during facility operations. No significant impact on public finances would occur as a result of in-migration, and fewer than 10 new local public service employees would be required to maintain existing levels of service in the four local community jurisdictions in Madison County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding the installation.

Electrochemical Oxidation. The potential socioeconomic impacts from operating an Elchem Ox facility at BGAD would be relatively small. Operational activities would create about 720 direct jobs annually, and an additional 600 indirect jobs in the ROI. An Elchem Ox facility would produce about $50 million annually during operations.

About 710 people would move to the area at the beginning of operations. However, in-migration would have only a marginal effect on population growth and would require 16% of vacant owner-occupied housing during facility operations. No significant impact on public finances would occur as a result of in-migration, and fewer than 10 new local public service employees would be required to maintain existing levels of service in the four local community jurisdictions in Madison County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding the installation.

7.19.4 Impacts of No Action

The socioeconomic impacts of continuing current BGCA site activities would be relatively small. The BGCA directly employs approximately 50 workers. Wage and salary expenditures by BGCA employees on goods and services have created an additional 40 indirect jobs in the ROI (Table 7.19-12) and increased the annual average employment growth rate in the ROI by less than 0.1% over the period 1990–2000. BGCA-related wage and salary expenditures also created an estimated $4 million in annual income in the ROI.

7.20 ENVIRONMENTAL JUSTICE

On February 11, 1994, President Clinton issued Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations (*Volume 59, page 7629 of the *Federal Register* [59 FR 7629]). This order, along with its accompanying cover memo, calls on federal agencies to incorporate environmental justice as part of their missions. It directs them to address, as appropriate, disproportionately high and adverse human health or environmental effects of their actions, programs, or policies on minority and low-income populations. Sections 7.20.1 through 7.20.4 of this EIS address environmental justice issues for the populations defined below.

This EIS uses data from the two most recent decennial censuses (1990 and 2000) to evaluate environmental justice in the context of the ACWA at BGAD. The 2000 census provides detailed data on race and ethnicity necessary for a systematic definition of minority populations. Although more than a decade old, the 1990 census nevertheless provides the most recent data available on income, which enabled the identification of low-income populations. To remain consistent with these data sources, the EIS employs the following definitions for minority and low-income:

- *Minority* — Individuals who classify themselves as belonging to any of the following racial groups: Black (including Black or Negro, African American, Afro-American, Black Puerto Rican, Jamaican, Nigerian, West Indian, or Haitian); American Indian, Eskimo, or Aleut; Asian or Pacific Islander; or "Other Race" (U.S. Bureau of the Census 1991). For present purposes, individuals characterizing themselves as belonging to two or more races also are counted as minorities. This EIS also includes individuals identifying themselves as Hispanic in origin (technically an ethnic category) under minority. To avoid double-counting, tabulations included only White Hispanics; the above racial groups already account for non-White Hispanics.

- *Low-Income* — Individuals falling below the poverty line. For the 1990 census, the poverty line was defined by a statistical threshold based on a weighted average that considered both family size and the ages of individuals in a family. For example, the 1990 poverty threshold annual income for a family of five with two children younger than 18 years was $15,169, while the poverty threshold for a family of five with three children aged less than 18 years was $14,796 (U.S. Bureau of the Census 1992a). If a family fell below the poverty line for its particular composition, the census considered all individuals in that family to be below the poverty line. Low-income figures in the 1990 census reflect incomes in 1989, the most recent year for which entire annual incomes were known at the time of the census.

For this EIS, an analysis of minority and low-income populations was done by using census data for two demographic units: counties and block groups. A block group is a geographic unit consisting of a cluster of blocks that is used by the Census Bureau to present data (U.S. Bureau of the Census 1991). Block groups contain enough blocks to encompass about 250–550 housing units, with the ideal one containing about 400 housing units. Because housing density varies over space, the geographic sizes of block groups vary; smaller units tend to occur in denser areas, such as urban areas. This dual focus on counties and block groups enables the evaluation of environmental justice to remain consistent with the geographical focus of analyses in two issue areas where environmental justice is of particular concern: socioeconomics and human health. To maintain consistency with the socioeconomic analysis, the sections on current conditions and impacts under environmental justice consider Madison County to be the core county for BGAD. To maintain consistency with the human health analysis, the environmental justice section considers population characteristics in census block groups within a 30-mi (50-km) radius of BGAD. The block groups considered include all of Clark, Estill, Fayette, Garrard, Jackson, Jessamine, Lee, Madison, Powell, and Rockcastle Counties and parts of Burbon, Boyle, Laurel, Lincoln, Menifee, Mercer, Owsley, Pulaski, Wolfe, and Woodford Counties.

To identify disproportionate representations of either minority or low-income populations, this EIS uses the United States as a whole as a reference point, thereby providing an identical comparison for all four installations considered in this EIS. This choice of a reference point, which is central to environmental justice analyses, reflects the desire to comply with Executive Order 12898 and is consistent with the need to select a meaningful reference point for any given impact assessment (Council on Environmental Quality [CEQ] 1997; EPA 1998a). The 2000 census indicates that the United States contains 30.9% minority persons (U.S. Bureau of the Census 2001c), while the 1990 census indicated that 13.1% of persons for whom poverty status was known were considered low-income population in 1989 (U.S. Bureau of the Census 1992c).

7.20.1 Current Environment

Of the Madison County residents recorded in the 1990 census, 7.6% were minority (U.S. Bureau of the Census 2001c). This percentage was well below the minority percentage for the United States as a whole and hence not disproportionately high. The largest percentage of minority persons in Madison County (4.4% of the total population) was Black. The 1990 census recorded that 21.2% of the Madison County population were below the poverty level; this percentage was higher than the percentage for the United States as a whole and thus disproportionately high.

Of the 337 census block groups defined in the 2000 census partially or totally within a 30-mi (50-km) radius of BGAD, 36 contained minority populations in excess of the percentage of minority representation in the United States (Figure 7.20-1). These 36 block groups contained a total of 27,050 minority persons in 2000. Block groups with disproportionately high minority populations included the communities of Mount Sterling and Winchester, as well as several block groups throughout portions of the city of Lexington.

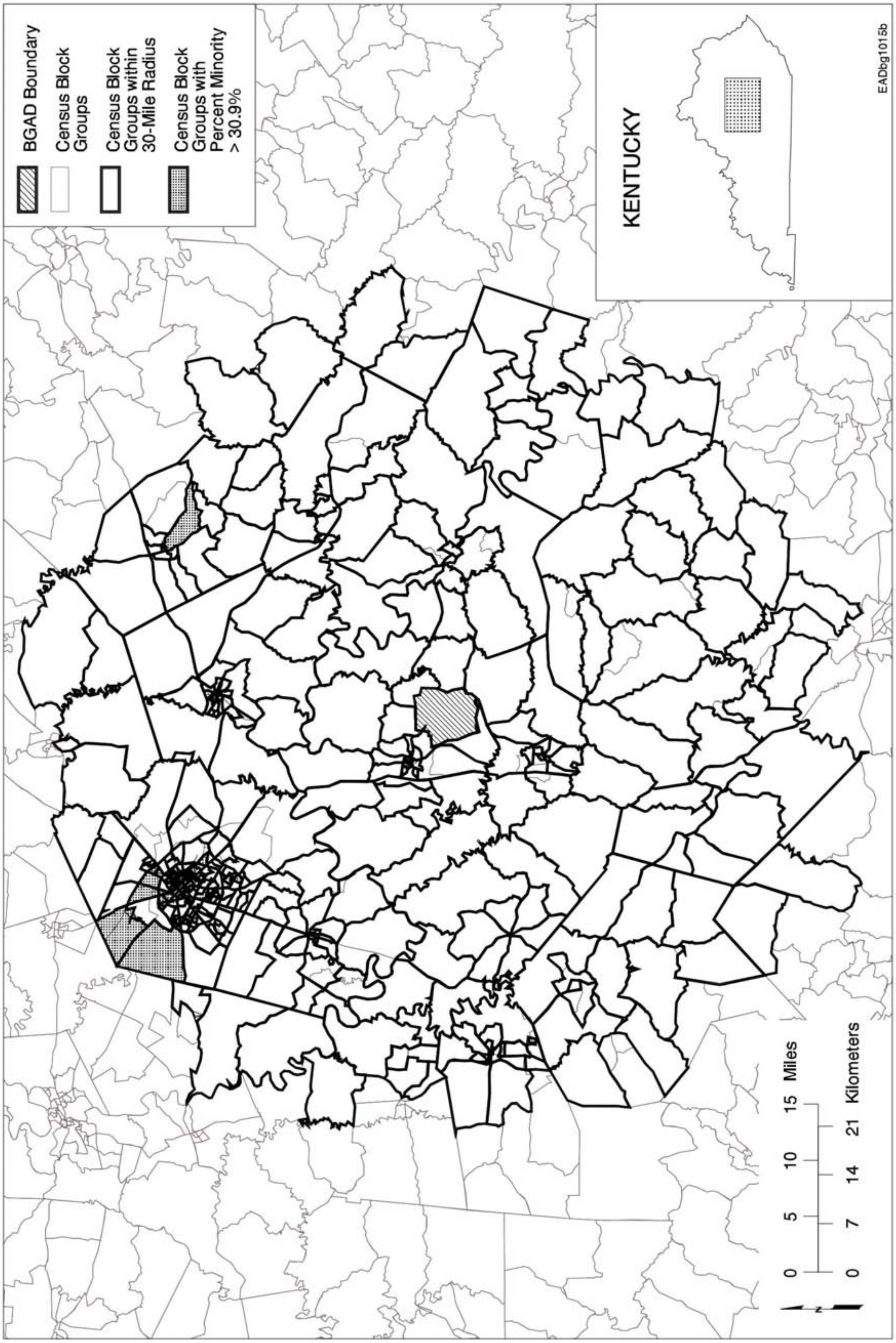

FIGURE 7.20-1 Census Block Groups within a 30-Mile (50-Kilometer) Radius of BGAD with Minority Populations Greater than the National Average in 2000 (Source: U.S. Bureau of the Census 2001d)

Two hundred fifty-seven of the 405 block groups that are defined in the 1990 census as lying partially or totally within a 30-mi (50-km) radius of BGAD contained low-income populations in excess of the 13.1% calculated for the United States as a whole (Figure 7.20-2). These block groups contained a total of 75,699 low-income persons in 1989. Block groups with a disproportionately high representation of low-income populations included the three communities discussed above as well as several others of varying size and proximity to the installation (Beattyville, Berea, Broadhead, Burgin, Camargo, Clay City, Crab Orchard, Danville, Irvine, Jeffersonville, Lancaster, Livingston, McKee, Mount Vernon, North Middletown, Ravenna, Richmond, Stanford, and Wilmore).

7.20.2 Site-Specific Factors

Factors considered in this EIS with potential implications for environmental justice are any activities associated with the ACWA program at BGAD. Included are impacts associated with construction, operations, and accidents. The evaluation of environmental justice consequences focuses on socioeconomic and human health impacts, two categories that directly affect all people, including minority and low-income populations.

To address Executive Order 12898, this analysis focuses on impacts that are both high and adverse and that disproportionately affect minority and low-income populations. Although it seems logical that certain characteristics of many environmental justice populations — such as having limited access to health care and reduced or inadequate nutrition — might make such populations disproportionately vulnerable to environmental impacts, there do not appear to be any scientific studies that support this contention for the types of impacts considered in this EIS. The absence of such information precludes any analysis that considers increased sensitivity of minority and low-income populations to impacts. To help compensate for this limitation, the analysis of human health impacts includes conservative assumptions and uncertainty factors to accommodate for potentially sensitive subpopulations (see Section 7.7.2.2). The present analysis considers that a disproportional effect could occur only if the proportion of a population is in excess of the proportion in the United States as a whole, as discussed above under existing conditions. Therefore, significant environmental justice impacts are those that would have a high and adverse impact on the population as a whole and that would affect areas (Madison County or census block groups within 30 mi [50 km] of BGAD) containing disproportionately high percentages of minority or low-income populations.

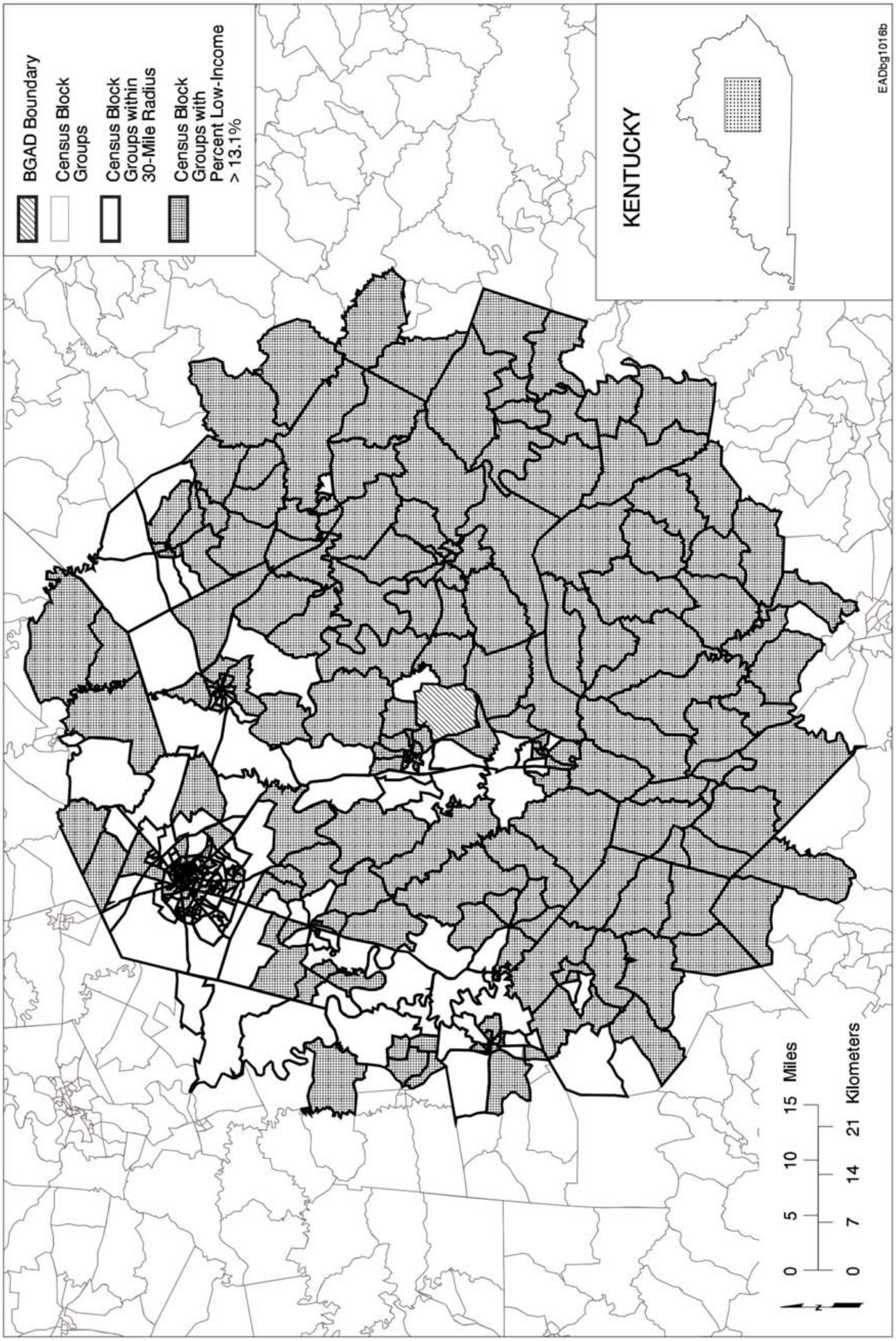

FIGURE 7.20-2 Census Block Groups within a 30-Mile (50-Kilometer) Radius of BGAD with Low-Income Popul.ations Greater than the National Average in 1989 (Source: U.S. Bureau of the Census 1992c)

7.20.3 Impacts of the Proposed Action

7.20.3.1 Impacts of Construction

The primary socioeconomic impacts from constructing any of the four alternative technologies, discussed in Section 7.19.3.1, would be increases in short-term employment and income. They would also include small increases in demand for local housing, schools, and public services. None of these impacts would be high or adverse; local governments and the existing housing stock should be able to accommodate increased demands, and the increased employment and income would be a positive consequence of construction. High and adverse impacts in other impact areas similarly would not be expected during construction of an ACWA facility at BGAD (see Section 7.7.2). As a result, no environmental justice impacts are anticipated from construction.

7.20.3.2 Impacts of Operations

The primary socioeconomic impacts from operating any of the four alternative technologies, discussed in Section 7.19.3.2, would be increases in employment and income. They would also include small increases in demand for local housing, schools, and public services. Once again, none of these impacts would be high or adverse; local governments and the existing housing stock should be able to accommodate increased demands, and the increased employment and income would be a positive consequence of construction. As a result, no environmental justice impacts are anticipated from operations.

As discussed in Section 7.7.3, occupational hazards to workers and releases of agents or other hazardous materials represent the main impacts that could occur during routine operations under the alternative technologies. However, the risk of a noncancer health effect and the risk of cancer from hazardous chemicals released during normal operations would be very low for both workers and the public. These impacts would not be high and adverse; as a consequence, no environmental justice impacts are anticipated from normal operations.

7.20.4 Impacts of No Action

As discussed in Section 7.19.4, socioeconomic impacts of continued operations at BGAD would be small: primarily a continuation of small, positive economic impacts and a slight increase in demand for housing, schooling, and public services. None of these impacts would be considered high and adverse. Similarly, high and adverse human health impacts on either the workers at BGAD or the general public are not anticipated (see Section 7.7.4). As a result, no environmental justice impacts are anticipated under the no action alternative.

7.21 ACCIDENTS INVOLVING ASSEMBLED CHEMICAL WEAPONS

7.21.1 Potential Accidental Releases

This analysis of accidents provides an estimate of the upper range of the potential impacts that might occur as a result of a hypothetical accident related to the proposed action (ACWA pilot testing) or related to the no action alternative (continued storage of the chemical weapons). The accidents selected for analysis were the accidents that were shown to have the highest risk in previous Army analyses (Science Applications International Corporation [SAIC] 1997). The highest-risk accidents are defined as those with the highest combined consequences (in terms of human fatalities) and probability of occurrence. For existing continued storage conditions and for operations, the highest-risk accidents would involve the release of chemical agent; release of other materials would result in lower consequences and risks. In general, the accidents considered in this EIS have a fairly low frequency of occurrence. The accident considered for continued storage (lightning strike into a storage igloo) has an estimated frequency on the order of 2×10^{-4} per year (i.e., one occurrence in 4,200 years). The accident considered for the pilot facilities (earthquake impacting the unpack area) has a somewhat lower estimated frequency of approximately 3×10^{-6} (i.e., one occurrence in 300,000 years).

7.21.1.1 Scenarios

The hypothetical highest-risk accident for ACWA pilot testing assumes that an earthquake would cause part of the unpack area where munitions are located to fall. The hypothetical highest-risk accident for continued storage assumes that lightning would strike a GB- or VX-rocket-containing igloo, and a fire and the release of agent from all the munitions in the igloo would follow. It is recognized that during operation of an ACWA pilot facility, the risk of a storage accident (as presented under the no action alternative in Section 7.21.3) is also present; however, in Section 7.21.2, the focus is on the consequences of accidents related to pilot testing in order to differentiate between facility risks and storage risks.

Impacts from accidents occurring during transport of agent from the storage igloos to the pilot testing facility were not assessed for this EIS, because the risks from these accidents would be less than those from the accidents included. Accident scenarios and probabilities from on-site transportation are discussed in a PEIS support document (GA Technologies 1987). However, potential accidents from handling munitions inside the igloos were considered. At BGAD, these accidents would not be the highest-risk accidents.

For the pilot facility accident scenario, data given in the BGAD Phase I quantitative risk assessment for a baseline incineration facility (SAIC 1997) were used to estimate the maximum amount of agent that could be released during an earthquake. All four ACWA technology providers would use a modified baseline process for ACW access (General Atomics 1999; Parsons and Allied Signal 1999; AEA/CH2M Hill 2000; Foster-Wheeler 2000); therefore, it was assumed that the unpack area configuration would not deviate significantly from the baseline. For BGAD, it was assumed that the maximum number of munitions in the unpack area would be the contents of four on-site containers (ONCs) containing either VX M55 rockets, GB 8-in. projectiles, or mustard 155-mm projectiles at the time of the crash. (These assumptions result in the largest possible amounts of chemical agent present in the unpack area among the munition types present at BGAD.)

ONCs are used to transport munitions at the Tooele Chemical Agent Disposal Facility, but the Army is investigating the feasibility of using modified ammunition vans. A change in the transport system used might also entail changes in the dimensions and capacity of the unpack area or a similarly functioning building or area. Such changes should not invalidate the impact estimates given here, because the assumption on number of munitions present in the unpack area was meant to represent a high-end estimate of the amount of agent that could be released in an earthquake. These accident impact estimates should be representative for either type of transportation system.

For the storage igloo accident scenario, it was assumed that the lightning strike could release the entire content of a rocket-containing storage igloo. The probability of such an event occurring is low (on the order of 10^{-4}), but it increases slightly with increasing length of continued storage. For this scenario, the maximum amount of agent at risk was obtained from estimates of the maximum amount of VX or GB agent stored in any single BGAD rocket-containing igloo (Hancock 2000).

7.21.1.2 Methods of Analysis

Potential accidental releases of chemical agent to the atmosphere and the associated consequences of such releases were assessed by using the D2PC[10] Gaussian dispersion model (Whitacre et al. 1987). Two meteorological conditions were assumed in the modeling to assess accident impacts. E-1 conditions consist of a slightly stable atmosphere (stability class E) with light winds (1 m/s). D-3 conditions consist of a neutral atmosphere (stability class D) with moderate winds (3 m/s). E-1 conditions would produce conservative impacts for the assessed accident scenarios. They represent accidents that would occur during the night or during a relatively short period after sunrise. The D-3 conditions would result in more rapid dilution of an accidentally released agent than would E-1 conditions. D-3 conditions represent accidents that would occur during daytime. When D-3 meteorological conditions are assumed, the size of the estimated plume is smaller. In conducting D2PC modeling, it was assumed that no plume depletion by agent deposition would occur. This is a conservative assumption for estimating the area potentially affected by an accidental release, because assuming that more agent remains in the plume allows farther plume travel before concentrations are diluted below the toxicological endpoint levels. The D2PC model default mixing height assumptions were used for modeling

[10] The Army has completed the development and validation of a new model (D2Puff). However, the new model is not accredited for use at all installations.

D-3 meteorological conditions, and per EPA guidance (EPA 1995), an unlimited mixing height was assumed for modeling E-1 meteorological conditions. A mixing height of 5,000 m is used as a default in D2PC to represent unlimited mixing. The D2PC model limits its application to accident release scenarios that could produce impacts at distances of less than or equal to about 30 mi (50 km).

For modeling mustard agent instantaneous releases, the "time after functioning" (TAF) parameter was assumed to be 20 hours. (The TAF was applicable only for accident modeling involving mustard agent instantaneous releases; it is defined as the time after detonation required to remove the agent source by decontaminating it or by containing it so it would no longer enter the atmosphere [Whitacre et al. 1987]).

7.21.1.3 Exposures and Deposition

For each of the accident scenarios assessed, the impacts of agent release were modeled by using D2PC-generated plumes with dosages estimated to result in adverse impacts for a certain percentage of the human population exposed (i.e., LCt_{50} = dosage corresponding to 50% lethality; LCt_{01} = dosage corresponding to 1% lethality; no deaths = dosage below which no deaths are expected in the human population exposed; no effects = dosage below which no adverse impacts are expected in the human population exposed). The distances to which these various plumes were predicted to extend were used as the starting point for the analyses of impacts to the various resources of concern under the proposed action and no action alternatives, as detailed in Sections 7.21.2 and 7.21.3 below. These distances are summarized in Table 7.21-1. For reference, the minimum distance from the hypothetical accident locations (i.e., the Chemical Limited Area or the unpack area within the proposed facility locations) to the BGAD installation boundary is 1.2 mi (1.9 km), and the distance to the on-site administrative area is about 2.5 mi (4.0 km). For all the hypothetical accidents assessed, the no effects plume contour extends into off-post areas (i.e., extending from 4 to 30 mi [6 to 50 km]). The extent of the no deaths contour varies from 0.4 to 30 mi (0.6 to 50 km), depending on the assumed type of chemical agent release and meteorological conditions.

7.21.2 Impacts of Accidents during the Proposed Action

7.21.2.1 Land Use

Impacts on land use from an accidental agent release during operation of an ACWA pilot test facility could generate serious negative land use impacts outside the installation, including the death and quarantine of livestock, interruption of agricultural productivity, and disruption of

TABLE 7.21-1 Chemical Agent Plume Distances Resulting from Accidents at an ACWA Pilot Test Facility (Proposed Action) or in the Chemical Limited Area (No Action) at BGAD[a]

Effect	Impact Distance, mi (km)[b]	Exposure Dose (mg-min/m^3)[c]	Impact Area	
			km^2	acres
GB Accidents				
Proposed action, D-3 (i.e., earthquake impacts; unpack area)				
1% lethality	5.0 (8.0)	10	4.3	1,100
No deaths	6.7 (11)	6	7.4	1,800
No effects	>30 (>50)	0.5	170	42,000
Proposed action, E-1 (i.e., earthquake impacts; unpack area)				
1% lethality	19 (31)	10	24	5,900
No deaths	27 (43)	6	44	11,000
No effects	>30 (>50)	0.5	120	30,000
No action, D-3 (lightning strike on rocket igloo)				
1% lethality	6.6 (11)	10	7.1	1,800
No deaths	8.9 (14)	6	13	3,200
No effects	>30 (>50)	0.5	200	49,000
No action, E-1 (lightning strike on rocket igloo)				
1% lethality	28 (45)	10	48	12,000
No deaths	>30 (>50)	6	73	18,000
No effects	>30 (>50)	0.5	130	32,000
VX Accidents				
Proposed action, D-3 (i.e., earthquake impacts; unpack area)				
1% lethality	1.0 (1.6)	4.3	0.43	110
No deaths	1.4 (2.2)	2.5	0.76	190
No effects	3.9 (6.3)	0.4	5.1	1,300
Proposed action, E-1 (i.e., earthquake impacts; unpack area)				
1% lethality	3.5 (5.6)	4.3	2.4	590
No deaths	4.9 (7.9)	2.5	4.4	1,100
No effects	15 (24)	0.4	33	8,200
No action, D-3 (lightning strike on rocket igloo)				
1% lethality	9.4 (15)	4.3	14	3,500
No deaths	14 (23)	0.4	27	6,700
No effects	>30 (>50)	0.4	200	49,000

TABLE 7.21-1 (Cont.)

Effects	Impact Distance, mi (km)[b]	Exposure Dose (mg-min/m³)[c]	Impact Area km²	Impact Area acres
No action, E-1 (lightning strike on rocket igloo)				
1% lethality	>30 (>50)	4.3	76	19,000
No deaths	>30 (>50)	2.5	92	23,000
No effects	>30 (>50)	0.4	130	32,000
Mustard Accidents				
Proposed action, D-3 (earthquake impacts; unpack area)				
1% lethality	0.31 (0.50)	150	0.03	7.4
No deaths	0.38 (0.62)	100	0.04	9.9
No effects	3.7 (6.0)	2	2.4	590
Proposed action, E-1 (earthquake impacts; unpack area)				
1% lethality	1.2 (1.9)	150	0.18	44
No deaths	1.5 (2.4)	100	0.27	67
No effects	14 (23)	2	15	3,700
No action, D-3 (lightning strike on rocket igloo) – Not applicable[d]				
No action, E-1 (lightning strike on rocket igloo) – Not applicable[d]				

[a] Distances and plume areas in table are from D2PC output. Meteorological conditions of either D stability and 3-m/s wind speed or E stability and 1-m/s wind speed and a “time after functioning” of 20 hours (for mustard releases) are assumed.

[b] Impact distances downwind of accident that would have 1% lethality, no deaths, or no effects on humans (see Table 7.21-2).

[c] Dosage for duration of accident at specific impact distance. The dosages correspond to default values used in the D2PC code (Whitacre et al. 1997).

[d] Highest-risk accidents for continued storage (no action) limited to rocket-containing igloos, which do not contain mustard agent.

local industrial activities (see Sections 7.21.2.9 and 7.23). Although such an accident would be capable of generating serious negative consequences, the likelihood of such an accident is extremely remote; consequently, the overall risk is very low.

7.21.2.2 Waste Management and Facilities

Hazardous Waste. The highest-risk accident scenario for ACWA pilot testing activities considers an earthquake impacting the unpack area. Waste generated under this scenario would be primarily contaminated soil and debris from dispersion of agent. An undeterminable amount of contaminated wastes could be produced by cleanup of a spill or accident involving dispersion of agent. Spill and emergency response plans and resources would be in place to contain, clean up, decontaminate, and dispose of wastes according to existing standards and regulations.

Mustard agent and nerve agents (GB, VX) are N-listed wastes in the Kentucky hazardous waste regulations (Kentucky listed wastes N001, N002, and N003). If an accident that would involve a listed hazardous waste were to occur, any contaminated residue, soil, water, or other debris resulting from the cleanup of that agent would also be characterized as a listed hazardous waste (401 KAR 31:010, Section 3(3) (b)(1)). In this case, the hazardous waste could have a serious impact on hazardous waste management capabilities in the area.

Pursuant to Kentucky hazardous waste regulations, debris contaminated with a listed hazardous waste may be exempt from regulation as hazardous waste if a demonstration test shows that the waste does not exhibit any hazardous characteristics or if the Cabinet determines, considering the extent of contamination, that the debris is no longer contaminated with hazardous waste (401 KAR 31:010). For contaminated soil or water that does not meet the definition of debris, the Army can consider filing a petition to delist the contaminated medium if a demonstration test shows that the waste does not contain the constituent that caused the Cabinet to list the chemical agent or if the hazardous constituent in the medium does not meet the criteria when the factors used by the Cabinet to list the chemical agent (401 KAR 31:070) are considered.

Nonhazardous Waste. Considering the particular accident conditions and pursuant to demonstration, the Army might be able to dispose of some or most of the cleanup material as nonhazardous waste in a local landfill. No significant impacts are expected from the generation of nonhazardous wastes in association with any of the considered accident scenarios

7.21.2.3 Air Quality

Depending on the amount, an accidental release of GB, VX, or mustard at BGAD during operation of an ACWA pilot test facility could have short-term but very significant adverse impacts on air quality, in terms of human injuries and fatalities (see Section 7.21.2.4). However, deposition of agent from air onto the ground surface and/or degradation in the environment would occur within a relatively short period of time. Mustard decomposes in air relatively quickly; its half-life is about 1.4 days (see Appendix A). GB is considered nonpersistent because it is volatile, soluble in water, and subject to acid-base hydrolysis. Although data on the fate of GB in the atmosphere are lacking, it is likely to be subject to photolysis, radical oxidation, or hydrolysis upon contact with water vapor (Munro et al. 1999). Therefore, it is unlikely to persist in air. VX is nonvolatile and persistent; however, after an accidental release, VX aerosols would be subject to rapid deposition onto ground surfaces. Therefore, long-term (e.g., more than a few days after release) adverse air quality impacts would not be expected from an accidental release of mustard, GB, or VX.

7.21.2.4 Human Health and Safety

For each of the accident scenarios assessed, the impacts of agent release were modeled by using plumes with dosages estimated to result in death for a certain percentage of the population exposed (i.e., LCt_{50} = dosage corresponding to 50% lethality; LCt_{01} = dosage corresponding to 1% lethality; no deaths = dosage corresponding to 0% lethality). The assumption was made that for any accident, the wind direction would be toward the direction where the largest number of people live. By using site-specific population data, the potential numbers of fatalities for each accident were estimated. Further details on the methods used to estimate number of fatalities are given in Appendix H. This evaluation did not specifically estimate the numbers of nonfatal injuries that would occur for each accident scenario, because there would be great variation in the number and severity of nonfatal injuries, depending on exposure concentration and duration and depending on variations in the populations exposed.

The population at risk at BGAD (i.e., persons residing within a 30-mi (50-km) radius of the post) is about 560,000 people. The accident scenario of an earthquake impacting the unpack area while GB was being processed, when E-1 meteorological conditions are assumed, would result in a no deaths distance distance of about 27 mi (43 km) (Table 7.21-2). The corresponding estimated number of fatalities among the general public would be 2,650. The estimated number of fatalities for the on-post population would be about 200. If such an accident occurred under D-3 meteorological conditions, the no deaths distance would decrease to 6.7 mi (11 km). The corresponding estimated number of fatalities among the general public would be about 890, and the estimated number of fatalities for the on-post population would be 70.

Since the Neut/Bio technology is applicable only to mustard agent and not nerve agent destruction, an earthquake impacting the unpack area while processing 155-mm projectiles containing mustard was also modeled. The impact distances for this accident were found to be much lower. The no deaths distance under E-1 meteorological conditions would be 1.5 mi (2.4 km) (see Table 7.21-2). The corresponding estimated number of fatalities among the general public would be 2. The estimated number of fatalities among the on-post population would be about 7. This scenario would apply to each of the technologies during mustard processing.

The above estimates are conservative with respect to several modeling assumptions, such as the number of munitions and amount of agent released, unvarying meteorology, no fire-

TABLE 7.21-2 Fatality Estimates for Potential Accidents Involving Agent Release at BGAD[a]

Accident Scenario[b]	Distance (mi): To LCt_{50} Dose	Distance (mi): To LCt_{01} Dose	Distance (mi): To No Deaths Dose	On-Post Population at Risk (no. of persons)[c]: Source to LCt_{50}	On-Post Population at Risk (no. of persons)[c]: LCt_{50} to LCt_{01}	On-Post Population at Risk (no. of persons)[c]: LCt_{01} to No Deaths	Maximum Estimated Fatalities for On-Post Population[d]
Continued storage highest-risk accident (applicable to no action and proposed action, all ACWA technologies)							
Lightning strike into VX rocket storage area with fire: D-3	4.1	9.4	14	133	225	12	156
Lightning strike into VX rocket storage area with fire: E-1	17	>30	>30	284	68	0	230
Facility highest-risk accident involving GB (applicable to all ACWA technologies except Neut/Bio)							
Earthquake impacting unpack area: D-3	2.2	5.0	6.7	0	280	74	70
Earthquake impacting unpack area: E-1	7.8	19	27	240	67	38	197
Facility highest-risk accident involving mustard (applicable to all ACWA technologies during mustard processing)							
Earthquake impacting unpack area: D-3	0.16	0.31	0.38	0	0	0	0
Earthquake impacting unpack area: E-1	0.54	1.2	1.5	0	26	0	7

Accident Scenario[b]	Off-Post Public Population at Risk (no. of persons)[c]: Source to LCt_{50}	Off-Post Public Population at Risk (no. of persons)[c]: LCT_{50} to LCt_{01}	Off-Post Public Population at Risk (no. of persons)[c]: LCT_{01} to No Deaths	Maximum Estimated Fatalities for Off-Post Population[d]
Continued storage highest-risk accident (applicable to no action and proposed action, all ACWA technologies)				
Lightning strike into VX rocket storage area with fire: D-3	945	6,909	1,933	2,446
Lightning strike into VX rocket storage area with fire: E-1	1,619	45,207	13,898	12,585
Facility highest-risk accident involving GB (applicable to all ACWA technologies except Neut/Bio)				
Earthquake impacting unpack area: D-3	98	3,224	2,606	893
Earthquake impacting unpack area: E-1	2,770	2,201	4,591	2,651
Facility highest-risk accident involving mustard (applicable to all ACWA technologies during mustard processing)				
Earthquake impacting unpack area: D-3	NA[e]	NA	NA	NA
Earthquake impacting unpack area: E-1	0	6	12	2

Footnotes appear on next page.

TABLE 7.21-2 (Cont.)

---

[a] Scenarios are highest-risk accidents for pilot facilities and for continued storage.

[b] D-3 corresponds to meteorological conditions of D stability with 3-m/s wind speed, and E-1 corresponds to conditions of E stability with 1-m/s wind speed. All accidents are assumed to occur with the wind blowing toward the location of maximum public or on-post population density.

[c] Population at risk indicates the number of individuals working (for on-post populations) or residing (for off-post populations) within the area encompassed by the plume. LCt_{50} values used were 18, 42, and 600, for VX, GB, and mustard, respectively, assuming a 25-L/min breathing rate (SAIC 1997; Goodheer 1994; Burton 2001). LCt_{01} and no deaths values were defaults from D2PC code (Whitacre et al. 1987), as given in Table 7.21-1. LCt_{50} values proposed by National Research Council (1997b) of <15, <35, and 900 for VX, GB, and HD, respectively (for 15-L/min breathing rate) were not used in this assessment; these values have not been formally approved for use by the Army.

[d] Total fatalities were calculated by assuming (1) a fatality rate of 75% in the area between the point of agent release and the 50% lethality dosage contour, (2) a fatality rate of 25% in the area between the 50% lethality dosage contour and 1% lethality dosage contour, and (3) a fatality rate of 0.5% in the area between the 1% lethality dosage contour and no deaths dosage contour.

[e] NA = not applicable; the no deaths plume for the mustard agent release did not extend off post.

induced plume buoyancy, and the size of the population exposed (e.g., wind assumed to be in direction of most populous area for an extended period of time). However, the toxicity levels used to estimate fatalities were originally developed for healthy adult males. If it is assumed that children and/or the elderly are substantially more susceptible to the effects of agent exposure than healthy adult males and all other conservative assumptions remain the same, then the estimated number of fatalities could increase. When a previously developed method for incorporating sensitive subpopulation risk assumptions is used (U.S. Army 1997b) and when it is assumed that about 30% of the general population in the BGAD ROI (see Section 7.19) falls into the sensitive subgroup, the fatality estimates for the accident scenarios addressed here for alternative technologies would increase by a factor of 1.3 to 1.9. (Details of this assessment are provided in Appendix H.) For example, if children and the elderly are up to 10 times more sensitive to the lethal effects than are healthy male adults, and if an earthquake were to impact the unpack area during GB processing under E-1 meteorological conditions, up to about 3,450 fatalities ($2{,}650 \times 1.3$) would be expected in the general population. It must be emphasized that this is a very conservative estimate of the maximum number of fatalities that would be expected from a highly improbable accident; sufficient data are not available to determine whether children or the elderly are actually more sensitive to the toxic effects of an acute chemical agent exposure than the rest of the population.

For the human health impacts assessment, an internally initiated accident was also modeled (i.e., an accident caused by equipment failure or human error at the pilot facility). The internally initiated accident that was modeled involved a rupture in the 500-gal (1,900-L) agent holding tank or the connecting piping in the filter farm that could result in the release of the tank's entire contents. Such an accident could result in the release of a small quantity of GB from the filter farm stack. Air concentrations would be too low to cause fatalities. If this accident occurred while mustard or VX agent was being processed, the amount released from the facility stacks would be negligible, because these agents are relatively nonvolatile and because the room in which the leak would occur is relatively small and would contain the agent, providing only a limited surface area for agent evaporation. In addition, the facility's pollution abatement system should capture most of the agent that might evaporate from the spill.

Except for biotreatment, the assessment did not find any difference between the technology systems with respect to accident impacts during pilot facility operations. This finding is attributable to the fact that acute health risks are mainly determined by the quantity of agent released in an accident (the source term). Once neutralization would occur inside the pilot facility, the acute health risks associated with an accidental release of process by-products (e.g., hydrolysate solution) would be negligible in comparison with the risks associated with the release of an agent. Because the alternative technologies would operate at similar throughput rates, with similar total amounts of agent present at the front end of the process (in the unpack area and during munitions disassembly), the maximum agent release amounts in the pilot facility would be similar for all technologies.

The main potential differences in accidents involving releases of agent for the different technology systems being tested would be related to the method used to access agent and explosives in the munitions. Cryofracture would be used for separation of energetics in some processes, while a reverse assembly process with some modifications would be used for other processes. Assessments of the consequences of accidents involving these separation processes are not presented here because the impacts would be substantially smaller than those of the other externally and internally initiated events considered. Also, the currently available design data do not indicate any major differences in the disassembly processes with respect to potential amounts of agent released.

The Neut/SCWO process would use five major process chemicals: sodium hydroxide, phosphoric acid, kerosene, liquid oxygen, and liquid nitrogen (PMACWA 1999). The Neut/Bio process would use seven: sodium hydroxide, sulfuric acid, hydrogen peroxide, ferrous sulfate, liquid nitrogen, aqueous ammonia, and dextrose (PMACWA 1999). The Neut/GPCR/TW-SCWO process would use several hazardous chemicals, including sodium hydroxide, liquid oxygen, hydrogen, and kerosene. Finally, the Elchem Ox process would use sodium hydroxide, nitric acid, sodium hypochlorite, hydrochloric acid, calcium oxide, silver nitrate, and liquid oxygen (PMACWA 2001). Several of these chemicals are flammable or reactive (e.g., sodium hydroxide, sulfuric acid, kerosene) and exhibit irritant properties when inhaled or touched. However, all are common industrial chemicals with well-established handling procedures and safety standards. According to PMACWA (1999), "the risk from gaseous emissions of these chemicals is minimal, but more work is needed to demonstrate the effectiveness of the containment design in the event of an accidental ignition of energetics during processing." The containment requirements are being further addressed in engineering design studies.

7.21.2.5 Soils

Under the accident scenarios considered for ACWA pilot testing activities at BGAD, contamination of surface soils could extend over an area beyond the installation boundaries. Given the nature of the accidents, it is assumed that chemical agent would be widely deposited downwind on surface soils as fine particles or droplets. Degradation rates for fine particles of agent typically are rapid, with rates being slightly faster for nerve agents than for mustard agent (see Appendix A). Therefore, any impacts on soils resulting from the deposition of fine particles of agent would be of limited duration — on the order of several days to two weeks — depending on ambient temperatures.

Pools or larger masses of chemical agent might be deposited near the location of the agent release. Although larger masses of chemical agent would degrade more slowly than fine particles, any agent released during such an accident would be removed during cleanup operations and would not have a long-term impact on surface soils. Contaminated soils excavated during cleanup would be disposed of in accordance with applicable requirements.

7.21.2.6 Water Resources

Impacting Factors. The agent deposited on the soil after an earthquake accident would be deposited as fine particles, aerosols, or vapor. No large masses (drops, pools, etc.) of agent would be deposited downwind of the accident site. Near the accident site, large drops or pools of agent might occur on the ground surface. This agent near the accident would be removed during cleanup operations and would not pose a long-term threat or be a source of water contamination. However, any agent deposited on the soil downwind of the accident as fine particles could be a potential source of surface or groundwater contamination.

The fine mustard particles on the soil surface downwind of the accident would degrade quickly. Under cold conditions, mustard might be present for as long as 2,000 hours (three months). However, even under cold conditions, within two weeks, the amounts present would be negligible: less than 0.0001% of the original deposition (see Appendix A). Under warmer conditions, the mustard would be degraded within a few hours to a few days of deposition. These estimates were based on tests of mustard droplets on the surface. Because the mustard particles deposited downwind of the accident would be very small, it is expected that the mustard would actually degrade in less time than predicted by these estimates.

GB deposited on the soil surface would degrade rapidly. GB has a volatilization half-life of 7.7 hours and a hydrolysis half-life of 46 to 460 hours, depending on the soil's pH (Appendix A). Within two to three days, surface concentrations of GB would be negligible. Only 0.1% of the original deposition would remain after about 10 half-lives; thus, within about three days, surface concentrations of GB would be below 0.01%, and within 15 half-lives (about five days), only 0.003% would remain.

VX deposited on the soil surface would be moderately persistent and could remain in significant concentrations for 15 to 20 days (Appendix A). The degradation half-life of VX in soil is estimated to be about 4.5 days, while the hydrolysis half-life ranges from 17 to 42 days, depending on temperature and pH. Within approximately 1.5 months, less than 0.1% of the VX would remain, and within about two months, less than 0.001% of the deposited VX would remain.

Once agent reached either surface water or groundwater, it would dissolve and begin to hydrolyze and undergo dilution as it mixed with the water. None of the agents would be persistent in water resources; however, some of the agent breakdown products would be more persistent in the environment.

Mustard has two breakdown products that are relatively persistent in groundwater: 1,4-oxathiane and 1,4-dithiane. These two products are not toxic at the levels that would be expected to be found in water resources after an accident, but their presence could be used to indicate that past contamination had occurred. GB has one breakdown product that is persistent in the environment: isopropyl methyl phosphonic acid (IMPA) (Appendix A). It is considered an eye and skin irritant with low to moderate toxicity. VX has two relatively stable degradation products: EA2192 and MPA (Appendix A). EA2192 retains some anticholinesterase properties and has the potential to affect human health through the oral pathway. However, at concentrations estimated in the environment, EA2192 would not be expected to pose a significant threat.

Groundwater. Transportation of agent by subsurface flow would be minimal. Surface sources would not last for significant periods, and degradation would occur as the agents moved through the vadose zone to the groundwater. Once in the groundwater, degradation would continue, and significant dilution would occur.

In addition to the fact that the agent source would be present on the surface to contaminate groundwater only for a relatively short length of time, once the agents were dissolved and mobile, they would hydrolyze. Both mustard and GB hydrolyze rapidly, and they would break down before being transported any significant distance in the subsurface. VX hydrolization takes a slightly longer time, but it still occurs rapidly when compared with groundwater travel times.

It is very unlikely that after an accident, conditions would exist that would allow significant impacts on groundwater resources. Trace amounts of agent breakdown products might be detected, but these contaminants would be present at low concentrations and would not pose significant threats to the environment.

Surface Water. Small ponds and other nonmoving surface water features would be affected after an accident for a short time. Concentrations would rapidly decrease as a result of agent degradation and dilution as the agent mixed with the water column.

Surface runoff might mobilize the agent present on the soil surface. If this occurred, the turbulent water would dissolve the agent rapidly. Once dissolved, the mustard and GB would hydrolize rapidly and not persist in the water. VX would be present for a slightly longer period but would also break down rapidly.

It is unlikely that agent transported by runoff would reach surface water bodies in appreciable concentrations because of agent dilution and degradation. Even if it did, impacts would be short-lived. Surface runoff might contain some agent when it reached various surface water bodies, but within a short time, depending on the agent and environmental conditions, these concentrations would be negligible. Dilution from both the overland flow and mixing in the water body would also reduce the concentration of agent reaching the water bodies. In addition, in order for any appreciable amount of agent to reach surface water bodies from overland flow, a rainfall event large enough to produce surface runoff, but small enough to not significantly dilute the dissolved agent, would have to occur shortly after an accident.

Because of the relatively low toxicity of the breakdown products and the low agent concentrations (because of dilution and low initial concentrations of agent or breakdown products), the impacts from degradation products on surface water resources would be none to negligible.

7.21.2.7 Biological Resources

Accident analyses were conducted for a scenario that involved an earthquake impacting the unpack area. Ecological impacts from a major accident associated with operation of an ACWA pilot test facility were assessed on the basis of atmospheric concentration estimates made by using the D2PC model (Whitacre et al. 1987). Model output was used to conduct impact analyses for vegetation, wildlife, aquatic habitats and fish, protected species, and wetlands.

Terrestrial Habitats and Vegetation. On the basis of the limited qualitative reports on the phytotoxicity studies of mustard, it is not possible to provide an area of impacts for acute exposure of terrestrial plants caused by an accidental release of mustard. In all likelihood, an accidental release of mustard would cause a certain degree of defoliation and retarded germination downwind from the accident location (Opresko et al. 1998). However, hydrolysis of mustard and GB would probably occur quickly after deposition on plant surfaces and soils. VX and GB mainly interfere with neurotransmission in animals and would not likely affect vegetation; however, VX has been shown to be phytotoxic to some plants at 10 ppm (soil and solution). The toxicity of GB to terrestrial plants is unknown, but it probably is similar in magnitude to the toxicity of VX, since both are organophosphates (Opresko et al. 1998). Model runs for an earthquake impacting the unpack area during mustard processing under D-3 (daytime) meteorological conditions showed an average mustard deposition area of 3 ha (7.4 acres) in the 1% human lethality area that extends to 0.31 mi (0.50 km) downwind of the accident site (see Table 7.21-1). The maximum deposition after an accident would occur during daytime conditions. The downwind distance from the accident location to the 1% human lethality location would be greater for accidents involving VX and GB. Distances and deposition areas for daytime (D-3) conditions would be 1.0 mi (1.6 km) and 43 ha (110 acres) for VX and 5.0 mi (8.0 km) and 430 ha (1,100 acres) for GB.

Wildlife. The deposition plume areas projected by the D2PC model are elliptical in shape and would occur mostly downwind of the accident. The location and geometry of the plume areas would vary, depending on the atmospheric stability and wind direction at the time of an accident. At BGAD, the prevailing winds that would result in the greatest consequences from an accident would be from the southwest. A release of mustard or nerve agents would thus have a higher probability of affecting ecosystems located northeast of the CHB. However, the release could presumably affect ecosystems in any direction, depending on the direction and speed of the wind at the time of the accident. Because of the limitations of the D2PC model, the size of habitat potentially exposed to agent cannot be reasonably approximated.

A screening-level ecological risk assessment was conducted to determine impacts of the bounding accident on four common wildlife species observed in grassland and forest habitats at BGAD. Species were white-tailed deer (*Odocoileus virginianus*), red fox (*Vulpes fulva*), meadow vole (*Microtus pennsylvanicus*), and white-footed mouse (*Peromyscus leucopus*). No benchmark values were found for the exposure of birds, reptiles, and amphibians to VX and GB.

Risks to the four ecological receptors from the accident scenarios were characterized by using the hazard quotient (HQ) approach for exposure to mustard, VX, and GB. The HQ is the ratio between the air concentration of a contaminant (i.e., mustard) and a contaminant-specific benchmark concentration representing a “no observed effects exposure level” (NOAEL) concentration on the basis of results from laboratory studies. HQs were calculated on the basis of inhalation benchmark values developed for use in ecological risk assessments of wildlife from exposure to combustion products at ANAD (U.S. Army Center for Health Promotion and Preventive Medicine [USACHPPM] 1999a). The HQ values could vary from zero to infinity. Values greater than one show a potential risk to the ecological receptor from the exposure. It is important to note that HQ values greater than one indicate only the potential for adverse risks (or effects) to individual animals and not actual impacts on them. Actual impacts would depend on many factors, such as the length of time of exposure to the plume, concentration of the chemical agent in air, and species sensitivities to various atmospheric concentration levels. HQ values were based on air concentrations estimated by the D2PC model under the air stability expected during typical nighttime conditions (wind speed of 1 m/s) and during typical daytime conditions (wind speed of 3 m/s). Benchmark values were adjusted for differences in inhalation rates on the basis of the body mass of the four species examined. Distances from the unpack area that were affected by an earthquake were determined for HQ values of less than one on the basis of D2PC model output for both NOAEL and "lowest observed adverse effects level" (LOAEL) exposures. Details of the HQ calculations are provided in Tsao (2000a–c).

The HQs indicated that LOAEL and NOAEL distances for all species after an accidental release of mustard were shorter during the day than at night. White-tailed deer and red fox would be less sensitive to exposure and would experience NOAELs at distances of 1.2 mi (2.0 km), downwind of the accident site during a daytime accident. Other species would experience NOAELs at greater distances (see Table 7.21-3) from the site. Dispersion of mustard at night would occur over a greater distance because of the lower wind speed assumed, resulting in HQ values of less than one occurring further from the accident site. Exposures of the wildlife to VX and GB could result in mortality or severe impacts beyond 30 mi (50 km) downwind of the accident, on the basis of HQ levels (see Tables 7.21-4 and 7.21-5).

Exposures to mustard for the four mammalian species evaluated in the ecological risk assessment would result in some mortality at distances less than 6 mi (10 km) downwind of the accident site (see Table 7.21-3). Wildlife species with small home ranges, such as small

TABLE 7.21-3 Distance from Accident Site That Would Result in No or Lowest Adverse Effects on Wildlife during Proposed Action at BGAD for Mustard Release[a]

	Distance (mi) with Hazard Quotient of <1[b]			
	Daytime Conditions		Nighttime Conditions	
Species	LOAEL[c]	NOAEL[d]	LOAEL[c]	NOAEL[d]
White-tailed deer	0.56	1.2	1.9	3.1
Red fox	1.2	1.2	2.5	3.7
Meadow vole	1.2	1.9	4.4	5.6
White-footed mouse	1.2	1.9	3.7	4.4

[a] Scenario is an earthquake impacting the unpack area.

[b] Hazard quotient = (dose at a given distance from the source) divided by (benchmark value of mustard for receptor species). The air concentration used to determine dose was obtained by using the D2PC model and assuming a wind speed of 3 m/s during daytime and 1 m/s during nighttime.

[c] LOAEL = lowest observed adverse effects level; the maximum distance from the site at which an adverse effect would be expected to occur.

[d] NOAEL = no observed adverse effects level; the distance from the site beyond which no adverse effects would be expected to occur.

TABLE 7.21-4 Distance from Accident Site That Would Result in No or Lowest Adverse Effects on Wildlife during Proposed Action at BGAD for VX Release[a]

Species	Distance (mi) with Hazard Quotient of <1[b]			
	Daytime Conditions		Nighttime Conditions	
	LOAEL[c]	NOAEL[d]	LOAEL[c]	NOAEL[d]
White-tailed deer	9.9	>30	>30	>30
Red fox	14	>30	>30	>30
Meadow vole	>30	>30	>30	>30
White-footed mouse	21	>30	>30	>30

[a] Scenario is an earthquake impacting the unpack area.

[b] Hazard quotient = (dose at a given distance from the source) divided by (benchmark value of VX for receptor species). The air concentration used to determine dose was obtained by using the D2PC model and assuming a wind speed of 3 m/s during daytime and 1 m/s during nighttime.

[c] LOAEL = lowest observed adverse effects level; the maximum distance from the site at which an adverse effect would be expected to occur.

[d] NOAEL = no observed adverse effects level; the distance from the site beyond which no adverse effects would be expected to occur.

mammals, reptiles, and amphibians, would remain in the mustard exposure plume during the accident and would thus experience higher mortality rates than more mobile species. Mammals that did survive within this distance would suffer from blistering skin, respiratory system irritation, eye irritation, and other chronic effects known to occur to humans and laboratory animals (Appendix B in U. S. Army 1988).

No data could be found on the uptake of mustard through ingestion under field conditions. Some uptake of mustard deposited on vegetation, particularly in areas downwind of the release, could occur by herbivores during the first few days after the accident. Hydrolysis of mustard would likely occur during the first one to two days after the accident, resulting in various degradation products. No data could be found on exposures of wildlife to mustard degradation products under field conditions. A recent article that reviews the toxicity of CWA degradation products suggested that thiodiglycol (TDG) could persist in soils following an accidental release (Munro et al. 1999). Laboratory exposures of rats for 90 days to various levels of TDG resulted in a NOAEL of 500 mg/kg/d. Even if all mustard degraded to TDG (low likelihood of occurrence) within the deposition area, it would be highly unlikely that a herbivore would receive a dose through the food pathway that would be above the NOAEL reported for laboratory rats (Munro et al. 1999).

TABLE 7.21-5 Distance from Accident Site That Would Result in No or Lowest Adverse Effects on Wildlife during Proposed Action at BGAD for GB Release[a]

	Distance (mi) with Hazard Quotients of <1[b]			
	Daytime Conditions		Nighttime Conditions	
Species	LOAEL[c]	NOAEL[d]	LOAEL[c]	NOAEL[d]
White-tailed deer	8.7	12	16	19
Red fox	12	15	19	23
Meadow vole	19	25	28	>30
White-footed mouse	14	18	22	27

[a] Scenario is an earthquake impacting the unpack area.

[b] Hazard quotient = (dose at a given distance from the source) divided by (benchmark value of GB for receptor species). The air concentration used to determine dose was obtained by using the D2PC model and assuming a wind speed of 3 m/s during daytime and 1 m/s during nighttime.

[c] LOAEL = lowest observed adverse effects level; the maximum distance from the site at which an adverse effect would be expected to occur.

[d] NOAEL = no observed adverse effects level; the distance from the site beyond which no adverse effects would be expected to occur.

Exposure of wildlife to VX and GB following an accident might have effects similar to those known to occur to humans. VX and GB are strong inhibitors of enzymes and effect neurotransmission by interfering with the enzyme cholinesterase, in particular. Nausea, vomiting, skeletal muscle twitching, seizures, and death typify the normal progression of effects from brief human exposures to high concentrations (see Appendix A). VX is not expected to be harmful to plants because of their low sensitivity, but it might be harmful to herbivores that consume contaminated vegetation downwind of the accident site over an extended period of time (Appendix O in U. S. Army 1988).

VX is not very volatile, is moderately persistent in the environment, and may occur in the environment for about 15 to 20 days following deposition on soil. The half-life of VX is about 4.5 days, and an estimated 90% of VX applied to soils would be lost in less than 15 days (Appendix A). No data were available to model wildlife uptake of VX or GB through ingestion. The nerve agent GB is considered nonpersistent in the environment and quickly breaks down in water. Impacts of GB through bioaccumulation in the food chain would not be likely to occur, given its tendency to volatilize quickly. The degradation products of GB have low toxicities (see Appendix A) and also would not be likely to pose a threat to wildlife through biomagnification in the food chain.

Aquatic Habitats and Fish. Aquatic habitats and fish in Lake Vega and other water bodies at BGAD might be affected by a release of mustard following an earthquake impacting the unpack area. Impacts would be relatively short term, but some fish mortality could occur within a few minutes of deposition of mustard on the water surface. Dilution would occur rather quickly, and hydrolysis of mustard into its degradation products would not be likely to cause mortality of fish over a long period.

VX is more environmentally persistent than GB. VX is moderately to highly soluble in water, with a solubility of 30 g/L at 25°C (77°F) (Munro et al. 1999). Its half-life ranges from 17 to 42 days at a temperature of 25°C (77 °F) and pH of 7 (Appendix A). Depending on the concentrations of VX reaching surface waters, fish, amphibians, and reptiles would be likely to die if their responses were similar to those of mammals under laboratory conditions (Munro et al. 1999). Analyses of the effects from potential accidental releases of VX on fish and other aquatic organisms (U.S. Army 1998c) indicate that the impacts at BGAD could be severe. Aquatic organisms in Lake Vega, Muddy Creek, and intermittent and ephemeral streams at BGAD would be killed from exposure to VX following an earthquake impacting the unpack area during VX processing. Aquatic species in surface waters located downwind to the northeast of BGAD would also be affected by accidental release concentrations projected by the D2PC model. (The D2PC model uses very conservative input parameters and assumptions; it is described in detail in Appendix H of this EIS.)

Impacts on aquatic species would probably be most severe in small, shallow streams. Exposure of aquatic organisms to VX would also increase after the first rainfall event, resulting in runoff of VX into surface waters. Impacts on aquatic organisms from exposure to GB would be likely to be short-term, since dilution in the water column would cause GB to break down by hydrolysis.

Protected Species. No federal listed threatened or endangered species would be adversely affected at BGAD from the release of a chemical agent after an earthquake affecting the unpack area. The only federal endangered species occurring on BGAD — running buffalo clover (*Trifolium stoloniferum*) — could experience a buildup of chemical agent deposited on leaf surfaces from fallout after an accident. The amount of deposition on the leaves would vary, depending on the degree of canopy closure provided by the trees above individual plants. No studies suggesting that chemical agent would adversely affect RBC were found.

Three federal endangered species, the Indiana bat (*Myotis sodalis*), gray bat (*M. grisescens*), and Virginia big-eared bat (*Corynorhinus townsendii virginianus*), are known to occur within a 30-mi (50-km) radius of BGAD (Barclay 2000). Individual bats occupying roosting and nursery habitat downwind of the accident site would be most susceptible to impacts from an earthquake causing munitions to fall at an unpack area and initiate subsequent release of chemical agent. Chemical agent released from the accident could adversely affect individual bats or bat colonies. Bats in caves would not be as seriously affected from exposure to airborne chemical agent as would bats in hollow trees or under loose bark. The gray bat and Virginia big-eared bat, which are considered to be exclusively cave dwellers (Brown 1997), would probably not be affected while roosting or while congregated in maternity colonies. Impacts would vary, depending on the bats' daily activity patterns. An accidental release of chemical agent during the night, when bats forage, could potentially affect more bats than would a release during daylight hours, when bats roost. The Indiana bat might experience more serious impacts from exposure to chemical agent (see Tables 7.21-3, 7.21-4, and 7.21-5). Indiana bats that might congregate in maternity colonies or roost sites located within 30 mi (50 km) downwind of the accident site would be expected to die from inhalation of airborne mustard, GB, or VX agents. On the basis of HQ calculations for other mammals, some bats would be likely to experience nonlethal effects such as skin blistering, similar to the effects that would occur to humans (U.S. Army 1988). Indiana bats hibernate in caves during the winter and would not be likely to be adversely affected by a chemical agent release from an accident at BGAD then.

Three endangered clam species, the Cumberland bean (*Villosa trabalis*), Cumberland elktoe (*Alasmidonta atropurpurea*) and little-wing pearly mussel (*Pegias fabula*), are known to occur with 30 mi (50 km) of BGAD (Barclay 2000). Clams in shallow perennial or intermittent streams could be exposed to relatively high concentrations of VX following an accident. VX is known to persist in water for 17 to 42 days at a temperature of 25°C (77°F) and a pH of 7 (Appendix A). Given the sedentary nature of clams, individuals would be exposed to the entire aliquot of water containing agent deposited from the vapor plume following an accident. Concentrations of agent in water both within and beyond the 30 mi (50 km) contour could be high enough to result in mortality of the Cumberland bean, Cumberland elktoe, and little-winged pearly mussel. Clams surviving the accident exposure would likely bioaccumulate VX in their soft tissues.

The impacts on endangered clams located downwind of the accident site would be smaller from a release of chemical agent during ACWA pilot test facility operations than from a release during continued storage. Smaller quantities of mustard, GB, and VX would be deposited during agent processing than would be deposited under the continued storage scenario following an accident.

Wetlands. Wetlands near the site of the earthquake accident would be exposed to VX and GB. The limited amount of data available on known impacts on plants suggests that some absorption of VX would occur (U.S. Army 1988). VX and its breakdown products would be harmful and potentially lethal to animals ingesting contaminated plant material. Plant species exposed to VX and GB downwind of the accident site would not be likely to become contaminated to a large extent because of the tendency of both compounds to break down relatively quickly by hydrolysis.

7.21.2.8 Cultural Resources

The occurrence of an accident, either during the proposed action or no action, could result in impacts on cultural resources within the area exposed to agent. The building materials used in historic structures or the exposed surfaces of archaeological sites could become contaminated during an accident. At a minimum, public access to these historic properties would be temporarily denied until contamination was degraded by exposure to light and moisture or by active decontamination.

For the hypothetical accidents assessed here, only temporary impacts (i.e., access restrictions) would be expected on cultural resources located outside the maximum radial no effects distance of 30 mi (50 km) (see Table 7.21-1). Access restrictions could last for a few days or longer, depending on the degree of contamination and the length of time required to certify that access to these properties could again be permitted. It is expected that low levels of agent contamination would degrade in a few hours under certain conditions, while larger quantities might take several weeks to degrade (see Appendix A).

Significant historic properties located within 30 mi (50 km) of the accident (see Appendix F) could be affected by temporary but extended restriction periods until the contaminant was degraded by light and moisture. If the contaminant was deposited as a liquid, the Army might require that the properties of concern undergo various decontamination procedures before being released for access by the public. These decontamination procedures could potentially damage the property. However, deposition of liquid agent in quantities that would require decontamination procedures that could damage or destroy cultural resources would most likely be confined to the pilot test facility or storage site. Extended public access restrictions, lasting until the contaminant dissipated, would be the most likely measure for preserving significant properties.

7.21.2.9 Socioeconomics

The accidental release of chemical agent at BGAD during ACWA pilot testing would have the potential to affect the socioeconomic environment in two ways. The demand for crops and livestock produced within the 30-mi (50-km) radius around the facility might change, and employees might need to be evacuated from work places.

Agriculture. The most significant impact of an accident on agriculture would be if all the crops and livestock produced in a single season were interdicted (either by federal or state authorities) and removed from the marketplace. Although the impacts from losses in agricultural output on the economy of the counties within the 30-mi (50-km) radius surrounding BGAD would be significant (Table 7.21-6), it is unlikely that the severity of these losses would be any different for the no action and the proposed action alternatives.

TABLE 7.21-6 Socioeconomic Impacts of Accidents at BGAD Associated with the Proposed Action and No Action[a]

Parameter	Neut/Bio	Neut/ SCWO	Neut/ GPCR/ TW-SCWO	Elchem Ox	No Action
Impacts from a one-year loss of agricultural output					
100% loss of agricultural output					
Employment (no. of jobs)	36,000	36,000	36,000	36,000	36,000
Income (millions of $)	840	840	840	840	840
75% loss of agricultural output					
Employment (no. of jobs)	27,000	27,000	27,000	27,000	27,000
Income (millions of $)	630	630	630	630	630
50% loss of agricultural output					
Employment (no. of jobs)	18,000	18,000	18,000	18,000	18,000
Income (millions of $)	420	420	420	420	420
Impacts from a single-day evacuation of businesses					
100% of economic activity affected					
Sales (millions of $)	12	12	12	12	12
Employment (no. of jobs)	32,000	32,000	32,000	32,000	32,000
Income (millions of $)	8	8	8	8	8
75% of economic activity affected					
Sales (millions of $)	9	9	9	9	9
Employment (no. of jobs)	24,000	24,000	24,000	24,000	24,000
Income (millions of $)	6	6	6	6	6
50% of economic activity affected					
Sales (millions of $)	6	6	6	6	6
Employment (no. of jobs)	16,000	16,000	16,000	16,000	16,000
Income (millions of $)	4	4	4	4	4

[a] Impacts for no action and the proposed action are presented for the first year of operation of an ACWA facility (2009).

Businesses and Housing. Although the evacuation of businesses as a result of an accident at BGAD would probably be temporary, disruption to the economy in the evacuated area (the CSEPP Protective Action Zone [PAZ]) surrounding BGAD, consisting of Madison County) could be significant. In the worst-case scenario, all business sales and employee income in the PAZ would be lost as a result of the evacuation. An evacuation that might be required after an accident could last for many days. Since the exact duration of the evacuation could not be determined, the consequent overall effect on local economic activity could not be determined. The impacts from a temporary, single-day evacuation of businesses in the PAZ are shown in Table 7.21-6. The data in the table may be used to estimate the impact of an evacuation over a multiple-day period.

Since it is likely that the presence of chemical agent and the risk of accidents at the site are already captured in housing values in the vicinity of the installation, an accident would probably not create significant additional impacts on the housing market, unless residents were prevented from quickly returning to their homes.

7.21.2.10 Environmental Justice

Within 30 mi (50 km) of BGAD, the analysis of human health impacts anticipates that highly unlikely accident scenarios causing the widespread release of an agent would indeed result in high and adverse impacts (see Section 7.21.2.4). In such a situation, minority and low-income populations could suffer fatalities and serious injuries disproportional to their representation in the United States as a whole, if the wind direction at the time of the accident put the agent plume in the direction of census tracts with high numbers of minority or low-income populations (see Section 7.20.1 for identification of these census tracts). Such severe human health impacts would have similarly high and adverse socioeconomic consequences for Madison County, including the removal of some of the work force and the interruption of agricultural activity (see Section 7.21.2.9). However, such accidents have a low frequency of occurrence, on the order of 2×10^{-4} per year (i.e., one occurrence in 4,200 years), so the risk of the resultant disproportionate impacts would be low. Such impacts are not anticipated.

7.21.3 Impacts of Accidents during No Action (Continued Storage)

7.21.3.1 Land Use

Land use impacts from accidents related to the no action alternative would be the same as those discussed in association with the proposed action (Section 7.21.2.1).

7.21.3.2 Waste Management and Facilities

Waste management impacts from accidents under the no action alternative would be the same as those discussed under the proposed action (Section 7.21.2.2).

7.21.3.3 Air Quality

After an accidental release of agent from a storage igloo at BGAD, deposition of agent from air onto the ground surface and/or degradation in the environment would occur within a relatively short period of time (see Section 7.21.2.3). Therefore, long-term (e.g., more than a few days after release) adverse air quality impacts would not be expected from an accidental release of mustard, GB, or VX.

7.21.3.4 Human Health and Safety

The U.S. Army and Federal Emergency Management Agency (FEMA) routinely conduct CSEPP exercises, in coordination with the communities surrounding BGAD installation and with their participation. These exercises are required under a 1988 memorandum of understanding (MOU) between FEMA and the Army. Because chemical agent is currently stored at the BGAD installation, some risk from accidents is already present. For example, agent could be released if a pallet were accidentally dropped during daily operations (i.e., maintenance and inspection). The most probable event would be that the pallet would be dropped from 4 feet, the average height that a pallet could be dropped during normal operations. This event would involve three rounds of munitions spilling their contents on the igloo floor. Emergency response preparation for potential accidents of this type during normal BGAD operations (e.g., maximum credible events [MCEs] for daily operations) is routinely evaluated under CSEPP (Freil 1997).

For the EIS, the hypothetical accident for continued storage is assumed to be an event that could release the entire content of a storage igloo containing GB or VX rockets (e.g., a lightning strike). The probability of such an event occurring is low (on the order of 2×10^{-4}) but increases slightly with increasing length of continued storage. A lightning strike could result in an explosion and propagation by fire, causing the entire igloo contents to explode and to burn (SAIC 1997). The consequences from a lightning strike on a VX rocket storage igloo have been estimated in terms of numbers of fatalities. For this scenario, the maximum amount of agent at risk was obtained from estimates of the maximum amount of VX stored in any single BGAD igloo (Hancock 2000). The accident scenario of a lightning strike on a VX rocket storage igloo under E-1 meteorological conditions resulted in 1% lethality and no deaths distances of more than 30 mi (50 km) and estimated fatalities of about 13,000 for the general public and 230 for the on-post population (see Table 7.21-2). If such an accident occurred under D-3 meteorological conditions, the no deaths distance would decrease to 14 mi (22 km), and the fatality estimate would be about 2,400 for the general public and 160 for the on-post population.

If it is assumed that children and/or the elderly are substantially more susceptible to the effects of agent exposure than healthy adult males, then the estimated number of fatalities could increase. When a method is used that assumes there is increased risk to sensitive subpopulations (i.e., that the subpopulations are 10 times more susceptible to fatality from agent exposure than the general public; see U.S. Army 1997b), the number of fatalities among the general public associated with continued storage accident scenarios could increase by a factor of about 1.8.

(Details of this assessment are provided in Appendix H.) For the bounding storage accident, if children and the elderly are assumed to be up to 10 times more sensitive to the lethal effects than are healthy male adults, and if a lightning strike on a VX rocket storage igloo occurred under E-1 meteorological conditions, up to about 23,000 fatalities (13,000 × 1.8) would be expected in the general population.

7.21.3.5 Soils

Potential impacts on soils associated with the accident scenarios considered under the no action alternative would be the same as those discussed under the proposed action (Section 7.21.2.5).

7.21.3.6 Water Resources

The factors that would affect water resources under the accident scenario would be similar for the no action and proposed action alternatives (Section 7.21.2.6). The difference between the no action and proposed action accident scenarios would not be significant in terms of the estimated impacts on water resources.

Impacts on surface water resources would be short-lived, although agent breakdown products might persist for some time. Impacts on groundwater resources would be unlikely and, if they did occur, would be negligible. Breakdown products might be detected, but their occurrence would be unlikely.

7.21.3.7 Biological Resources

The impact from an accident involving a lightning strike on a GB or VX rocket storage igloo in the Chemical Limited Area, followed by a fire, was evaluated for the no action alternative. The methodology used for assessing impacts to biological receptors associated with the no action alternative accident scenario was the same as that used for the proposed action accident evaluation (see Section 7.21.2.7). Table 7.21-1 presents the agent exposures and deposition areas that could result from the bounding accident scenario for the 1% lethality, no deaths, and no effects distances to humans.

Terrestrial Habitats and Vegetation. Impacts on vegetation from VX and GB deposited after the accident would likely be negligible. VX and its breakdown products could accumulate in plant tissues, but they would not be likely to cause adverse impacts because of the relatively low sensitivity of plants to nerve agents. Mustard release is not considered under the no action alternative because the hypothetical highest-risk scenario is a lightning strike on a GB or VX rocket storage igloo followed by a fire.

Wildlife. Tables 7.21-7 and 7.21-8 present the distances from the accident site for HQ values of less than one based on the D2PC model output for both the NOAEL and LOAEL exposures of the four wildlife species evaluated. The distances for which HQ values would be less than one from nighttime exposure to VX and GB following the accident were more than 30 mi (more than 50 km) for each of the four species.

Aquatic Habitats and Fish. The amount of GB or VX that would be deposited into aquatic habitats as the result of a lightning strike on a storage igloo would be the same as the deposition amounts that would result from an earthquake affecting an unpack area (see Table 7.21-1). Aquatic habitats and fish would experience impacts similar to those discussed for the proposed action (Section 7.21.2.7).

TABLE 7.21-7 Distance from Accident Site That Would Result in No or Lowest Adverse Effects on Wildlife If VX Were Released during Continued Storage (No Action) at BGAD[a]

	Distance (mi) with Hazard Quotients of <1[b]			
	Daytime Conditions		Nighttime Conditions	
Species	LOAEL[c]	NOAEL[d]	LOAEL[c]	NOAEL[d]
White-tailed deer	>30	>30	>30	>30
Red fox	>30	>30	>30	>30
Meadow vole	>30	>30	>30	>30
White-footed mouse	>30	>30	>30	>30

[a] Scenario is a VX release due to a lightning strike on a rocket storage igloo.

[b] Hazard quotient = (dose at a given distance from the source) divided by (benchmark value of VX for receptor species). The air concentration used to determine dose is obtained by using the D2PC model and assuming a wind speed of 3 m/s during daytime and 1 m/s during nighttime.

[c] LOAEL = lowest observed adverse effect level; the maximum distance from the site at which an adverse effect would be expected to occur.

[d] NOAEL = no observed adverse effect level; the distance from the site beyond which no adverse effects would be expected to occur.

TABLE 7.21-8 Distance from Accident Site That Would Result in No or Lowest Adverse Effects on Wildlife If GB Were Released during Continued Storage (No Action) at BGAD[a]

	Distance (mi) with Hazard Quotients of <1[b]			
	Daytime Conditions		Nighttime Conditions	
Species	LOAEL[c]	NOAEL[d]	LOAEL[c]	NOAEL[d]
White-tailed deer	23	>30	>30	>30
Red fox	>30	>30	>30	>30
Meadow vole	>30	>30	>30	>30
White-footed mouse	>30	>30	>30	>30

[a] Scenario is a GB release due to a lightning strike on a rocket storage igloo.

[b] Hazard quotient = (dose at a given distance from the source) divided by (benchmark value of GB for receptor species). The air concentration used to determine dose is obtained by using the D2PC model and assuming a wind speed of 3 m/s during daytime and 1 m/s during nighttime.

[c] LOAEL = lowest observed adverse effect level; the maximum distance from the site at which an adverse effect would be expected to occur.

[d] NOAEL = no observed adverse effect level; the distance from the site beyond which no adverse effects would be expected to occur.

Protected Species. The impacts on protected species from exposure to chemical agents released following an accident during continued storage would be expected to be similar to impacts from an accident under the proposed action (Section 7.21.2.7). No federal listed threatened or endangered species at BGAD would be adversely affected from the release of a chemical agent after a lightening strike on a rocket storage igloo.

Wetlands. The impacts on wetland vegetation from a lightning strike on a storage igloo during continued storage would be the same as those from an earthquake affecting an unpack area (under the proposed action (Section 7.21.2.7).

7.21.3.8 Cultural Resources

Potential impacts on cultural resources associated with accident scenarios under the no action alternative would be as those discussed under the proposed action (Section 7.21.2.8). See Appendix F for the listing of historic properties that could be affected by the modeled accidents under the no action alternative.

7.21.3.9 Socioeconomics

Potential impacts on socioeconomics associated with the accident scenarios under the no action alternative would be the same as those discussed under the proposed action (Section 7.21.2.9).

7.21.3.10 Environmental Justice

Potential impacts on environmental justice associated with the accident scenarios considered under the no action alternative would be the same as those discussed under the proposed action (Section 7.21.2.10).

7.22 CUMULATIVE IMPACTS

Cumulative impacts would result from adding the incremental impacts of the proposed action to other past, present, and reasonably foreseeable future actions. "Reasonably foreseeable future actions" are considered to be (1) actions that are covered in an environmental impact document that was either published or in preparation, (2) formal actions such as initiating an application for zoning approval or a permit, or (3) actions for which some funding has already been secured. Cumulative impacts could result from actions occurring at the same time or from actions occurring over a period of time.

Depending on the technology chosen, an ACWA pilot test facility would take up to 34 months to construct and would operate for up to about 36 months. This short operational time frame reduces the potential for cumulative impacts.

This cumulative impacts analysis does not cover areas in which the proposed action and other reasonably foreseeable future actions would have no impacts or only localized impacts. Thus, the following areas were not analyzed for cumulative impacts:

- Geological resources,
- Cultural resources, and
- Communications infrastructure.

In addition, cumulative impacts were not assessed for accidents. Accidents are low-probability events whose exact nature and time of occurrence cannot reasonably be foreseen. Although their impacts may be large, these impacts cannot be added in a reasonably predictable manner to the impacts of other reasonably foreseeable future actions.

Finally, the analyses in this EIS were based on the assumption that a single, full-scale ACWA pilot test facility would be built. If two or more ACWA pilot test facilities were built, they would share common facilities, and each one would be smaller than the full-scale pilot facility. Collectively, they would be similar in size to a full-scale pilot test facility, and their impacts together would reasonably be bounded by the impacts of the full-scale pilot facility and incinerator. On an installation without a baseline incinerator, the impacts of two ACWA pilot test facilities and/or an increase in weapons throughput would reasonably be bounded by the impacts of the full-scale pilot facility or the combined full-scale pilot facility and baseline incinerator. Thus, this cumulative impacts analysis should represent the impacts from either one or two ACWA pilot test facilities.

Government and private organizations were contacted to identify reasonably foreseeable on-post and off-post actions for inclusion in this cumulative impacts analysis. Organizations contacted included the following:

- Blue Grass Army Depot;
- City of Richmond Department of Codes and Planning;
- Madison County Industrial Board;
- Kentucky Natural Resources and Environmental Protection Cabinet, Division of Air Quality;
- Kentucky Transportation Cabinet;
- Kentucky Transportation Cabinet, Lexington District Office;
- Madison County Planning and Zoning;
- City of Berea Planning; and
- Blue Grass Area Development Council.

7.22.1 Other Reasonably Foreseeable Future Actions

The impacts of past and present actions were considered in previous sections of Chapter 7 under the discussions of the affected environment. They are summarized here, when needed, in the corresponding discussions of cumulative impacts.

7.22.1.1 On-Post Actions

Some on-post actions have already been included in the proposed action as defined and analyzed in this EIS. These include building an access road to the ACWA site, building an electrical substation, building a power distribution system, and building an associated wastewater treatment plant. Other reasonably foreseeable on-post actions included in this cumulative impacts analysis include:

- Upgrading roads, including widening Route 2 along the Chemical Limited Area, and

- Constructing and operating new facilities, including the molten salt operation facility, the explosive detonation chamber for conventional munitions, and the Site Security Control Center.

The impacts of these actions were assessed on the basis of information obtained during discussions with post personnel (Smith 2001) and information in environmental assessments for the molten salt operation facility and the explosive detonation chamber (U.S. Army 1998a,b).

The only other potential on-post Chem Demil action would be the construction and operation of a baseline incinerator. An EIS for a baseline incinerator at BGAD is being prepared, but it is not known whether such a facility will be built. To account for this uncertainty, cumulative impacts are assessed in this section of the EIS under two scenarios:

- Impacts from the construction and operation of an ACWA pilot test facility (proposed action) combined with other reasonably foreseeable on-post and off-post actions that do not include a baseline incinerator, and

- Impacts from the construction and operation of an ACWA pilot test facility (proposed action) combined with other reasonably foreseeable on-post and off-post actions, including a baseline incinerator.

7.22.1.2 Off-Post Actions

The reasonably foreseeable off-post actions have been identified broadly as (1) road construction, (2) light industrial expansion associated with industrial parks (including Richmond Industrial Park and Berea Industrial Park), (3) housing growth and development (including the potential mobile home park between BGAD and Richmond Industrial Park), and (4) some commercial development. No reasonably foreseeable new major industrial facilities are expected to have significant impacts.

7.22.2 Land Use

Land in the vicinity of BGAD is used for a mix of agricultural, light industrial, low-density residential, and commercial uses. The main trend nearby is the conversion of small blocks of farm land to light industrial use. Past, present, and planned future land use on BGAD involves industrial and related activities associated with the storage and maintenance of conventional and chemical weapons. It includes administrative, residential, and recreational uses. The site has large tracts of undeveloped woodland, and more than 48% of the land is leased to local farmers. There are 3,200 acres (1,300 ha) of forest at BGAD.

7.22.2.1 Cumulative Impacts with Other Actions

Using the land in the 250-acre (100-ha) Chemical Limited Area in the northern portion of the installation for an ACWA pilot test facility, with or without a baseline incinerator, would be consistent with other past, current, and planned land use at BGAD. Constructing an ACWA pilot test facility would disturb up to about 95 acres (38 ha) of land, which represents about 0.6% of the total area of BGAD. On-post and off-post impacts on land use due to an ACWA pilot test facility are expected to be negligible (Section 7.2). Constructing other on-post facilities, including the detonation chamber, molten salt operation facility, and Site Security Control Center, would disturb more land. An ACWA pilot test facility as well as other on-post actions would be consistent with use of the BGAD installation for industrial-type activities.

The City of Richmond is expanding. The number of new housing developments south of the city in the direction of BGAD has accelerated in the past decade, and the expansion is expected to continue. Zoning has been approved to permit development of a mobile home park between BGAD and Richmond Industrial Park, but the date for the park's development is uncertain. These and other anticipated activities in the vicinity of BGAD would further the trend of residential development in the vicinity of BGAD. These developments plus an ACWA pilot test facility would further the trend of urban development in the Richmond area. The cumulative land use impacts of an ACWA pilot test facility and other reasonably foreseeable actions should not be significant.

7.22.2.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

If built, a baseline incinerator would be located in Proposed Area A or B, the same general area as the area in which an ACWA pilot test facility would be located. Building a baseline incinerator in one of these locations would be consistent with the use of the BGAD installation for industrial-type activities. The incinerator's impacts on land use would not be expected to vary significantly from the impacts of an ACWA pilot test facility. As indicated by other EISs for incinerators, building a baseline incinerator could disturb up to 85 acres (34 ha) of land in addition to the land that would be disturbed to build an ACWA pilot test facility (U.S. Army 1991, 1997b, 2001). Together with the ACWA pilot test facility, this area would amount to 1.2 % of the total area of BGAD. Because use of Proposed Area A for any facility could interfere with other site activities, development of two destruction facility sites, such as a site for an ACWA facility and a site for an incineration facility, might also interfere with other site activities. Constructing other on-post facilities, including the detonation chamber, molten salt operation facility, and Site Security Control Center, would disturb more land.

The expansion of the city of Richmond and other developments in the vicinity of BGAD, plus an ACWA pilot test facility, a baseline incinerator, and other on-post actions, would continue the trend of urban development in the Richmond area. The cumulative land use impacts of a baseline incinerator, an ACWA pilot test facility, and other reasonably foreseeable actions should not be significant.

7.22.3 Infrastructure

Table 7.22-1 presents the expected utility demands for a baseline incinerator at BGAD.

TABLE 7.22-1 Estimated Annual Utility Demands for a Baseline Incinerator at BGAD

Utility	Annual Demand
Electric power (GWh)	36
Natural gas (scf)	840,000,000
Process water (gal)	97,000,000
Potable water (gal)	6,400,000
Sewage produced (gal)	7,500,000

Source: Folga (2001).

7.22.3.1 Electric Power Supply

BGAD has an electric capacity of just under 31 GWh/yr, and it used about 7.8 GWh in 2000.

Cumulative Impacts with Other Actions. The current infrastructure would not be able to meet the electric power needs of an ACWA pilot test facility (Section 7.3.1). With other reasonably foreseeable on-post actions, the cumulative needs would exceed those of an ACWA pilot test facility alone. Depending on the ACWA technology chosen, more than 120 GWh of additional electric power, an increase of 1,500% over 2000 consumption, might be needed annually while other on-post uses were still being supplied (Table 7.3-1). New power lines, service connections, and substations would need to be added or sized to provide the electric power needs of the ACWA pilot test facility. Other potential on-post actions would also require additional power lines and connections. Discussions with local planners indicated no current or foreseen problems in supplying electric power in the vicinity of BGAD (Smith 2001).

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. Building a baseline incinerator would require additional electric infrastructure beyond that needed by the ACWA pilot test facility and other future on-post facilities. Depending on the ACWA technology chosen, more than 150 GWh of additional power, an increase of about 2,000% over 2000 consumption, might be needed annually while other on-post uses were still being supplied. New power lines, service connections, and substations would be needed to provide the electric power needs of the ACWA pilot test facility and a baseline incinerator. Other potential on-post actions would also require additional power lines and connections. Discussions with local planners indicated no current or foreseen problems in supplying electric power in the vicinity of BGAD (Smith 2001).

7.22.3.2 Natural Gas Supply

Cumulative Impacts with Other Actions. The current infrastructure would not be able to supply the natural gas needs of the ACWA pilot test facility (Section 7.3.2). Additional gas lines and a metering station would be needed. Other possible on-post actions would require additional gas lines and possibly additional metering stations. Conversion of existing buildings to natural gas is ongoing, and additional conversions are scheduled for the future. With other reasonably foreseeable on-post actions, the cumulative needs for natural gas would exceed those of an ACWA pilot test facility alone. Depending on the technology chosen, more than 140 million scf/yr (4 million m^3/yr) of additional natural gas might be needed while existing on-post uses were still being supplied (Table 7.3-1). This amount would represent an increase of somewhat more than 310,000% over the 45,000 scf (1,300 m^3) of natural gas used at BGAD in

FY 2000. Discussions with local planners indicated no current or foreseen problems in supplying natural gas in the vicinity of BGAD (Smith 2001).

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. The current infrastructure would not be able to supply the natural gas needs of an ACWA pilot test facility (Section 7.3.2). Additional gas lines and a metering station would be needed. A baseline incinerator would require additional infrastructure in addition to that required by an ACWA pilot test facility alone. Other possible on-post actions would require additional gas lines and possibly additional metering stations. Conversion of existing buildings to natural gas is ongoing, and additional conversions are scheduled for the future. Through the first four months of FY 2001, BGAD consumed about 20,000 ft^3 (570 m^3) of gas, about 33% more than in the same period the previous year. With other reasonably foreseeable on-post actions, the cumulative needs for natural gas would exceed those of an ACWA pilot test facility alone. Operating both a baseline incinerator and an ACWA pilot test facility might require more than 980 million scf (28 million m^3/yr) of additional natural gas while existing on-post uses were still being supplied (Table 7.3-1 and Folga 2001). This amount would represent a large increase over the 45,000 scf (1,300 m^3) of natural gas used at BGAD in FY 2000. Discussions with local planners indicated no current or foreseen problems in supplying natural gas in the vicinity of BGAD (Smith 2001).

7.22.3.3 Water (Supply and Sewage Treatment)

There would be no off-post impacts on the water supply or sewage treatment infrastructure, since these systems are self-contained at BGAD. Currently, water is supplied from Lake Vega, an on-post impoundment with a capacity of about 600 million gal (2.3 million m^3). In FY 1999, 51 million gal (190,000 m^3) of water was consumed, and in FY 2000, 39 million gal (150,000 m^3) was consumed.

There are two wastewater treatment plants on post. One plant, WTTP #1, which is located in the southwest corner of the post, treats more than 26 million gal/yr (98,000 m^3/yr) of sewage and would not be a candidate to receive wastewater from an ACWA pilot test facility. The second plant does not have sufficient capacity to support an ACWA pilot test facility (Section 7.3). BGAD produced 28 million gal (110,000 m^3) of sanitary sewage in 2000.

Cumulative Impacts with Other Actions. Cumulative uses of water for construction would be small (less than 8.1 million gal [31,000 m^3] for any ACWA technology) when compared with the existing water supply capacity, even if all potential on-post actions, including an ACWA pilot test facility, were under construction simultaneously.

Water use during operation of an ACWA pilot test facility would exceed water use during construction. Depending on the technology chosen, an ACWA pilot test facility could use up to

24 million gal/yr (91,000 m^3/yr) of potable and process water (Table 7.3-1) during normal operations. The additional requirements for other reasonably foreseeable on-post actions could not be quantified but are expected to be minor. The current water supply capacity of roughly 260 million gal/yr (980,000 m^3/yr) would be sufficient to meet these demands (Section 7.12.3). Other reasonably foreseeable on-post actions would use additional, minor quantities of water. New water distribution pipelines would be needed to supply water to an ACWA pilot test facility (Section 7.3.3). Additional new pipelines would also be required for other on-post facilities. The ACWA pilot test facility would require additional supply systems for fire fighting and other emergency response needs. It could not be determined whether other future on-post facilities would require construction of any additional emergency infrastructure.

An ACWA pilot test facility would produce an additional 7.5 million gal (28,000 m^3) of sanitary sewage annually. A new sewage treatment plant and sewer lines would be needed to treat the effluent from an ACWA pilot test facility (Section 7.3.3). Alternatively, sewage could be routed to the treatment facilities of the city of Richmond. According to U.S. Army (1998a,b), there would be no need for expanded capacity to operate the molten salt operation facility or explosive detonation chamber. Other reasonably foreseeable on-post facilities would not be expected to require additional wastewater treatment capacity.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. Cumulative uses of water for construction would be small when compared with existing water supply capacity, even if all potential on-post actions, including an ACWA pilot test facility and a baseline incinerator, were under construction simultaneously.

If built, a baseline incinerator would require new water supply pipelines in addition to those required for an ACWA pilot test facility and other on-post facilities. Water use during operation of an ACWA pilot test facility and a baseline incinerator would exceed water use during construction. Depending on the technology chosen, an ACWA pilot test facility could use up to 24 million gal/yr (91,000 m^3/yr) of potable and process water (Table 7.3-1). A baseline incinerator might use an additional 103 million gal/yr (390,000 m^3/yr). The current water supply capacity of roughly 260 million gal/yr (980,000 m^3/yr) would be sufficient to meet these demands (Section 7.12.4). Other reasonably foreseeable on-post actions would use additional, minor quantities of water. Both the ACWA pilot test facility and a baseline incinerator would require additional supply systems for fire fighting and other emergency response needs. It could not be determined whether other future on-post facilities would require the construction of any additional emergency infrastructure.

An ACWA pilot test facility and a baseline incinerator would produce an additional 15 million gal (57,000 m^3) of sanitary sewage annually. The current sewage treatment capacity would need to be expanded to meet the needs of the proposed ACWA pilot test facility (Section 7.3.3). If a baseline incinerator were also built, the cumulative treatment needs would exceed those of the ACWA pilot test facility alone, and additional sewage treatment capacity would be required beyond the capacity needed for an ACWA pilot test facility.

7.22.4 Waste Management

Cumulative impacts on waste management from the construction and operation of an ACWA pilot test facility with or without a baseline incinerator and other reasonably foreseeable facilities should be minimal. Discussions with local planners indicated that current off-post hazardous and nonhazardous waste disposal capacities appear adequate (Smith 2001).

Hazardous wastes are stored at a number of locations around BGAD. In 2000, BGAD disposed of about 1,330,000 lb (600,000 kg) of hazardous wastes off post (Table 7.4-1). Nonhazardous solid wastes are disposed of off post at a local landfill. Most sanitary wastewater is treated on post in the wastewater treatment plant. In 2000, BGAD treated 28 million gal (106,000 m^3) of sewage.

7.22.4.1 Cumulative Impacts with Other Actions

The quantities of construction wastes generated by an ACWA pilot test facility (Table 7.4-2) and other on-post actions would be small and would have minimal impacts on waste management systems. Operation of any of the ACWA pilot test facility technologies would produce amounts of hazardous and nonhazardous wastes that could, depending on the technology chosen, represent a substantial increase in the amounts of wastes generated by BGAD (Tables 7.4-3 and 7.4-4). These amounts would be minimal in the BGAD vicinity.

Constructing and operating an ACWA pilot test facility and other reasonably foreseeable on-post facilities would increase the amount of sanitary sewage requiring disposal. Depending on the technology chosen, an ACWA pilot test facility would produce up to 7.5 million gal/yr (28,000 m^3/yr) of sanitary sewage, which represents an increase of about 21% over the amount treated in 2000. Other reasonably foreseeable on-post facilities would produce smaller additional quantities of sewage.

7.22.4.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

Since an EIS for a baseline incinerator at BGAD has not yet been published, information on post-specific impacts on waste management systems was not available. However, the EISs for incinerators at other facilities indicate that the amount of wastes produced by a baseline incinerator would represent a substantial increase for BGAD but would be minimal in the vicinity of the post (U.S. Army 1991, 1997b, 2001). Whether or not a baseline incinerator is built, the total stockpile to be demilitarized is fixed, and the amounts and types of wastes produced would depend on the distribution of the stockpile between an ACWA pilot test facility and a baseline incinerator. Either technology would produce minimal amounts of hazardous wastes, which, even when added to other reasonably foreseeable hazardous wastes, should have a minimal impact on waste management systems. In addition to the wastes produced by an ACWA pilot test facility, a baseline incinerator would also produce brine salts, for which the ultimate disposal requirements are currently unclear (Section 7.4.3).

Constructing and operating an ACWA pilot test facility and other reasonably foreseeable on-post facilities would increase the amount of sanitary sewage requiring disposal. Depending on the technology chosen, an ACWA pilot test facility would produce up to 7.5 million gal/yr (28,000 m^3/yr) of sanitary sewage, which represents an increase of about 21% over the amount treated in 2000. A baseline incinerator would produce up to about 7.5 million gal/yr (28,000 m^3/yr). The two facilities together would produce sewage in an amount that would represent an increase of about 54% over the quantity of sewage treated in 2000. Other reasonably foreseeable on-post facilities would produce smaller additional quantities of sewage.

7.22.5 Air Quality

Emissions of toxic and hazardous air pollutants and agent are of interest primarily because of their potential impacts on human health and biological resources. Sections 7.22.6 and 7.22.12 discuss potential cumulative impacts in these areas. This analysis assumes that an ACWA pilot test facility and a baseline incinerator would be constructed and operated at the same time.

7.22.5.1 Impacts of Construction

PM_{10} and $PM_{2.5}$ from fugitive emissions would be the pollutants of principal concern during construction. Emissions of pollutants from worker and delivery vehicles, construction equipment, fuel storage, and refueling operations would be small. Off-post concentrations from these sources would not exceed NAAQS levels (Section 7.5.3).

Cumulative Impacts with Other Actions. Except for the annual $PM_{2.5}$ level, which currently exceeds the NAAQS level, construction of an ACWA pilot test facility would not result in ambient concentrations in excess of particulate NAAQS levels. Table 7.5-9 summarizes the off-post particulate impacts from construction of an ACWA pilot test facility. Construction of the facility alone would produce, at most, an emission level that would be 42% of any particulate NAAQS level. When current on-post and off-post sources are taken into account (the background levels), total PM_{10} concentrations would be less than 83% of the NAAQS levels. The total 24-hour $PM_{2.5}$ concentration would be 95% of the NAAQS level, and the total annual $PM_{2.5}$ concentration of 17.4 μg/m^3 would exceed the NAAQS level. However, even without an ACWA pilot test facility or any other reasonable foreseeable on-post or off-post actions, annual levels of $PM_{2.5}$ are already 114% of the NAAQS level of 15 μg/m^3. Construction of an ACWA pilot test facility would contribute another 0.3 μg/m^3 (Table 7.5-9). (Annual background concentrations of $PM_{2.5}$ throughout Kentucky tend to be higher than the NAAQS level.)

Construction of the Site Security Control Center and vehicle storage facility area simultaneously with an ACWA pilot test facility would increase off-post particulate concentrations. Other reasonably foreseeable future on-post actions include the construction of a molten salt operation facility and an explosive detonation chamber for the destruction of conventional munitions. As an alternative for open detonation, the detonation chamber is expected to reduce particulate emissions from detonation activities (U.S. Army 1998b). The molten salt operation facility would be located about 2 mi (3 km) south of Proposed Areas A and B. The detonation chamber would be located about 4 mi (6 km) south of Proposed Areas A and B. Both would be far enough away to preclude significant interactions. Local road construction, including the widening of Duncannon Lane and widening of Interstate 75, would be too far away to cause significant particulate concentrations in the areas receiving the greatest impacts from an ACWA pilot test facility. However, new on-post and off-post activities would add small concentrations to the current background levels of $PM_{2.5}$.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. Except for the annual $PM_{2.5}$ level, which currently exceeds the NAAQS level, construction of an ACWA pilot test facility and a baseline incinerator would not result in ambient concentrations in excess of the particulate NAAQS levels. To assess the impacts from the simultaneous construction of an ACWA pilot test facility and a baseline incinerator, PM_{10} air quality and $PM_{2.5}$ air quality were modeled for two proposed construction sites, one in Proposed Area A and one in Proposed Area B. The results are presented in Table 7.22-2. Together, both facilities would produce, at most, 46% of any particulate NAAQS level. When current on-post and off-post sources are taken into account (the background levels), total PM_{10} concentrations would be less than 87% of the NAAQS levels. The total 24-hour $PM_{2.5}$ concentration would be just at the NAAQS level; these modeled impacts are maximums and overestimate the 85th percentile values specified in the NAAQS. Hence, the 24-hour $PM_{2.5}$ NAAQS level would not be exceeded. However, even without an ACWA pilot test facility, a baseline incinerator, or any other reasonably foreseeable on-post and off-post actions, annual levels of $PM_{2.5}$ are already 114% of the NAAQS level of 15 $\mu g/m^3$. Simultaneous construction of an ACWA pilot test facility and a baseline incinerator would add, at most, 0.47 $\mu g/m^3$ to the annual $PM_{2.5}$ concentration. (Background concentrations for annual $PM_{2.5}$ throughout Kentucky tend to be higher than the NAAQS level.) Other reasonably foreseeable future on-post actions include a molten salt operation facility and a detonation chamber for the destruction of conventional munitions. As a replacement for open detonation, the detonation chamber is expected to reduce particulate emissions from detonation activities (U.S. Army 1998b). The molten salt operation facility would be located about 2 mi (3 km) south of Proposed Areas A and B; the detonation chamber would be located about 4 mi (6 km) south of Proposed Areas A and B. Both would be far enough away to preclude significant interactions. Local road construction, including the widening of Duncannon Lane and widening of Interstate 75, would be too far away to cause significant particulate concentrations in the areas receiving the greatest impacts from an ACWA pilot test facility. However, new on-post and off-post activities would add small concentrations to the current background levels of $PM_{2.5}$.

TABLE 7.22-2 Air Quality Impacts from Construction of an ACWA Pilot Test Facility and a Baseline Incinerator at BGAD and Other Nearby Actions[a]

		Concentration ($\mu g/m^3$)				
Pollutant	Averaging Time	Maximum Increment	Background	Total	NAAQS	Percentage of NAAQS[b]
PM_{10}	24 hours	60	70	130	150	87 (40)
	Annual	0.93	28.5	29	50	58 (1.9)
$PM_{2.5}$	24 hours	30	34.5	65	65	100[c] (46)
	Annual	0.47	17.1	17.6	15	117 (3)

[a] See Section 7.5 for details on background and modeling.

[b] Values are based on total concentration, including the background concentration and maximum increment, from the simultaneous construction of an ACWA pilot test facility and a baseline incinerator. Values in parentheses are based on the construction of the facilities and ignore background levels.

[c] The 24-hour $PM_{2.5}$ NAAQS level is a 98th percentile value. The 98th percentile value would be less than the maximum presented here; hence, the NAAQS level would probably not be exceeded.

7.22.5.2 Impacts of Operations

Cumulative Impacts with Other Actions. For all technologies, the largest incremental air quality impact from operating an ACWA pilot test facility by itself would be about 3.1% of the applicable NAAQS levels for all pollutants. Except for the annual $PM_{2.5}$ level, the maximum estimated concentrations of all criteria pollutants, including the effects of current on-post and off-post sources (background), would be less than 67% of the NAAQS levels (see Tables 7.5-10 through 7.5-13 for all four technologies). Even without an ACWA pilot test facility or any other reasonably foreseeable on-post or off-post action, annual levels of $PM_{2.5}$ are already 114% of the NAAQS level of 15 $\mu g/m^3$. Operating an ACWA pilot test facility would add, at most, 0.11 $\mu g/m^3$. For the reasons noted above, other reasonably foreseeable on-post and off-post actions would not cause significant criteria pollutant concentrations in areas receiving the greatest impacts from an ACWA pilot test facility. However, all new activities would add small concentrations to the current background levels of $PM_{2.5}$.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. Table 7.22-3 presents the air quality impacts from the simultaneous operation of an ACWA pilot test facility and a baseline incinerator. The concentrations were determined on the basis of the assumption that the facilities are collocated; thus, they overestimate the impacts. The values rely on baseline incinerator impacts modeled for ANAD, PCD, and PBA. Although the modeled results would be different if done for BGAD, these results were used because they are the best available indicators of impacts from a baseline incinerator.

TABLE 7.22-3 Air Quality Impacts from Operation of an ACWA Pilot Test Facility and a Baseline Incinerator at BGAD and Other Nearby Actions

		Concentration ($\mu g/m^3$)				
Pollutant	Averaging Time	Maximum Increment[a]	Background	Total	NAAQS	Percentage of NAAQS[b]
SO_2	3 hours	20.8	172	193	1,300	15 (1.6)
	24 hours	5.7	81	87	365	24 (1.6)
	Annual	0.51	21	22	80	28 (0.63)
NO_2	Annual	3.2	32	35	100	35 (3.2)
CO	1 hour	78	9,829	9,900	40,000	25 (0.19)
	8 hours	16	6,700	6,700	10,000	67 (0.16)
PM_{10}	24 hours	5.0	70	75	150	50 (3.3)
	Annual	0.41	28.5	28.9	50	58 (0.82)
$PM_{2.5}$[c]	24 hours	5.0	34.5	39.5	65	61 (7.7)
	Annual	0.41	17.1	17.5	15	117 (2.7)

[a] Sum of increment for an ACWA pilot test facility and increment for a baseline incinerator. The ACWA pilot test facility increment was based on the largest modeled value for any technology (Tables 7.5-10 through 7.5-13). The baseline incinerator NO_2 increment was taken from U.S. Army (2001) for PCD. Other baseline incinerator increments were taken as the larger of modeled values for ANAD and PBA (U.S. Army 1991, 1997b).

[b] Values are based on the total concentration, including the background concentration and maximum increment, from the simultaneous operation of an ACWA pilot test facility and a baseline incinerator. Values in parentheses are based on operation of the facilities and ignore background levels.

[c] Not available in references. Overestimated as equal to PM_{10}.

The maximum impact from an ACWA pilot test facility and a baseline incinerator together would be less than 8% of any NAAQS level. Except for the $PM_{2.5}$ level, an ACWA pilot test facility and a baseline incinerator, together with other current sources, would produce, at most, 67% of any NAAQS level. Even without an ACWA pilot test facility, a baseline incinerator, or any other reasonably foreseeable on-post or off-post actions, annual levels of $PM_{2.5}$ are already 114% of the NAAQS level of 15 $\mu g/m^3$. Operation of an ACWA pilot test facility and a baseline incinerator would contribute about 0.4 $\mu g/m^3$, which would represent less than 3% of the NAAQS level (Table 7.22-3). (Background concentrations for annual $PM_{2.5}$ throughout Kentucky tend to be higher than the NAAQS levels.) For the reasons noted above, other reasonably foreseeable on-post and off-post actions would not cause significant criteria pollutant concentrations in areas receiving the greatest impacts from an ACWA pilot test facility. However, all new activities would add small concentrations to the current background levels of $PM_{2.5}$.

7.22.6 Human Health and Safety — Routine Operations

7.22.6.1 Impacts of Construction

PM_{10} and $PM_{2.5}$ from fugitive emissions would be the pollutants of principal concern during construction. Emissions of pollutants from worker and delivery vehicles, construction equipment, fuel storage, and refueling operations would be small, and off-post concentrations would not exceed NAAQS levels (Section 7.5).

Cumulative Impacts with Other Actions. Except for the annual $PM_{2.5}$ level, particulate NAAQS levels would not be exceeded during construction of an ACWA pilot test facility alone or with other reasonably foreseeable on-post and off-post actions (Section 7.22.5). Even without any new actions, the background level of $PM_{2.5}$ already exceeds the NAAQS level. (Background concentrations for annual $PM_{2.5}$ throughout Kentucky tend to be higher than the NAAQS levels.) Any potential for increased health risk to the off-post public associated with the annual $PM_{2.5}$ level would exist even if the ACWA pilot test facility were not built. Except for the potential for adverse health impacts associated with the existing $PM_{2.5}$ background level, no adverse cumulative impacts on the health of the off-post public would occur.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. Except for the annual $PM_{2.5}$ level, particulate NAAQS levels would not be exceeded off post during construction, even if a baseline incinerator were built at the same time as an ACWA pilot test facility and other reasonably foreseeable on-post and off-post actions (Section 7.22.5). Even without any new actions, the background level of $PM_{2.5}$ already exceeds the NAAQS level. (Background concentrations for annual $PM_{2.5}$ throughout Kentucky tend to be higher than the NAAQS levels.) Any potential for increased health risk to the off-post public associated with the annual $PM_{2.5}$ background level would exist even if the ACWA pilot test facility and the baseline incinerator were not built. Except for the potential for adverse health impacts associated with the existing $PM_{2.5}$ background level, no adverse cumulative impacts on the health of the off-post public would occur.

7.22.6.2 Impacts of Operations

Emissions of toxic air pollutants, agent, and criteria pollutants are of interest.

Cumulative Impacts with Other Actions. On the basis of risks from agent processing and worst-case mustard emissions, the maximum increase in carcinogenic risk to on-post and off-post populations associated with air toxic emissions from any ACWA pilot test facility would be 2×10^{-9}, or 0.2% of the 1×10^{-6} level generally considered representative of negligible risk (Table 7.7-2). Noncarcinogenic risks would be 0.2% or less of the levels considered to present hazards. Increases in health risks beyond those associated with an ACWA pilot test facility would be negligible. The maximum estimated concentrations of agent from ACWA pilot test facility operations would be, at most, 0.26% of the maximum allowable level recommended by the CDC for all technologies and agents (Table 7.6-6). Other reasonably foreseeable on-post and off-post actions would make no contribution or negligible contributions to concentrations of air toxics and would not emit agent. Increases in health risks beyond those associated with an ACWA pilot test facility would be negligible.

Only annual $PM_{2.5}$ concentrations would exceed NAAQS levels (Section 7.22.5). Even without any new actions, the annual background level of $PM_{2.5}$ already exceeds the NAAQS level. (Background concentrations for annual $PM_{2.5}$ throughout Kentucky tend to be higher than the NAAQS levels.) An ACWA pilot test facility and other on-post and off-post actions, including the operation of the detonation chamber, operation of the molten salt operation facility, and temporary local highway construction, would add minor amounts to this background level. Any potential for increased health risk to the off-post public associated with annual $PM_{2.5}$ levels would exist even if the ACWA pilot test facility were not built. Except for the potential for adverse health impacts associated with the existing $PM_{2.5}$ background level, no adverse cumulative impacts to the health of the off-post public would occur.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. Since an EIS has not yet been published for a baseline incinerator at BGAD, post-specific risk estimates were not available. This EIS uses the risks for the Johnston Atoll Chemical Agent Disposal System (JACADS) incinerator, which were estimated on the basis of measured stack concentrations. Risk estimates based on representative conditions at BGAD would differ from those derived for JACADS. However, the methodology used in assessing risks from JACADS emissions was very conservative (i.e., it overestimated risks). Thus, the JACADS risks can be taken as reasonable indicators of the expected risks from a baseline incinerator at BGAD.

The maximum increase in carcinogenic risk from agent processing and worst-case mustard emissions to on-post and off-post populations associated with any technology for an ACWA pilot test facility would be 2×10^{-9}, or 0.2% of the 1×10^{-6} level generally considered representative of negligible risk (Table 7.7-2). Noncarcinogenic risks would be equal to or less than 0.2% of the levels considered to present hazards. As summarized in the EIS for PBA (Appendix H of U.S. Army 1997b), the maximum risk for a baseline incinerator would be 6.2×10^{-7}, or 62% of the 1×10^{-6} generally considered representative of negligible risk. When additivity for the carcinogens is assumed (a common assumption in risk assessments), a baseline incinerator and an ACWA pilot test facility operating simultaneously would represent an increased carcinogenic risk of approximately 6.2×10^{-7}. The total risk would still be generally be considered negligible.

Risks from the maximum possible release of agent from an ACWA pilot test facility were estimated by assuming that agent could be emitted continuously from the filter farm stack at the agent detection limit of the in-stack monitor (Section 7.6). The detection limit is about 20% of the concentration allowed in the stack. Operations would be shut down if the detection limit were reached. Thus, the estimate of risk is conservative (i.e., it overestimates risk). The maximum estimated risk from ACWA pilot test facility emissions would be 0.26% of the maximum allowable level recommended by the CDC (Table 7.6-6). Risk estimates for BGAD were not available. The U.S. Army (1991, 1997b, 2001) estimate the maximum risk from baseline incinerators at ANAD, PBA, and PCD conservatively and assume that emissions are at the allowable level. This EIS assumes lower emissions are at the detection limit. By choosing the largest of these estimates and adjusting the Army's results for lower emissions to put them at the detection limit, the maximum risk from the baseline incinerator would be 4.0% of the maximum allowable level recommended by the CDC. If an ACWA pilot test facility and a baseline incinerator were operating concurrently, the worst case would have agent levels equal to 2.6% of the allowable level. However, it is unlikely that such levels would be reached under routine operating conditions, because the two plants would have separate stacks at different locations, which would lead to lower maximum air concentrations than would occur if all emissions were from one stack. Also, the assumption of continuous agent release at the detection limit (Section 7.6) is very conservative and results in overestimates of possible agent releases.

Only annual $PM_{2.5}$ concentrations would exceed NAAQS levels (Section 7.22.5). Even without any new actions, the annual background level of $PM_{2.5}$ already exceeds the NAAQS level. (Background concentrations for annual $PM_{2.5}$ throughout Kentucky tend to be higher than the NAAQS levels.) An ACWA pilot test facility, a baseline incinerator, and other on-post and off-post actions, including operation of the detonation chamber, operation of the molten salt operation facility, and temporary local highway construction would add minor amounts to this background level. Any potential for increased health risk to the off-post public associated with the annual $PM_{2.5}$ level would exist even if the ACWA pilot test facility and the baseline incinerator were not built. Except for the potential for adverse health impacts associated with the existing $PM_{2.5}$ background level, no adverse cumulative impacts to the health of the off-post public would occur.

7.22.7 Noise

Currently, explosives are disposed of by open detonation. They are buried in the ground and detonated, which produces noise that annoys the surrounding community. BGAD has taken steps, including establishing limits on the quantity of munitions detonated and limits on the weather in which detonations can occur, to reduce noise (U.S. Army 1998a,b). This analysis assumes that an ACWA pilot test facility and a baseline incinerator would be constructed and operated simultaneously.

7.22.7.1 Cumulative Impacts with Other Actions

Construction and operation of an ACWA pilot test facility would result in maximum noise levels that would not exceed 48 dBA (Section 7.8) at the nearest installation boundary. This level is less than EPA's guideline of 55 dBA for protection of the public against interference and annoyance during outdoor activities. Even if all potential on-post construction projects along the southern boundary of the Chemical Limited Area were under construction at the same time as the ACWA pilot test facility, the cumulative noise level would still be under EPA's 55-dBA guideline. Noise from the new detonation chamber being built in the southern part of BGAD, more than 3.7 mi (5.6 km) from the proposed pilot test facility sites, is expected to be less than noise from open detonation (U.S. Army 1988b). This facility is about 3.7 mi (5.6 km) away from the potential ACWA sites and would not add appreciably to off-post noise levels from an ACWA pilot test facility.

7.22.7.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

Construction and operation of a baseline incinerator would, at most, double noise generation, resulting in an increase of less than 3 dBA in noise levels over those associated with an ACWA pilot test facility alone and other reasonably foreseeable on-post facilities. This increase would be barely perceptible.

7.22.8 Visual Resources

BGAD is in a semiurban area that includes agricultural, industrial, residential, and some commercial and public areas. The post itself is of a military and industrial nature and is mostly hidden from off-post view (Section 7.9). This analysis assumes than an ACWA pilot test facility and a baseline incinerator would be constructed and operated at the same time.

7.22.8.1 Cumulative Impacts with Other Actions

Both current actions and reasonably foreseeable future actions on post appear to be in keeping with the existing visual character of BGAD. They take place in areas that are not in constant view from the perimeter fence. Traffic and dust during construction of an ACWA pilot test facility and other on-post facilities would affect the visual character of BGAD. These impacts would be intermittent and temporary. During operations, an ACWA pilot test facility could produce a small steam plume. Any plumes associated with other reasonably foreseeable facilities would also be small. The cumulative visual impacts would remain in keeping with the visual character of BGAD and the surrounding area and would not be significant.

7.22.8.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

Construction of a baseline incinerator would add to the visual impacts associated with an ACWA pilot test facility and other on-post actions. Increased traffic and dust during construction of both facilities would increase the potential for temporary and intermittent disruption of the view of BGAD. During operations, the baseline incinerator would produce a large steam plume that would add to the visual impact of an ACWA pilot test facility's plume. Any plumes associated with other reasonably foreseeable facilities would be small. The cumulative visual impacts would remain in keeping with the visual character of BGAD and the surrounding area and would not be significant.

7.22.9 Soils

With the exception of soil contamination resulting from air emissions during operations, the area that was analyzed with regard to cumulative impacts on soils was limited to the immediate on-post vicinity of the proposed sites. Activities that would disturb soils would have very localized impacts and hence little chance to contribute to cumulative impacts. Both Area A and Area B are largely undisturbed. Construction of an ACWA pilot test facility in either area would disturb about 25 acres (10 ha) of soils.

7.22.9.1 Cumulative Impacts with Other Actions

Construction of an ACWA pilot test facility and its associated utility infrastructure would disturb up to 95 acres (38 ha) if built in Area A and up to 88 acres (36 ha) if built in Area B. Construction activities associated with other potential construction actions in the vicinity of Proposed Areas A and B would increase soil erosion and accidental spills and releases. These are the same type of impacts as those that would be associated with the construction of an ACWA pilot test facility. These impacts would be temporary and would be minor if the best management practices (see Section 7.10) were followed.

There would be no significant cumulative impacts on surface soils from the routine operation of an ACWA pilot test facility plus potential on-post and off-post actions. Anticipated facilities near the Chemical Limited Area would have very low or no emissions associated with their operation, and those with potential emissions would be located in the southern portion of the post, away from Proposed Areas A and B. Reasonably foreseeable off-post sources would have very low emissions and be located far enough away to preclude significant on-post deposition.

7.22.9.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

Although an EIS for a baseline incinerator at BGAD has not yet been published, it is estimated that construction of an incinerator and an ACWA pilot test facility could disturb up to about 160 acres (64 ha). Construction activities associated with a baseline incinerator would add to soil erosion and accidental spills and releases from construction of an ACWA pilot test facility and other construction activities in the vicinity of Proposed Areas A and B. These impacts would be temporary and would be minor if best management practices (see Section 7.10) were followed.

There would be no significant cumulative impacts on surface soils from the routine simultaneous operation of an ACWA pilot test facility and a baseline incinerator and other identified on-post and off-post actions. Impacts on soils from emissions from a baseline incinerator would be expected to be low (U.S. Army 1991, 1997b; Raytheon 1996) and would not increase the impacts from an ACWA pilot test facility significantly.

7.22.10 Groundwater

Groundwater is not used for the water supply at BGAD (Section 7.11).

7.22.10.1 Cumulative Impacts with Other Actions

During construction of an ACWA pilot test facility and other on-post facilities, standard construction practices, such as siltation fences, would be used to control erosion. Standard precautions would be followed to prevent leaks and spills during equipment refueling and other activities (Section 7.11). With the use of such mitigating practices, the overall cumulative impacts on groundwater from all construction activities would be negligible.

Routine operation of an ACWA pilot test facility would cause a slight increase in releases from the domestic sewage treatment plant, but the increased flow would not affect groundwater resources (Section 7.11). The detonation facility is designed to avoid any contact of explosives with groundwater (U.S. Army 1998b). Other reasonably foreseeable on-post facilities would have negligible or no impacts on groundwater.

7.22.10.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

Standard practices and precautions for preventing leaks and spills should be followed during construction of a baseline incinerator. Any impacts would add to the impacts associated with an ACWA pilot test facility and other possible on-post activities. However, if prevention measures were taken, the cumulative impacts from all construction activities on groundwater would be negligible.

Neither an ACWA pilot test facility nor a baseline incinerator would release process water (Section 7.11) (U.S. Army 1991, 1997b). A baseline incinerator would release about the same amount of domestic sewage as an ACWA pilot test facility, but the increased flow would not affect groundwater resources. These and other reasonably foreseeable on-post actions would have negligible or no impacts on groundwater.

7.22.11 Surface Water

This analysis assumes that an ACWA pilot test facility and a baseline incinerator would be constructed and operated simultaneously. Lake Vega, an on-post impoundment with a capacity of about 600 million gal (2.3 million m^3), currently supplies the water for BGAD. In FY 1999, 51 million gal (190,000 m^3) of water were consumed. In FY 2000, 39 million gal (150,000 m^3) were consumed.

7.22.11.1 Cumulative Impacts with Other Actions

During construction of an ACWA pilot test facility and other on-post facilities, standard construction practices should be used to control erosion. Standard precautions should be followed to prevent and clean up leaks and spills during equipment refueling and other activities (Section 7.12). With the use of such mitigating practices, the overall cumulative impacts on surface waters from all construction activities would be negligible.

Water use during operation of an ACWA pilot test facility would exceed water use during construction. Depending on the technology chosen, an ACWA pilot test facility could use up to 24 million gal/yr (91,000 m^3/yr) of potable and process water (Table 7.3-1) during normal operations. The additional requirements for other reasonably foreseeable on-post actions could not be quantified but are expected to be minor. The current water supply capacity of roughly

260 million gal/yr (980,000 m^3/yr) would be sufficient to meet these demands (Section 7.12.3). Other reasonably foreseeable on-post actions would use additional, minor quantities of water.

None of the ACWA technologies discharge process water; the only outfall to surface waters would be treated domestic sewage (see Section 7.4 for a discussion of sewage). The discharge of up to 7.5 million gal/yr (28,000 m^3/yr) of sanitary sewage from operation of an ACWA pilot test facility would not have a significant impact on surface water flows (Section 7.12.3). Other reasonably foreseeable on-post facilities would produce additional, minor quantities of sewage.

7.22.11.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

During construction of an ACWA pilot test facility, a baseline incinerator, and other on-post facilities, standard construction practices should be used to control erosion. Standard precautions should be followed to prevent and clean up leaks and spills during equipment refueling and other activities (Section 7.12). With the use of such mitigating practices, the overall cumulative impacts on surface waters from all construction activities would be negligible.

Water use during operation of an ACWA pilot test facility and a baseline incinerator would exceed water use during construction. Depending on the technology chosen, an ACWA pilot test facility could use up to 24 million gal/yr (91,000 m^3/yr) of potable and process water (Table 7.3-1). A baseline incinerator might use an additional 103 million gal/yr (390,000 m^3/yr). The current water supply capacity of roughly 260 million gal/yr (980,000 m^3/yr) would be sufficient to meet these demands (Section 7.12.4). Other reasonably foreseeable on-post actions would use additional, minor quantities of water.

None of the ACWA technologies or a baseline incinerator would discharge process water. The only outfall to surface waters would be treated domestic sewage (see Section 7.4 for a discussion of sewage). A baseline incinerator could discharge about 7.5 million gal/yr (28,000 m^3/yr) of sanitary sewage (Table 7.22-1) in addition to the discharge from an ACWA pilot test facility alone. The total discharge would not have a significant impact on surface water flows. Other reasonably foreseeable on-post facilities would produce additional, minor quantities of sewage.

7.22.12 Biological Resources

7.22.12.1 Terrestrial Habitats and Vegetation

Natural vegetation of the site is dominated by forested habitats. Large tracts of fescue-dominated pasture are maintained by mowing. Forest stands consisting of upland forest, riparian forest, and flatwood forest occur on roughly 2,900 acres (1,200 ha) of BGAD's 14,600 acres (5,900 ha). Cattle grazing and deer browsing have adversely affected about 75% of the forested areas at BGAD (Section 7.13).

Cumulative Impacts with Other Actions. Section 7.13 describes the impacts on terrestrial habitats and vegetation that might result from disturbing up to 95 acres (38 ha) of land while constructing an ACWA pilot test facility. Construction in Area A would affect about 22 acres (9 ha) of fescue-dominated grassland community. Construction in Area B would affect upland forest and grassland communities. Construction of other on-post facilities would increase the loss of vegetation as sites would be cleared. The area involved would be smaller than the area disturbed for an ACWA pilot test facility alone, but the acreage is not known exactly. Using standard erosion and runoff controls could mitigate impacts on vegetation that could result from sedimentation and erosion. A screening-level ecological risk assessment for soils found that air emissions from routine operation of an ACWA pilot test facility would have negligible impacts on terrestrial habitats and vegetation (Section 7.13). Given the small emissions potential of other reasonably foreseeable actions, or given their distance from the ACWA pilot test facility, cumulative impacts on terrestrial habitats and vegetation would be negligible.

Impacts on terrestrial habitats and vegetation associated with off-post facilities would be related to the size of the developments and the land area occupied. No new, large industrial facilities were identified. Other reasonably foreseeable actions, including highway and residential construction near BGAD, would have localized impacts that would add to the impacts of actions at BGAD. The impacts of off-post actions could not be quantified but are expected to be temporary or minor.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. Since an EIS for an incinerator at BGAD has not yet been published, information on post-specific impacts was not available. About 85 acres (34 ha) of land could be disturbed from building a baseline incinerator, which would add to the land disturbed from building an ACWA pilot test facility and other on-post actions. Constructing either facility in Area A would affect fescue-dominated grassland, and construction in Area B would affect upland forest and grassland. This increased disturbance would result in increased loss of vegetation. Using standard erosion and runoff controls would mitigate the additional impacts on vegetation and terrestrial habitats that could result from sedimentation and runoff.

A screening-level ecological risk assessment for soils found that air emissions from routine operations of an ACWA pilot test facility would have negligible impacts on terrestrial habitats and vegetation (Section 7.13). The EISs for ANAD and PBA indicate that impacts on terrestrial habitats and vegetation from a baseline incinerator should be negligible (U.S. Army 1991, 1997b). In addition, the total stockpile to be demilitarized is fixed; if a baseline incinerator were built and operated, fewer munitions would be demilitarized in an ACWA pilot test facility, thereby reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions or their distance from the ACWA pilot test facility, cumulative impacts on terrestrial habitats and vegetation from an ACWA pilot test facility, a possible baseline incinerator, and other potential facilities during routine operations would be negligible.

Impacts on terrestrial habitats and vegetation associated with off-post facilities would be related to the size of the developments and the land area occupied. No new, large industrial facilities were identified. Other reasonably foreseeable actions, including highway and residential construction near BGAD, would have localized impacts that would add to the impacts of actions at BGAD. The impacts of off-post actions could not be quantified but are expected to be temporary or minor.

7.22.12.2 Wildlife

Livestock grazing has adversely affected wildlife habitat at BGAD. Species diversity is relatively low at BGAD when compared with diversity at similar, undisturbed habitats in eastern Kentucky.

Cumulative Impacts with Other Actions. Section 7.14 describes the impacts on wildlife that might result from disturbing up to 95 acres (38 ha) of largely undisturbed habitat while constructing an ACWA pilot test facility in Area A or Area B. Loss of this amount of shrub, upland forest, and grassland habitat would not be expected to eliminate any wildlife species, since similar habitat is relatively common near both areas and elsewhere on BGAD. In Area B, construction could affect birds and mammals typical of upland forest, forest edge, and shrub habitats. Each new on-post construction activity would affect wildlife by increasing loss of habitat and increasing human activity and construction traffic. Cumulatively, these increases would cause additional deaths among burrowing and less mobile species (such as amphibians, some reptiles, and small mammals) and displace additional small mammals and songbirds. If possible, construction disturbance to the tributaries to Muddy Creek and portions of Proposed Area B should be avoided to protect floodplain riparian community that provides habitat for amphibians and reptiles.

Additional operations on post would increase the number of workers and deliveries. Roadkills would increase as a result of the consequent increase in traffic. The nearby Site Security Control Center would result in some increased noise from traffic, but even with other on-post actions, there would be no appreciable cumulative increase in noise levels. A screening-level ecological risk assessment for soils found that air emissions from routine operations of an ACWA pilot test facility would have negligible impacts on wildlife (Section 7.14). Given the small emissions potential of other reasonably foreseeable actions, cumulative impacts on wildlife would be negligible.

Cumulative impacts on wildlife associated with the off-post trend of increasing urbanization would be negligible. Impacts associated with off-post facilities would be related to the size of the developments and the land area occupied. No new, large industrial facilities were identified. Other reasonably foreseeable actions, including highway and residential construction near BGAD, would have localized impacts that would add to the impacts of actions at BGAD. The impacts of off-post actions could not be quantified but are expected to be temporary or minor.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. About 85 acres (34 ha) of additional land beyond that disturbed by building an ACWA pilot test facility could be disturbed by building a baseline incinerator in Area A or Area B. Loss of a total of up to 180 acres (73 ha) of largely undisturbed habitat consisting of shrub, upland forest, and grassland habitat would not be expected to eliminate any wildlife species, since similar habitat is relatively common near both areas and elsewhere on BGAD. In Area B, construction could affect birds and mammals typical of upland forest, forest edge, and shrub habitats. The construction of a baseline incinerator would increase loss of habitat, human activity, and construction traffic over the levels associated with an ACWA pilot test facility; cause additional deaths among less mobile and burrowing species; and displace additional wildlife during the temporary construction period. Increased noise would displace additional small mammals and potentially lead to increased habitat abandonment by songbirds.

A screening-level ecological risk assessment for soils found that air emissions from routine operations of an ACWA pilot test facility would have negligible impacts on wildlife (Section 7.14). EISs for ANAD and PBA indicate that impacts on wildlife from a baseline incinerator should be negligible (U.S. Army 1991, 1997b). In addition, the total stockpile to be demilitarized is fixed; if a baseline incinerator were built and operated, fewer munitions would be demilitarized in an ACWA pilot test facility, thereby reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions, cumulative impacts on wildlife from an ACWA pilot test facility, a possible baseline incinerator, and other potential facilities during routine operations would be negligible.

Additional workers and deliveries would be required for the construction and operation of a baseline incinerator, resulting in a consequent increase in worker traffic over the levels associated with an ACWA pilot test facility alone. This additional traffic would result in an increase in roadkills.

Adding a baseline incinerator near the ACWA pilot test facility would result in an increase of less than 3 dBA in the noise levels associated with an ACWA pilot test facility alone.

This noise and noise from other new facilities would make no appreciable contributions to noise levels.

Impacts on wildlife associated with off-post facilities would be related to the size of the developments and the land area occupied. No new, large industrial facilities were identified. Other reasonably foreseeable actions, including highway and residential construction near BGAD, would have localized impacts that would add to the impacts of actions at BGAD. The impacts of off-post actions could not be quantified but are expected to be temporary or minor.

7.22.12.3 Aquatic Habitats and Fish

Cumulative Impacts with Other Activities. Adverse cumulative impacts on aquatic habitats and fish from construction of an ACWA pilot test facility and other on-post facilities and off-post road construction would not be likely if measures were taken to control erosion and runoff (Section 7.15).

Routine operations of the ACWA pilot test facility would have negligible impacts on aquatic habitats and fish (Section 7.15). Given the small emissions and deposition potential of other reasonably foreseeable on-post actions or their distance from the ACWA pilot test facility, cumulative impacts on aquatic habitats and fish during routine operations would be negligible.

Cumulative Impacts with Other Activities, Including a Baseline Incinerator. Since an EIS for a baseline incinerator has not yet been published, post-specific impacts were not available. Impacts from construction would add to those associated with an ACWA pilot test facility, but adverse impacts on aquatic habitats and fish would not occur if measures to control erosion and runoff were taken for all facilities. Likewise, adverse cumulative impacts during construction of roads in the vicinity of BGAD would not occur if standard erosion and runoff control measures were taken.

Routine operations of an ACWA pilot test facility would have negligible impacts on aquatic habitats and fish (Section 7.15). EISs for ANAD and PBA indicate that a baseline incinerator should have negligible impacts on aquatic habitats and fish (U.S. Army 1991, 1997b). In addition, the total stockpile to be demilitarized is fixed; if a baseline incinerator were built and operated, fewer munitions would be demilitarized in an ACWA pilot test facility, thereby reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions or their distance from the ACWA pilot test facility, cumulative impacts on aquatic habitats and fish from an ACWA pilot test facility, a baseline incinerator, and other potential facilities during routine operations would be negligible.

7.22.12.4 Protected Species

Of the federally listed species in the vicinity of BGAD, only running buffalo clover and the bald eagle are known to occur on post (Section 7.16).

Cumulative Impacts with Other Actions. Construction associated with on-post actions, including an ACWA pilot test facility in either Proposed Area A or Proposed Area B, could have adverse cumulative impacts on running buffalo clover, a federally listed endangered species. The clover typically grows in disturbed areas. Some of this habitat would be disturbed during construction. Surveying for running buffalo clover and marking and avoiding patches during construction would reduce potential impacts.

Cumulative impacts on the bald eagle, a federally listed threatened species, would be minor, since it might inhabit BGAD only periodically during the winter months or as a transient species during migration between wintering areas and its breeding range in the northern United States and Canada.

Routine operations of an ACWA pilot test facility would have negligible impacts on federally protected species at BGAD (Section 7.16). Emissions from other reasonably foreseeable on-post sources would also be small or emitted far enough away from Proposed Areas A and B so as to contribute only negligible amounts to overall deposition. Reasonably foreseeable future off-post actions could affect the same overall populations as on-post actions at BGAD. These impacts could not be quantified but are expected to be minor. Cumulative impacts on protected species from atmospheric emissions would be negligible.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. If a baseline incinerator were also built, its construction could disturb more RBC patches than would be disturbed from constructing an ACWA pilot test facility alone. Surveying for RBC and marking and avoiding patches during construction would reduce potential impacts. A baseline incinerator would necessitate additional construction activities and additional human presence. These would increase the potential for minor impacts on the bald eagle, as noted above.

Routine operations of an ACWA pilot test facility would have negligible impacts on protected species (Section 7.16). EISs for ANAD and PBA indicate that a baseline incinerator should have negligible impacts on protected species (U.S. Army 1991, 1997b). In addition, the total stockpile to be demilitarized is fixed; if a baseline incinerator were built and operated, fewer munitions would be demilitarized in an ACWA pilot test facility, thereby reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions or their distance from the ACWA pilot test facility, cumulative impacts on protected species from an ACWA pilot test facility, a baseline incinerator, and other reasonably foreseeable actions should be negligible.

Reasonably foreseeable future off-post actions could affect the same overall populations as those affected by on-post actions at BGAD. These impacts could not be quantified but are expected to be minor. Cumulative impacts on protected species from atmospheric emissions would be negligible.

7.22.12.5 Wetlands

A wetland inventory was conducted for BGAD in 1999 and 2000.

Cumulative Impacts with Other Actions. No wetlands would be directly affected by construction of an ACWA pilot test facility in Proposed Area A. Construction in Proposed Area B could affect three small wetlands, each less than 0.5 acre (0.2 ha). In addition, a 1.5- to 2.0-acre (0.6- to 0.8-ha) wetland could be affected if Route 2 is widened under Option 2 (Section 7.17). Any potential wetland impacts could be mitigated by using the measures listed in Section 7.17. The locations of the detonation facility and the molten salt operation facility would avoid wetlands (U.S. Army 1998a,b). Locations of other reasonably foreseeable on-post actions would also avoid wetlands. Local off-post road construction would not affect wetlands on BGAD if standard erosion and runoff control measures were taken.

Routine operation of an ACWA pilot test facility would have negligible impacts on wetlands (Section 7.17). Emissions from other reasonably foreseeable on-post sources would also be small or emitted far enough away from the chosen ACWA pilot facility site that cumulative impacts on wetlands would be negligible. Discharge from the new sanitary waste treatment facility for the ACWA pilot test facility could lead to a small area of new wetland vegetation.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. Since an EIS for a baseline incinerator at BGAD has not yet been published, information on post-specific impacts was not available. During construction, a baseline incinerator would likely use the same gate, parking area, and access road as those used by an ACWA pilot test facility. There are no wetlands in Proposed Area A. Constructing a baseline incinerator in Proposed Area B could adversely affect the three small wetlands, each less than 0.5 acre (0.2 ha). In addition, a 1.5 to 2.0-acre (0.6 to 0.8-ha) wetland could be affected if Route 2 is widened under Option 2 (Section 7.17.3). Depending on the corridors chosen for utility infrastructure, construction of a baseline incinerator could increase the cumulative impacts on wetlands over those associated with an ACWA pilot test facility alone. Any potential wetland impacts could be mitigated by taking the measures listed in Section 7.17. The detonation facility and the molten salt operation facility would avoid wetlands (U.S. Army 1998a,b). Locations of other reasonably foreseeable on-post actions would also avoid wetlands. Local off-post road construction would not affect wetlands on BGAD if standard erosion and runoff control measures were taken.

Routine operations of an ACWA pilot test facility would have negligible impacts on wetlands (Section 7.17). EISs for ANAD and PBA indicate that a baseline incinerator should have negligible impacts on wetlands (U.S. Army 1991, 1997b). In addition, the total stockpile to be demilitarized is fixed; if a baseline incinerator were built and operated, fewer munitions would be demilitarized in an ACWA pilot test facility, thereby reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions or their distance from the ACWA pilot test facility, cumulative impacts on wetland vegetation and wildlife from an ACWA pilot test facility, a baseline incinerator, and other potential facilities would be negligible during routine operations.

7.22.13 Socioeconomics

Construction and operation of an ACWA pilot test facility might produce cumulative impacts if construction and operations occurred concurrently with other existing or future activities on post at BGAD or in the five-county ROI surrounding the post.

7.22.13.1 Cumulative Impacts with Other Actions

The on-post development of alternate uses for BGAD facilities might create additional demands on post utility and transportation infrastructures if on-post activities occurred concurrently with the construction and operation of an ACWA facility. However, other reasonably foreseeable on-post actions would be expected to employ far fewer people than would an ACWA facility. In the area surrounding the post, any industrial, commercial, and residential development that might occur could also lead to cumulative impacts on local socioeconomic resources if impacts were not adequately planned for.

The cumulative socioeconomic impacts of construction and operation of an ACWA facility, together with existing or planned economic development activities, would be relatively small. In addition to a local road expansion program planned for the period 2003–2005, a number of small commercial and industrial facilities are expected to be built in Richmond Industrial Park and Berea Industrial Park. Also, more than 4,000 lots are slated for residential construction in Madison County (Smith 2001) over the next five years. More specific information on the size and precise timing of any of these projects was not available. However, judging from the size of the impacts from similar activities in other rural communities, even if these projects occurred during the construction and operation of an ACWA pilot test facility, the potential cumulative impact of these activities, together with those of an ACWA pilot test facility, on the local economy, local labor markets, and public and community services would be minor. Impacts on the local transportation network would be moderate.

7.22.13.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

More significant cumulative socioeconomic impacts would occur with the additional concurrent construction of an incinerator at the post, together with current and projected off-post activities. Construction of both the ACWA facility and baseline incinerator would be expected to generate approximately 3,000 direct and indirect jobs in the peak year in the ROI, with the operation of both facilities likely to employ roughly 2,600 persons. Construction and operations jobs for both facilities would be partially filled by workers moving into the ROI, which would have only a minor effect on the local housing market. Demand for rental housing during the peak year of construction would require approximately 5% of the vacant rental housing stock, and roughly 24% of vacant owner-occupied housing would be required during operations. More than 4,000 lots are slated for residential development in Madison County (Smith 2001). If current vacancy rates and housing development continue, adverse cumulative impacts on housing should not occur.

Local labor markets would probably not be adversely affected by the concurrent construction and operation of an ACWA facility and baseline incinerator and projected off-post activities. The post is located in the Lexington Metropolitan Statistical Area, in which a variety of occupations are represented and in which unemployment levels are high enough to meet the demand for local labor that would be created by both projects.

Concurrent construction and operation of the two facilities and projected off-post activities might cause moderate impacts on the local transportation network. Taken together, construction of both facilities would result in an additional 2,100 daily trips on US 421/25 North, the local road segment most heavily used by existing post employees, or an 8% increase in annual average daily traffic. Concurrent operation of both facilities would result in an additional 1,600 daily trips, or an increase of 6% in annual average daily traffic on US 421/25 North.

Although more local public service employees, medical services workers, and teachers would be needed if the construction and operation of both the ACWA facility and the incinerator and projected off-post activities were to occur concurrently, given sufficient planning, local public service providers should be able cope with the additional demands through associated increases in city, county, and school district revenue collections.

7.22.14 Environmental Justice

Environmental justice impacts would be related to socioeconomic and human health impacts. No environmental justice impacts are anticipated from construction and routine operation of an ACWA pilot test facility (Section 7.20).

7.22.14.1 Cumulative Impacts with Other Actions

During the construction and routine operations of an ACWA pilot test facility, high and adverse impacts would not be anticipated with regard to either socioeconomic activities or human health (Sections 7.7 and 7.19). Moreover, the cumulative impacts associated with an ACWA pilot test facility and other reasonably foreseeable actions would not be expected to contribute to high and adverse impacts on minority or low-income populations (Sections 7.22.6 and 7.22.13). However, even without new facilities at BGAD, annual $PM_{2.5}$ concentrations already exceed the NAAQS level. Significant cumulative environmental justice impacts from construction and routine operations are not anticipated.

7.22.14.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

A baseline incinerator would increase the human health and socioeconomic impacts over those of an ACWA pilot test facility alone (Sections 7.22.6 and 7.22.13). However, even without new facilities at BGAD, annual $PM_{2.5}$ concentrations already exceed the NAAQS level. Sufficient planning would be needed to meet additional demands for local services if both an ACWA pilot test facility and a baseline incinerator were constructed and operated simultaneously (Section 7.22.13). Overall, the impacts from an ACWA pilot test facility, a baseline incinerator, and other actions would not be considered high and adverse. Significant cumulative environmental justice impacts from the construction and routine operations of an ACWA pilot test facility, a baseline incinerator, and other reasonably foreseeable actions are not anticipated.

7.23 AGRICULTURE

This section was prepared in response to public comment on the draft of this EIS (see Volume 2, Section 2, Part DD of this final EIS). This assessment describes agriculture near BGAD and evaluates whether toxic air pollutants from pilot facility operations would impact crops and livestock. It also assesses potential agricultural losses from an accident involving release of chemical agent.

7.23.1 Current Environment

7.23.1.1 Land Use

The region of influence (ROI) used to assess impacts on agriculture consists of 22 counties located entirely or partly within a radius of 30 mi (50 km) around BGAD. This agricultural ROI contains 3.9 million acres (1.6 million ha) of land, of which 64% were farmland in 1997 (USDA 1999). There were 17,000 farms, of which more than a third were operated by full-time farmers (Table 7.23-1). Average farm size in the ROI ranged from 88 to 216 acres (36 to 87 ha).

7.23.1.2 Employment

Although agriculture was historically a significant local source of employment in the 22-county ROI, its importance declined during the 1990s. In 1999, there were 4,917 employees on farms and in agricultural services, accounting for a little less than 15% of total employment in the ROI (U.S. Bureau of the Census 2001a). Agriculture, which has historically been a significant local source of employment in Madison County, contributed 13% to total county employment in 2000 (U.S. Bureau of the Census 2001a). Information on numbers of migrant and seasonal farm workers was unavailable. Within the South Census Region in 1998, about half of such farm workers were White, 37% were Hispanic, and the remainder were Black and other racial/ethnic groups (Runyan 2000).

TABLE 7.23-1 Farms and Crop Acreage in the Agricultural Region of Influence around BGAD in 1997[a]

	Land (acres) and Farms (no.)	
Farms and Land	ROI	State
Land in farms (acres)	2,512,767	13,334,234
Number of farms	16,997	82,273
Full-time farms	7,328	33,841
Average farm size (acres)	88 – 216	162
Total cropland (acres)	1,574,242	8,549,027
Harvested cropland (acres)	615,431	4,678,622

[a] The agricultural ROI is composed of the following counties: Bath, Bourbon, Boyle, Clark, Estill, Fayette, Garrard, Jessamine, Jackson, Laurel, Lee, Lincoln, Madison, Menifee, Mercer, Montgomery, Owsley, Powell, Pulaski, Rockcastle, Wolfe, and Woodford.

Source: USDA (1999).

7.23.1.3 Production and Sales

Hay, tobacco, corn, and beans are the primary crops harvested (Table 7.23-2). Cattle and hog production are the major types of livestock produced in the ROI. Farms in the agricultural ROI generated $752 million in agricultural sales in 1997, representing 25% of total agricultural sales in the state as a whole. The majority of sales (65%) consisted of livestock, with a smaller contribution made by crops (Table 7.23-3) (USDA 1999).

TABLE 7.23-2 Agricultural Production in the Agricultural Region of Influence around BGAD in 1997[a]

	Crops (acres) and Livestock (no.)	
Crops and Livestock	ROI	State
Selected crops harvested		
Hay	434,864	2,009,061
Tobacco	71,434	255,053
Corn	66,252	104,920
Beans	25,009	1,214,938
Wheat	7,153	408,771
Livestock inventory		
Cattle and calves	579,248[b]	2,428,891
Hogs and pigs	19,732[b]	563,797
Sheep and lambs	5,957[b]	21,664
Layers and pullets	6,051[b]	3,500,904
Broilers sold	0[b]	91,548,829

[a] The agricultural ROI is composed of the following counties: Bath, Bourbon, Boyle, Clark, Estill, Fayette, Garrard, Jessamine, Jackson, Laurel, Lee, Lincoln, Madison, Menifee, Mercer, Montgomery, Owsley, Powell, Pulaski, Rockcastle, Wolfe, and Woodford.

[b] ROI inventory is an underestimate due to data unavailability for some counties.

Source: USDA (1999).

TABLE 7.23-3 Sales by Farms in the Agricultural Region of Influence around BGAD in 1992 and 1997[a]

	Sales (millions of $)	
Product	1992	1997
Livestock	388.5	488.4
Harvested crops	270.2	263.3
Agricultural ROI total	658.7	751.8
State total	2,663.7	3,064.5

[a] The agricultural ROI consists of the following counties: Bath, Bourbon, Boyle, Clark, Estill, Fayette, Garrard, Jessamine, Jackson, Laurel, Lee, Lincoln, Madison, Menifee, Mercer, Montgomery, Owsley, Powell, Pulaski, Rockcastle, Wolfe, and Woodford.

Source: USDA (1994, 1999).

In addition to agricultural production of food products, the ROI is a major production site for the horse breeding industry. A major portion of the U.S. thoroughbred breeding stock is raised in the region. No estimates were available of the numbers of horses in the region or their value, but this is a multi-million-dollar industry that employs thousands of workers.

7.23.2 Site-Specific Factors

The only aspect of pilot facility operations that could have an impact on agriculture is the release of substances that could cause toxic effects on crops or livestock. Routine or fluctuating operations of a pilot facility or an accident could release organic or inorganic compounds, including agent or processing by-products, to the environment (see Sections 7.5 and 7.6). Atmospheric releases could result in the widespread dispersal and deposition of contaminants. Exposures might result in lethal effects, reduced growth or other limiting effects, or no observable effect.

7.23.3 Impacts of the Proposed Action

Impacts from construction and operations are discussed below. This analysis considers effects on agricultural production, employment, and sales. The impacts of no action are provided for comparison.

7.23.3.1 Impacts of Construction

Construction impacts would be confined to the installation; therefore, no significant impacts on agriculture would be likely from facility construction activities.

7.23.3.2 Impacts of Routine Operations

During routine operations, crops and livestock in the vicinity of the pilot test facility would be exposed to atmospheric emissions from the boiler stack and process stack. All such facility emissions, including emissions of criteria pollutants, organic compounds, and trace elements, would be within applicable air quality standards (see Sections 7.5 and 7.6).

A screening-level ecological/agricultural risk assessment was conducted to assess the risk to agriculture resources from deposition of air emissions during routine operations of each of the four pilot test technologies. For this evaluation, it was assumed that all emissions were deposited on the soils within a circle defined by the distance from the proposed pilot test site to the nearest BGAD installation boundary. This assumption provides an upper limit on possible deposition at off-site locations. Actual deposition of pollutants would be less than this value and would tend to decline with distance from BGAD. Within this area, the deposited emissions were assumed to be completely mixed into the top 1 cm (0.5 in.) of soil. The resulting pollutant concentration was compared with the lowest soil benchmark value available from the EPA and state sources. These benchmark concentrations for soil are based on conservative ecological endpoints and sensitive toxicological effects on plants, wildlife, and soil invertebrates. Soil chemical concentrations that fall below the benchmark are considered to have negligible risk. Those chemicals that exceed the benchmark values are considered to be contaminants of concern and would be evaluated in further detail. Xylene isomers from Neut/Bio pilot testing would be the only chemicals emitted by a pilot test facility that, when deposited on soils, would exceed their soil benchmark values. Because xylene is a gas with high volatility and low solubility in water, it would be unlikely to be deposited to soils as assumed. Maximum air concentrations of xylenes (before dispersion) would be many times lower than levels at which effects have been induced in laboratory animals. The analysis indicates that the risks of impacts on agriculture from maximum concentrations would be negligible (Tsao 2001). Off-site concentrations would be substantially lower due to the effect of emission dilution over a larger area.

Most of the toxic air pollutants emitted by a pilot test facility (Section 7.6) would be from the boiler stack, a source type commonly found in any combustion facility that requires fuel to heat up the system. Boiler emissions would be followed in quantity by the emissions from the emergency diesel generator, which would operate only in case of power failure. The technology-specific emissions would contribute very little to the overall deposition of metals and organics onto soil. There is no evidence that deposited residuals from agent emitted due to fluctuating operations would bioaccumulate through the food chain (USACHPPM 1999b).

7.23.3.3 Impacts of Accidents

Section 7.21 describes potential accidents for both the proposed action and no action, including a catastrophic event that would release agent to surrounding land areas. Although extremely unlikely, release of agent might affect a major portion of the ROI. The largest impact of an accident on agriculture would result if all of the crops and livestock produced in a single season in the ROI were interdicted (either by federal or state authorities) and removed from the marketplace. The impacts from such losses in agricultural output on the economy of the counties within the 30-mi (50-km) radius surrounding BGAD would be significant. Table 7.23-4 presents

TABLE 7.23-4 Agricultural Impacts of Accidents at BGAD Associated with the Proposed Action and No Action[a]

Parameter	Neut/Bio	Neut/ SCWO	Neut/ GPCR/ TW-SCWO	Elchem Ox	No Action
Impacts to the regional economy from a one-year loss of agricultural output					
100% loss of agricultural output					
Employment (no. of jobs)	36,000	36,000	36,000	36,000	36,000
Income (millions of $)	840	840	840	840	840
75% loss of agricultural output					
Employment (no. of jobs)	27,000	27,000	27,000	27,000	27,000
Income (millions of $)	630	630	630	630	630
50% loss of agricultural output					
Employment (no. of jobs)	18,000	18,000	18,000	18,000	18,000
Income (millions of $)	420	420	420	420	420

[a] Impacts for no action and the proposed action are presented for the first year of operation of an ACWA facility (2009).

three scenarios of regional losses of employment and income associated with 50, 75, or 100% loss of agricultural production (see Appendix G). These scenarios are presented for each of the pilot test technologies and for no action. The estimated losses do not include the losses that would occur in the case of death of breeding stocks of animals. Because scenarios involving widespread agent release were identified for both the proposed action and no action, the magnitude of such losses is unlikely to differ between the proposed action and no action.

7.23.4 Impacts of No Action

7.23.4.1 Impacts of Routine Operations

The agricultural impacts of continuing routine operations at BGAD would be negligible and as included in baseline conditions for the BGAD region.

7.23.4.2 Impacts of Accidents

Potential impacts on agriculture associated with the accident scenarios under the no action alternative would be the same as those discussed under the proposed action alternatives (Section 7.23.3.3).

7.24 OTHER IMPACTS

7.24.1 Unavoidable Adverse Impacts

Most potential adverse impacts identified in this EIS would either be negligible or could be avoided through careful facility siting and adherence to best management practices during the construction and operation of industrial facilities. However, some minor unavoidable adverse impacts could result from implementation of an ACWA technology. These are described in this section.

ACWA facility construction activities, including land clearing and moving of personnel and equipment in the construction staging area(s), would require disturbance of as much as 25 acres (10 ha) and could result in unavoidable adverse impacts comparable to those that would occur at any construction site of similar size. An additional 70 acres (28 ha) could be disturbed by utility construction.

- As much as 95 acres (38 ha) of vegetative and terrestrial habitats could be disturbed. Most disturbances would be short-term (less than 34 months) and would be mitigated through revegetation and careful construction siting and planning.

- Wildlife would be affected by loss of habitat, increased human activity in the construction area, increased traffic on local roads, and noise. Less mobile and burrowing species (such as amphibians, some reptiles, and small mammals) could be killed during vegetation clearing and other site preparation activities.

- Running buffalo clover (RBC), a federal endangered species, could be affected by habitat disturbance or loss of individual plants in patches along the proposed 69-kV transmission line. Protection measures, as outlined in the biological assessment (Appendix E), would be implemented to minimize potential losses.

- Several archaeological sites occur in the vicinity of the project area. Further surveys would be conducted before construction would begin. These surveys might identify additional archaeological resources in the construction areas. If important cultural resources could possibly be affected by construction activities, mitigation would be conducted. If the sites could not be avoided, data would be recovered, and the site(s) would be lost.

- Air quality would be affected during construction as a result of increased fugitive dust emissions (PM_{10} and $PM_{2.5}$). Background concentrations of $PM_{2.5}$ are already near the maximum levels of applicable air quality standards. Emissions from construction of an ACWA pilot test facility, although they would be very low overall, would result in levels above the applicable NAAQS, primarily because of high background concentration levels. Similarly, emissions of $PM_{2.5}$ during operations would be very low, but would exceed the NAAQS because the background levels are already over the standard.

- Adverse health impacts from PM inhalation could occur because the background level for $PM_{2.5}$ in the vicinity of BGAD is at the health-based annual NAAQS level. (Note: This risk would be present with or without an ACWA facility.)

- A small number of worker injuries would be expected during construction of an ACWA facility: 48 for Neut/Bio, 57 for Neut/SCWO, 65 for Neut/GPCR/TW-SCWO, and 61 for Elchem Ox. Worker injuries were estimated on the basis of the number of workers and duration of construction. When workers follow established safety precautions, the risk of worker fatalities is very low.

The normal operations of an ACWA facility would have minor unavoidable adverse impacts. Facility workers would be subject to some risks from operations, and an estimated 18–70 worker injuries would be expected (about 18 for mustard agent processing only and about 60–70 for both mustard and nerve agent processing). There would also be minor increases in emissions of air pollutants, but these emissions would be well below allowable levels and would not significantly affect human health, ecological resources, or wetlands. Impacts related to fluctuating operations are also expected to be minimal, given the safety features that would be built into the design of ACWA facilities, which would prevent migration of contaminants to the environment in the event of a spill or other operational accident. While there would be significant unavoidable adverse impacts related to a catastrophic accident, the probability of this scenario is extremely remote.

7.24.2 Irreversible and Irretrievable Commitment of Resources

Irreversible commitments are those that cannot be reversed (i.e., the resource is permanently lost or consumed). Irreversible commitments that would result from the construction and operation of a proposed ACWA pilot test facility include consumption of electricity, natural gas, and fuel oil, as described in Section 7.3. Materials such as the concrete and steel used to construct the pilot test facility would also generally be irreversible commitments because they would probably not be recyclable because of potential agent contamination. Data on the quantities of construction materials required for an ACWA pilot facility are provided in Kimmell et al. (2001).

Irretrievable commitments are those that are lost for a period of time. Irretrievable commitments that would result from the construction and operation of a proposed ACWA pilot test facility would include water and habitat. Implementation of an ACWA technology would consume both process and potable water for the period of construction and operations (i.e., less than six years total). (Amounts of water consumed are discussed in Section 7.3.) When proposed operations would cease, water used by an ACWA technology would be available for other uses. Habitat lost because of the construction of an ACWA pilot test facility would also represent an irretrievable commitment. Habitat in the footprint of an ACWA pilot facility would be lost during the period of construction and operations (i.e., less than seven years total). After decontamination and decommissioning, the land could be revegetated, and habitat could be restored. Depending on the methods chosen for decommissioning, habitat losses could also be considered irreversible.

7.24.3 Short-Term Uses of the Environment and Enhancement of Long-Term Productivity

Constructing and operating one or more pilot test facilities would be an action of limited duration — less than six years. Construction would disturb soils, wildlife, and other biota, and it would produce temporary air emissions. Operations would produce air emissions, liquid effluents, and liquid and solid wastes. Air emissions and liquid effluent releases would be temporary, ceasing at the end of the project life. Disposal of wastes on post and off post would be a long-term commitment of land with restricted use. Construction and operation of one or more pilot test facilities would have short-term socioeconomic impacts for the duration of construction and pilot testing by creating jobs, increasing tax revenues, and increasing demand for housing and public services.

After pilot testing, the ACWA facility might be used to destroy the remaining on-post ACW stockpile. At the end of stockpile destruction, the facilities would be decontaminated and demolished, and the land would be returned to long-term productivity.

The pilot testing of an ACWA technology system would not substantially reduce or increase the risks to the public from accidents involving chemical agent. This situation would occur because the accidents with the greatest consequences, although highly unlikely, are associated with ACW storage, and ACW storage would continue during pilot testing. The consequences from highly unlikely accidents involving agents at a pilot test facility would be less than the consequences from similar highly unlikely accidents, including ACW storage.

7.25 MITIGATION

For environmental resource areas where adverse impacts have been identified, mitigation measures have been developed to minimize or avoid potential impacts from constructing and operating an ACWA pilot facility. The mitigation measures are outlined below. Because no adverse impacts on land use, infrastructure, noise, visual resources, socioeconomics, or environmental justice were identified, no mitigation would be required for these resource areas.

7.25.1 Waste Management

Adequate facilities exist to handle hazardous and nonhazardous wastes that would be generated by construction activities. Large potentially hazardous waste streams would be produced from operating any of the neutralization pilot test facilities; a smaller volume of hazardous wastes would be generated by Elchem Ox. The Army would work with regulators to develop procedures for handling potentially hazardous wastes resulting from ACW destruction. These procedures might include conducting tests to determine the toxicity of wastes, developing a process to stabilize salt wastes, sending wastes to a permitted hazardous waste disposal facility, or others.

7.25.2 Air Quality — Criteria Pollutants

Fugitive dust emissions would be generated during construction of an ACWA pilot facility. To minimize dust emissions, access roads would be paved with asphaltic concrete, and standard dust suppression measures (i.e., watering) would be employed at the construction sites.

7.25.3 Air Quality — Toxic Air Pollutants

No significant emissions of hazardous air pollutants are expected during construction of an ACWA pilot facility. During operations, the ACWA facility would be equipped with multiple carbon filter banks and with agent monitoring devices between banks to ensure that, in the unlikely event that some agent was not destroyed in the neutralization process and subsequent treatment, it would be detected, and the causes would be mitigated immediately.

7.25.4 Human Health

Some risk to workers would result from constructing and operating an ACWA pilot facility. Workers would adhere to safety standards and use protective equipment as necessary to reduce these risks. Also, the ACWA facility would be designed and operated to contain potential agent emissions to air, water, or soils. Design components (e.g., recycling process effluents, surrounding the facility with a berm, installing automated agent detection devices) would be incorporated to minimize operational and accidental emissions. Emergency response procedures are in place to protect human health and safety, both on post and off post, in the unlikely event of a significant release to the environment from a catastrophic accident (see Section 7.21).

7.25.5 Geology and Soils

Best management practices (e.g., use of siltation fences, berms, and liners; revegetation of disturbed land following construction) would be employed to minimize the potential for soil erosion potentially caused by construction of an ACWA pilot facility. A berm would surround the facilities to contain any potential releases from spills or fluctuating operations. In addition, the facilities would be designed with many safety features (e.g., detection devices, automatic shutoff) to prevent migration of spills from an operational accident.

7.25.6 Groundwater, Surface Water, and Wetlands

Runoff created by construction would be contained or minimized by using standard erosion control measures (i.e., siltation fences or straw bales). The sedimentation pond would be designed and placed to avoid impacts on wetlands from soil erosion and runoff during construction, including potential impacts from sediment input to tributaries of Muddy Creek. Pipelines and power lines would be routed to avoid existing wetlands.

A berm would surround the facilities to contain any potential releases from spills or fluctuating operations. The facilities would be designed with many safety features (e.g., detection devices, automatic shutoff) to prevent migration of spills from an operational accident.

7.25.7 Vegetation, Wildlife, Protected Species, and Aquatic Resources

Construction could affect as much as 95 acres (38 ha) of vegetative, terrestrial, and aquatic habitat. The following mitigation measures would be implemented to reduce adverse impacts on ecological resources during construction.

- Construction of the 69-kV transmission line would be planned to (1) avoid sensitive riparian habitats and highly erodible slopes by spanning such areas and (2) preclude the use of construction vehicles where possible.

- In designing the 69-kV transmission line, suggested practices for raptor protection would be followed in order to prevent raptor electrocution.

- Disturbance to the tributaries to Muddy Creek along the proposed transmission line and portions of Proposed Area B would be avoided to protect a relatively rich herbaceous layer in the floodplain riparian community that provides habitat for amphibians and reptiles.

- The sedimentation pond would be designed and placed to avoid impacts on vegetation and wetlands from soil erosion and runoff during construction, including potential impacts from sediment input to tributaries of Muddy Creek.

- Siltation fencing or other mechanical erosion control measures would be employed during construction to control runoff in areas where surface disturbance could affect aquatic species or wetlands.

- The Army would conduct clearance surveys for RBC, mark patches discovered, and avoid patches when placing electrical towers and erecting the conductors.

- Construction workers would be briefed on sensitive ecological resources and mitigation measures.

- Disturbed areas would be revegetated as soon as possible after construction was completed.

7.25.8 Cultural Resources

Archaeological surveys of the selected construction site, selected utility and access road corridors, and other areas of ground disturbance would be conducted before the start of any activities. Upon completion of these surveys, the Army would obtain SHPO concurrence with a determination of "no adverse effect" before beginning construction. If sites that would be eligible for listing on the National Register of Historic Places were found during surveys, mitigation of the effects to those sites (e.g., avoidance, protection, data recovery), determined in consultation with the SHPO, would be completed before any ground was disturbed.

If cultural material were unexpectedly encountered during ground-disturbing activities at previously disturbed or surveyed areas of the depot, construction would stop immediately, and the Kentucky SHPO and a qualified archaeologist would be consulted to evaluate the significance of the cultural artifacts.

7.26 REFERENCES FOR CHAPTER 7

Acoustical Society of America, 1983, *American National Standard Specification for Sound Level Meters, ANSI S1.4-1983*, New York, N.Y., Feb.

Acoustical Society of America, 1985, *American National Standard Specification for Sound Level Meters, ANSI S1.4A-1985, Amendment to ANSI S1.4-1983*, New York, N.Y., June.

AEA/CH2M Hill, 2000, *Draft Final PMACWA Demonstration II Test Program for Assessment of Technologies for Assembled Chemical Weapons Demilitarization,* DAAM01-98-006, prepared by AEA Technology Engineering Services, Inc. Sterling, Va., and CH2M Hill for U.S. Department of Defense, Program Manager Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md., Nov.

Allen, J., 2000, *Toxic Release Inventory (TRI) Report*, *Reporting Period January 01 to December 31, 1999*, letter from Allen (Colonel, U.S. Army, Commanding Officer, Blue Grass Army Depot, Richmond, Ky.) to A. Barber (Kentucky Department of Environmental Protection, Ky.), June 21.

Allison, T., 2001, *Forecasted Data for ACWA Socioeconomic Analyses*, intralaboratory memorandum from Allison to M. Goldberg (Argonne National Laboratory, Argonne, Ill.), Oct. 22.

American Medical Association, 1999, *Physician Characteristics and Distribution in the U.S.*, Chicago, Ill.

Andersen, P., 2000, e-mail on noise associated with Tooele incinerator from Andersen (EG&G Inc., Tooele, Utah) to Y.-S. Chang (Argonne National Laboratory, Argonne, Ill.), Oct. 4.

Anderson, W.H., and G.R. Dever Jr., 1998, *Mineral and Fuel Resources Map of Kentucky*, Map and Chart Series 21, http://www.uky.edu/KGS/gis/minmap.pdf, accessed on Sept. 14, 2000.

Avian Power Line Interaction Committee, 1996, *Suggested Practices for Raptor Protection on Power Lines: The State of the Art in 1996*, Edison Electric Institute/Raptor Research Foundation, Washington, D.C.

Baldwin, B., 2000, record of telephone conversation between Baldwin (Madison County, Ky.) and L. Nieves (Argonne National Laboratory, Argonne, Ill.), Oct.

Ball, D.B., 1983, *An Archaeological Reconnaissance of a Proposed Rocket Demilitarization Facility at the Lexington-Blue Grass Army Depot, Madison County, Kentucky*, submitted to the U.S. Army Corps of Engineers, Louisville District.

Barbour, R.W., 1971, *The Amphibians and Reptiles of Kentucky*, University Press of Kentucky, Lexington, Ky.

Barclay, L., 2000, letter on federal listed endangered species from Barclay (U.S. Fish and Wildlife Service, Cookeville, Tenn.) to E. Pentecost (Argonne National Laboratory, Argonne, Ill.), July 25.

BGAD: see Blue Grass Army Depot.

Bloom, T., et al., 1995, *Rare Species and Aquatic Faunal Survey of Blue Grass Army Depot, Kentucky*, prepared by Kentucky State Nature Preserves Commission, Frankfort, Ky., for Blue Grass Army Depot, Richmond, Ky., May.

Blue Grass Army Depot, 1984, *Installation Environmental Assessment, Lexington-Bluegrass Depot Activity*, draft report, U.S. Army Materiel Command, Nov. 30.

Blue Grass Army Depot, 2000a, *Endangered Species Management Plan and Environmental Assessment, Blue Grass Army Depot, Richmond, Kentucky*, prepared by G.E.C., Inc., Baton Rouge, La., for U.S. Army Corps of Engineers, Louisville District, Louisville, Ky., and Blue Grass Army Depot, Richmond, Ky., March.

Blue Grass Army Depot, 2000b, *Integrated Natural Resource Management Plan and Environmental Assessment, Blue Grass Army Depot, Richmond, Kentucky*, prepared by G.E.C., Inc., Baton Rouge, La., for U.S. Army Corps of Engineers, Louisville District, Louisville, Ky., and Blue Grass Army Depot, Richmond, Ky., Jan.

Blue Grass Army Depot, 2000c, *Toxic Chemical Leakers*, Chemical Surety Office, July 26.

Blue Grass Army Depot, 2000d, *BGAD Disaster Control Plan Annex C, 6/30/2000*.

Brattstrom, G.H., and M.C. Bondello, 1983, "Effects of Off-Road Vehicles on Desert Vertebrates," pp. 167–206 in R.H. Webb and H.G. Wilshore (editors), *Environmental Effects of Off-Road Vehicles: Impacts and Management of Arid Regions*, Springer Verlag, New York, N.Y.

Brown, L.N., 1997, *A Guide to the Mammals of the Southeastern United States*, University of Tennessee Press, Knoxville, Tenn.

Burton, T.M., 2001, *Breathing Rates for Toxicity Data*, memorandum from Burton (U.S. Army Nuclear and Chemical Agency, Springfield, Va.) to Commander (Soldier and Biological Chemical Command, Aberdeen Proving Ground, Md.), May 24.

Cabinet: see Kentucky Natural Resources and Environmental Protection Cabinet.

CBDCOM, 1997, *Solication No. DAAM01-97-R-0031*, U.S. Army Chemical and Biological Defense Command, Aberdeen Proving Ground, Md., Aug.

CDC: see Centers for Disease Control and Prevention.

Centers for Disease Control and Prevention, 1988, "Final Recommendations for Protecting the Health and Safety against Potential Adverse Effects of Long-Term Exposure to Low Doses of Agents: GA, GB, VX, Mustard Agent (H, HD, T) and Lewisite (L)," U.S. Department of Health and Human Services, *Federal Register* 53(50):8504–8507, March 15.

CEQ: see Council on Environmental Quality.

COE: see U.S. Army Corps of Engineers.

Commonwealth of Kentucky, Department of Fish and Wildlife Resources, 1983, *Stream Research Management, Annual Performance Report for Statewide Fisheries Management Project*, Part III of IV, Subsection III, Frankfort, Ky.

Commonwealth of Kentucky, Department of Fish and Wildlife Resources, 1996, *Sport Fish Restoration Grant No. F-50, Segment 18, Annual Performance Report, District Fisheries Management*, Fisheries Division, Frankfort, Ky., June 30.

Conant, R., and J.T. Collins, 1998, *A Field Guide to Reptiles & Amphibians: Eastern and Central North America*, Houghton Mifflin Co., Boston, Mass.

Corbitt, R.A., 1990, *Standard Handbook of Environmental Engineering*, McGraw-Hill, Inc.

Council on Environmental Quality, 1997, *Environmental Justice Guidance under the National Environmental Policy Act*, CEQ, Executive Office of the President, Washington, D.C., Dec.

Dawson, S.V., and G.V. Alexeeff, 2001, "Multi-Stage Model Estimates of Lung Cancer Risk from Exposure to Diesel Exhaust, Based on a U.S. Railroad Worker Cohort," *Risk Analysis* 21(1):1–18.

DOI: see U.S. Department of the Interior.

Duguay, J.P., and C.L. Elliott, 1994, *Activities Report — Summer Densities of Nongame Birds at the Blue Grass Army Depot — 1993*, submitted by Duguay and Elliott, Department of Biological Sciences, Eastern Kentucky University, Richmond, Ky., to B.C. Haslett, Blue Grass Army Depot, Richmond, Ky., May 6.

Efroymson, R.A., et al., 1997, *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision*, Oak Ridge National Laboratory, Oak Ridge, Tenn.

Elliott, J., 2000, *Emissions Summary*, fax from Elliott (Blue Grass Army Depot, Richmond, Ky.) to H. Hartmann (Argonne National Laboratory, Argonne, Ill.), Oct. 13.

Elliott, J., 2001, e-mail on BGAD and BGCA employment from Elliott (Blue Grass Army Depot, Richmond, Ky.) with attachment from V. Erwin (Blue Grass Army Depot, Richmond, Ky.) to K. Wescott (Argonne National Laboratory, Argonne, Ill.), Nov. 14.

EPA: See U.S. Environmental Protection Agency.

Executive Order 13045, 1997, "Protection of Children from Environmental Health Risks and Safety Risks," *Federal Register* 62(78):19885–19888, Apr. 23.

Folga, S.M., 2001, *Incinerator Utility Usage*, interoffice e-mail from Folga to A.E. Smith and L.A. Nieves (Argonne National Laboratory, Argonne, Ill.) May 25.

Foster Wheeler et al., 2000, *Draft Final PMACWA Demonstration II Test Program Technical Report*, prepared by Foster Wheeler Corporation, Eco Logic Inc., and Kvaerner, Nov.

Freil, G.E., 1997, *Maximum Credible Events (MCE) for Daily Chemical Operations*, memo and attachments from Freil (U.S. Army Materiel Command, Alexandria, Va.) to various Army staff, AMCCB (385-61), Apr. 30.

Fritz, L., 2000, record of telephone conversation between Fritz (City of Richmond, Ky.) and L. Nieves (Argonne National Laboratory, Argonne, Ill.), Sept.

GA Technologies, 1987, *Risk Analysis of the Continued Storage of Chemical Munitions, Chemical Stockpile Disposal Program*, SAPEO-CDE-IS-87009, prepared by GA Technologies, Inc., San Diego, Calif., for Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Aug.

General Atomics, 1999, *Assembled Chemical Weapons Assessment (ACWA) Draft Test Technical Report,* DAAM01-98-D-003 129300/0, San Diego, Calif., June 30.

Geo-Marine, Inc., 1996, *Blue Grass Army Depot Cultural Resources Management Plan*, prepared for Blue Grass Army Depot, Madison County, Ky., Nov.

Goodheer, I., 1994, *Dose Response Data for the Tooele Chemical Agent Disposal Facility Quantitative Risk Assessment (TOCDF QRA)*, memorandum from Goodheer (U.S. Army Nuclear and Chemical Agency, Springfield, Va.) to Commander (U.S. Army Chemical Materiel Destruction Agency, Aberdeen Proving Ground, Md.), June 13.

Greene, R.C., 1968, *Geologic Map of the Moberly Quadrangle, Madison and Estill Counties, Kentucky*, Map GQ-664, U.S. Geological Survey, Washington, D.C.

Hall, F.R., and W.N. Palmquist, 1960, *Availability of Ground Water in Clark, Estill, Madison, and Powell Counties, Kentucky*, Atlas HA-19, U.S. Geological Survey, Washington, D.C.

Hancock, R., 2000, *Igloo Munitions Inventories*, e-mail from Hancock (BGCA Surety Officer, Blue Grass Army Depot, Richmond, Ky.), to H. Hartmann (Argonne National Laboratory, Argonne, Ill.), July 12.

Hazardous Substances Data Bank, 2001, *Xylene CAS No. 1330-20-7*, National Library of Medicine, National Institutes of Health, U.S. Department of Health and Human Services, Bethesda, Md., http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB, revised Aug. 2001.

IT Corp., 2000, *Eighth Quarter Report, Long Term Sampling and Analysis Program, Blue Grass Army Depot, Richmond, Kentucky*, draft prepared by IT Corp. for U.S. Army Corps of Engineers, July.

Jackson, D., 2000, personal communication from Jackson (Kentucky Transportation Cabinet, city, Ky.) to T. Allison (Argonne National Laboratory, Argonne, Ill.), June.

Kentucky Department of Education, 2000, *Superintendent's Annual Attendance Reports*, 2000 data, http://www.kde.state.ky.us/odss/finance/whatsnew.asp, accessed in 2000.

Kentucky Division for Air Quality, 1999, *Kentucky Ambient Air Quality Annual Report 1998*, Frankfort, Ky.

Kentucky Division for Air Quality, 2000a, *Emissions Inventory System Report*, 1998 database, Frankfort, Ky.

Kentucky Division for Air Quality, 2000b, *Ambient Air Quality Summary Statistical Report, January–December 1999*, Frankfort, Ky.

Kentucky Division for Air Quality, 2000c, *Kentucky Emissions Inventory System Detailed Plant Information*, data for 1999, Frankfort, Ky., Oct. 3.

Kentucky Natural Resources and Environmental Protection Cabinet, 1986, *Permit, Lexington-Bluegrass Depot Activity, Lexington, Kentucky 40511, RE: Richmond Facility*, Division of Air Pollution Control (DAPC), Department of Environmental Protection, Frankfort, Ky.

Kentucky State Nature Preserves Commission, 2001, *Kentucky's Natural Heritage Program*, www.kynaturepreserves.org/secondary/index.html, accessed in March 2001.

Kimmell, T.A., et al., 2001, *Technology Resource Document for the Assembled Chemical Weapons Assessment Environmental Impact Statement*, ANL/EAD/TM-101, Vols. 1–5 and errata, Argonne National Laboratory, Argonne, Ill.

KSNPC: see Kentucky State Nature Preserves Commission.

Lexington-Blue Grass Army Depot, 1987, *Installation Compatible Use Zone Study*.

Libby, G.W., 1995, letter transmitting report entitled *Botanically Significant Areas of the Bluegrass Army Depot, Madison County, Kentucky*, from Libby (Kentucky Nature Preserves Commission, Frankfort, Ky.) to B. Haslett (Bluegrass Army Depot, Richmond, Ky.), May 11.

Liebich, R.E., and M.P. Cristoforo, 1988, "The Use of Audibility Analysis to Minimize Community Noise Impact of Today's Smaller Generation Facilities Located near Residential Areas," presented at American Power Conference 50th Annual Meeting, Chicago, Ill., Apr.

Luz, G.A., and J.B. Smith, 1976, "Reactions of Pronghorn Antelope to Helicopter Overflight," *Journal of the Acoustical Society of America* 59:1514–1515.

Madison County Rescue Squad, 2000a, *Richmond Police Department*, 1996 data, http://speedy.cc.uky.edu/Rescue/Madison/rpd.html, accessed in Sept. 2000.

Madison County Rescue Squad, 2000b, *Blue Grass Army Depot Fire Department*, 1996 data, http://speedy.cc.uky.edu/Rescue/Madison/depot.fd.html, accessed in Sept. 2000.

Manci, K.M., et al., 1988, *Effects of Aircraft Noise and Sonic Booms on Domestic Animals and Wildlife*, AFESC TR 88-14, NERC-88/29, U.S. Air Force, Engineering and Service Center, and U.S. Fish and Wildlife Service, Fort Collins, Colo.

Mauk, F.J., et al., 1982, "The Sharpsburg, Kentucky, Earthquake, 27 July 1980: Main Shock Parameters and Isoseismal Maps," *Bulletin of the Seismological Society of America* 72(1):221–236.

McDowell, R.C., et al., 1981, *Geologic Map of Kentucky*, Kentucky Geological Survey, Lexington, Ky.

Mitretek, 2001a, *Estimates of Environmental Releases Associated with the Destruction of Assembled Chemical Weapons during Pilot Plant Testing of the Parsons Honeywell Neutralization/Biotreatment Process*, Mitretek Systems, Inc., McLean, Va., May.

Mitretek, 2001b, *Estimates of Environmental Releases Associated with the Destruction of Assembled Chemical Weapons during Pilot Plant Testing of the General Atomics Neutralization/Supercritical Water Oxidation Process*, Mitretek Systems, Inc., McLean, Va., May.

Mitretek, 2001c, *Estimates of Environmental Releases Associated with the Destruction of Assembled Chemical Weapons during Pilot Plant Testing of the Foster Wheeler-Ecologic-Kvaerner Neutralization/Supercritical Water Oxidation with Gas Phase Chemical Reduction Process*, Mitretek Systems, Inc., McLean, Va., May.

Mitretek, 2001d, *Estimates of Environmental Releases Associated with the Destruction of Assembled Chemical Weapons during Pilot Plant Testing of the AEA Technology Silver II Electrochemical Oxidation Process*, Mitretek Systems, Inc., McLean, Va., May.

Moore, F., 2000, record of telephone conversation between Moore (Berea, Ky.) and L. Nieves (Argonne National Laboratory, Argonne, Ill.), Sept.

Munro, N.B., et al., 1999, "The Sources, Fate, and Toxicity of Chemical Warfare Agent Degradation Products," *Environmental Health Perspectives* 107(12):933–974, Dec.

National Oceanic and Atmospheric Administration, 1999, *Local Climatological Data: Annual Summary with Comparative Data for Lexington, Kentucky*, National Climatic Data Center, Asheville, N.C.

National Research Council, 1997a, *Risk Assessment and Management at Deseret Chemical Depot and the Tooele Chemical Agent Disposal Facility*, prepared by National Research Council, Washington, D.C., published by National Academy Press, Washington, D.C.

National Research Council, 1997b, *Review of Acute Human-Toxicity Estimates for Selected Chemical-Warfare Agents*, prepared by Subcommittee on Toxicity Values for Selected Nerve and Vesicant Agents, Washington, D.C., published by National Academy Press, Washington, D.C.

National Research Council, 1999, *Review and Evaluation of Alternative Technologies for Demilitarization of Assembled Chemical Weapons*, Washington, D.C.

National Safety Council, 1999, *Injury Facts, 1999 Edition*, Itasca, Ill.

NOAA: see National Oceanic and Atmospheric Administration.

Opresko, D.M., et al., 1998, "Chemical Warfare Agents: Estimating Oral Reference Doses," in Ware, G.W. (editor), *Reviews of Environmental Contamination and Toxicology*, Vol. 156, Springer-Verlag, New York, N.Y.

Palmquist, W.N., and F.R. Hall, 1961, *Reconnaissance of Ground-Water Resources in the Blue Grass Region, Kentucky*, Water-Supply Paper 1533, U.S. Geological Survey, Washington, D.C.

Parker, P.L., 1995, *Guidelines for Evaluating and Documenting Traditional Cultural Properties*, National Register Bulletin 38, U.S. Department of the Interior, National Park Service, Washington, D.C.

Parsons and Allied Signal, 1999, *Assessment of Technologies for Assembled Chemical Weapon Demilitarization*, draft demonstration test final report, prepared by Parsons Infrastructure & Technology Group, Inc., and Allied Signal for U.S. Army, Chemical and Biological Defense Command, July.

PMACWA, 1999, *Assembled Chemical Weapons Assessment Program: Supplemental Report to Congress*, U.S. Department of Defense, Program Manager Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md., Sept. 30.

PMACWA, 2001, *Final Technical Evaluation: AEA Technology/CH2MHill SILVER II Electrochemical Oxidation, Foster Wheeler/Eco Logic International/Kvaerner Neutralization/GPCR/TW-SCWO, Teledyne-Commodore Solovated Electron Systems,* Appendix C in *Assembled Chemical Weapons Assessment Program: Supplemental Report to Congress*, June 2001, U.S. Department of Defense, Program Manager Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md., March.

Raytheon, 1996, *Johnston Atoll Chemical Agent Disposal System (JACADS) Human Health & Ecological Risk Assessment*, prepared by Raytheon Engineers & Constructors, Inc., Philadelphia, Penn., for U.S. Army Chemical Demilitarization and Remediation Activity, Aberdeen Proving Ground, Md., Dec. 30.

Rhodes, M., 2000, e-mail from Rhodes (University of Illinois, Urbana, Ill.) to Y.-S. Chang (Argonne National Laboratory, Argonne, Ill.), Sept. 1.

Runyan, J.L., 2000, *Profile of Hired Farmworkers, 1998 Annual Averages*, U.S. Department of Agriculture, Economic Research Service, Washington, D.C., http://www.ers.usda.gov/Publications/AER790/.

SAIC: see Science Applications International Corporation.

Science Applications International Corporation, 1997, *Blue Grass Chemical Agent Disposal Facility Phase 1 Quantitative Risk Assessment*, SAIC-96/1118, prepared by SAIC, Abingdon, Md., for U.S. Army, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Jan.

SMG Marketing Group, Inc., 2001, data from Medical Select web site, Chicago, Ill., http://www.hospitalselect.com.

Smith, A.E., 2001, record of telephone conversations on actions in Madison County in the vicinity of Blue Grass Army Depot between Smith (Argonne National Laboratory, Argonne, Ill.) and various sources, Feb. 27.

Staub, W.P., 1991, "Nuclear Power Station Seismic Hazard Curves in the Eastern United States and the Uniform Building Code," *Bulletin of the Association of Engineering Geologists* 28(3):227–232.

Storm Prediction Center, 2000, *Historical Tornado Data Archive,* http://www.spc.noaa.gov/archive/tornadoes/index.html.

Transportation Research Board, 1985, *Highway Capacity Manual*, National Research Council, Washington, D.C.

Tsao, C.L., 2000a, *Calculation of Inhalation HQ of HD (Mustard Gas) for Terrestrial Wildlife Ecological Risk Assessment at Blue Grass Army Depot (BGAD)*, intraoffice memorandum from Tsao to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), Dec. 4.

Tsao, C.L., 2000b, *Calculation of Inhalation HQ of GB (Sarin) for Terrestrial Wildlife Ecological Risk Assessment at Blue Grass Army Depot (BGAD)*, intraoffice memorandum from Tsao to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), Dec. 4.

Tsao, C.L., 2000c, *Calculation of Inhalation HQ of VX for Terrestrial Wildlife Ecological Risk Assessment at Blue Grass Army Depot (BGAD)*, intraoffice memorandum from Tsao to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), Dec. 4.

Tsao, C.L., 2001, *Ecological Risk Assessment of Chemical Emissions from ACWA Pilot Facility during Normal Operation at Blue Grass Army Depot (BGAD)*, intraoffice memorandum from Tsao to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), Nov. 30.

URS, 2000, *Final Report, Conceptual Sitewide Groundwater Flow Model at Blue Grass Army Depot, Richmond, Kentucky*, prepared by URS, Cincinnati, Ohio, in cooperation with Jacobs Engineering, Maryland Heights, Mo., for U.S. Army Corps of Engineers, Louisville District, Ky., Oct.

USACHPPM: see U.S. Army Center for Health Promotion and Preventive Medicine.

U.S. Army, 1988, *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Jan.

U.S. Army, 1991, *Final Environmental Impact Statement for Disposal of Chemical Agents and Munitions Stored at Anniston Army Depot, Anniston, Alabama*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., May.

U.S. Army, 1997a, *Environmental Protection and Enhancement*, Army Regulation 200-1, Headquarters, Washington, D.C.

U.S. Army, 1997b, *Revised Final Environmental Impact Statement for Disposal of Chemical Agents and Munitions Stored at Pine Bluff Arsenal, Arkansas*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Apr.

U.S. Army, 1998a, *Environmental Assessment for Construction of CIP Project # 6-97 Molten Salt Operation Facility at the Blue Grass Army Depot, Richmond, Kentucky*, Blue Grass Army Depot, Richmond, Ky., May.

U.S. Army, 1998b, *Environmental Assessment for Construction and Operation of an Explosive Detonation Chamber at the Blue Grass Army Depot*, Blue Grass Army Depot, Richmond, Ky., May.

U.S. Army, 1998c, *Final Environmental Impact Statement for Pilot Testing of Neutralization/Supercritical Water Oxidation of VX Agent at Newport Chemical Depot, Indiana*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Dec.

U.S. Army, 2001, *Draft Environmental Impact Statement for Destruction of Chemical Munitions at Pueblo Chemical Depot, Colorado*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., May.

U.S. Army Center for Health Promotion and Preventive Medicine, 1999a, *Development and Derivation of Inhalation Benchmark Values for Wildlife: An Application to Identify Ecological Risk to Airborne Contaminants*, Study 87-1299-99, prepared by Health Effects Research Program, Toxicology Directorate, USACHPPM, Aberdeen Proving Ground, Md., Dec.

U.S. Army Center for Health Promotion and Preventive Medicine, 1999b, *Derivation of Health-Based Environmental Screening Levels for Chemical Warfare Agents*, Aberdeen Proving Ground, Md.

U.S. Army et al., 1987, *Geological-Seismological Investigation of Earthquake Hazards for a Chemical Stockpile Disposal Facility at the Lexington-Bluegrass Army Depot, Kentucky*, prepared by the U.S. Army Engineer Division, Huntsville, Ala.; Jacobs Engineering Group, Inc.; and URS/John A. Blume & Associates, Engineers, for the Office of the Program Manager for Chemical Munitions, Oct.

U.S. Army Corps of Engineers, 2000, *Spill Prevention Control and Countermeasure Plan and Installation Spill Contingency Plan, Blue Grass Army Depot, Richmond, Kentucky*, 2000 revision, Louisville District, Louisville, Ky., March.

U.S. Bureau of Labor Statistics, 2001, *Local Area Unemployment Statistics*, Washington, D.C., ftp://ftp.bls.gov/pub/time.series/la/, accessed in Feb. 2001.

U.S. Bureau of the Census, 1991, *1990 Census of Population and Housing, Summary of Population and Housing Characteristics, Kentucky*, Washington, D.C.

U.S. Bureau of the Census, 1992a, *1990 Census of Population and Housing, Summary of Social, Economic, and Housing Characteristics, Kentucky*, Washington, D.C.

U.S. Bureau of the Census, 1992b, *County Business Patterns, 1990*, Washington, D.C., http://www.census.gov/ftp/pub/epcd/cbp/view/cbpview.html.

U.S. Bureau of the Census, 1992c, *1990 Census of Population and Housing*, data including STF 1 and STF 3a, Washington, D.C., http:/factfinder.census.gov., accessed in Feb. 2000.

U.S. Bureau of the Census, 1994, *City and County Data Book, 1994*, Washington, D.C.

U.S. Bureau of the Census, 2000, *1997 Census of Governments*, Compendium of Public Employment, Washington, D.C., http://www.census.gov/ftp/pub/govs/www/cog.html.

U.S. Bureau of the Census, 2001a, *County Business Patterns, 1999*, Washington, D.C., http://www.census.gov/ftp/pub/epcd/cbp/view/cbpview.html.

U.S. Bureau of the Census, 2001b, *American FactFinder*, Washington, D.C., http://factfinder. census.gov/.

U.S. Bureau of the Census, 2001c, *State and County Quickfacts*, Washington, D.C., http://quickfacts.census.gov/qfd/states/21000.html, accessed in Sept. 2001.

U.S. Bureau of the Census, 2001d, *Census 2000 Redistricting Data (Public Law 94-171) Summary File*, Washington, D.C., http://www.census.gov/clo/www/redistricting.html, accessed in Aug. 2001.

U.S. Department of Agriculture, 1973, *Soil Survey of Madison County, Kentucky*, Soil Conservation Service in cooperation with Kentucky Agricultural Experiment Station, March.

U.S. Department of Agriculture, 1994, *Census of Agriculture 1992*, National Agricultural Statistics Service, Washington, D.C., http://www.nass.usda.gov/census/census92/agrimenu.htm.

U.S. Department of Agriculture, 1999, *Census of Agriculture 1997*, National Agricultural Statistics Service, Washington, D.C., http://www.nass.usda.gov/census/census97/volume1/vol1pubs.htm, accessed in Feb. 2000.

U.S. Department of Commerce, 2001, *Local Area Personal Income*, Bureau of Economic Analysis, Washington, D.C., http://www.bea.doc.gov/bea/regional/reis/.

U.S. Department of the Interior, 1986a, *Visual Resource Inventory*, BLM Manual Handbook H-8410-1, Bureau of Land Management, Washington, D.C., Jan.

U.S. Department of the Interior, 1986b, *Visual Resource Contrast Rating*, BLM Manual Handbook H-8431-1, Bureau of Land Management, Washington, D.C., Jan.

U.S. Environmental Protection Agency, 1974, *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, EPA-550/9-74-004, Washington, D.C.

U.S. Environmental Protection Agency, 1979, "Protective Noise Levels" (condensed version of *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, EPA/ONAC 550/9-74-004, March 1974), http://www.nonoise.org/library/levels/levels.htm.

U.S. Environmental Protection Agency, 1989, *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A)*, EPA/540/1-89/002, Interim Final, Office of Emergency and Remedial Response, Washington, D.C., Dec.

U.S. Environmental Protection Agency, 1994, *Exposure Assessment Guidance for RCRA Hazardous Waste Combustion Facilities (Draft)*, EPA 530/R-94/021, Office of Solid Waste, Washington, D.C.

U.S. Environmental Protection Agency, 1995, *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models*, EPA-454/B-95-003a and updated model (Version 00101), Office of Air Quality Planning and Standards, Research Triangle Park, N.C., Sept.

U.S. Environmental Protection Agency, 1997, *Exposure Factors Handbook*, EPA/600/P-95/002Fa, Office of Health and Environmental Assessment, Washington, D.C., Aug.

U.S. Environmental Protection Agency, 1998a, *Final Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses*, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency, 1998b, *Human Health Risk Assessment Protocol for Hazardous Waste Combustion, Peer Review Draft*, EPA/530/D-98/001A, July.

U.S. Environmental Protection Agency, 2000a, *Surface Meteorological Data*, Office of Air Quality Planning and Standards, Research Triangle Park, N.C., Support Center for Regulatory Air Models (SCRAM), TTNWeb, http://www.epa.gov/ttn/scram, accessed in Sept. 2000.

U.S. Environmental Protection Agency, 2000b, *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources*, Office of Air Quality Planning and Standards, Research Triangle Park, N.C., Clearinghouse for Inventories and Emission Factors (CHIEF), TTNWeb, http://www.epa.gov/ttn/chief/ap42/index.htm.

U.S. Environmental Protection Agency, 2000c, *Documentation for the 1996 Base Year National Toxics Inventory for Nonroad Vehicle and Equipment Mobile Sources*, prepared by Eastern Research Group, Inc., Morrisville, N.C., for EPA, Emissions Monitoring and Analysis Division, Research Triangle Park, N.C., June 2.

U.S. Environmental Protection Agency, 2000d, *Technical Support Document: Control of Emissions of Hazardous Air Pollutants from Motor Vehicles and Motor Vehicle Fuels*, EPA-420-R-00-023, Office of Air Radiation, Dec.

U.S. Environmental Protection Agency, 2001a, *AIRSData, Monitor Values Report*, Office of Air Quality Planning and Standards, Research Triangle Park, N.C., http://www.epa.gov/air/data/monvals.html, accessed in March 2001.

U.S. Environmental Protection Agency, 2001b, *Region 4 Waste Management Division Soil Screening Values for Hazardous Waste Sites*, EPA Region 4 Ecological Risk Assessment Bulletins — Supplement to Ecological Risk Assessment Guidance for Superfund, updated Apr. 2001.

U.S. Fish and Wildlife Service, 2001, *Endangered Species*, Region IV (Southeast Region), http://www.southeast.fws.gov/endangered/index/htm, accessed in March 2001.

U.S. Geological Survey, 2000, NWIS-W web site, http://waterdata.usgs.gov/nwis-w/KY/data.components/hist.cgi?statnum=03284000, accessed on Oct. 11, 2000.

USDA: see U.S. Department of Agriculture.

USFWS: see U.S. Fish and Wildlife Service.

USGS: see U.S. Geological Survey.

Weston Geophysical Corporation, 1996, *Probabilistic Seismic Hazard Analysis of the Blue Grass, Ky., Chemical Agent Demilitarization Facility, Final Report*, prepared by Weston, Northboro, Mass., for Science Applications International Corporation, Abingdon, Md., Oct. 15.

Whitacre, G.C., et al., 1987, *Personal Computer Program for Chemical Hazard Prediction (D2PC)*, CRDEC-TR-87021, U.S. Army, Armament Munitions Chemical Command, Chemical Research, Development, and Engineering Center, Aberdeen Proving Ground, Md., Jan.

Williams, T.G., 2001, *Annual Hazardous Waste Report and Hazardous Waste Assessment Return for January–December 2000, Richmond Facility of the Blue Grass Army Depot, Richmond, Kentucky*, letter with attachment from Williams (U.S. Army, Blue Grass Army Depot, Richmond, Ky.) to T. Hecker (Division Waste Management, Hazardous Waste Branch, Frankfort, Ky.), Feb. 27.

8 CLOSURE AND DECOMMISSIONING

The legislation that established ACWA (P.L. 104-208) instructed DOD to demonstrate alternatives to the baseline incineration process for the demilitarization of ACWs. Subsequent legislation specified development and testing of technologies for the destruction of lethal chemical munitions; however, this legislation did not address the disposition of ACWA pilot test facilities once pilot testing was completed. After completion of pilot testing, a facility could be (1) closed and decommissioned (i.e., operations ceased and the site secured), (2) converted to an operational chemical weapons destruction facility, or (3) converted to another use, within the constraints imposed by the *National Defense Authorization Act for Fiscal Year 2000*.

This EIS addresses the closure and decommissioning option but not the latter two options, since those options depend on the weapons stockpile and decisions by DOD that are beyond the scope of this ACWA EIS. Whether an ACWA pilot test facility would be converted to an operational destruction facility or some other use would depend on (1) whether any chemical agents remained at the end of pilot testing, (2) whether an existing destruction facility was in operation, (3) what technology was determined (as a result of other deliberations) to be most appropriate for chemical munitions destruction, and (4) what the future plans of other programs and the installations and the states involved were. Whether any option for continued use would be proposed is speculative at this time, and such a proposal would require additional NEPA evaluations. Hence, only closure and decommissioning of the ACWA pilot facility are addressed in this EIS. This discussion applies to the four installations (ANAD, PBA, PCD, and BGAD) and to the four destruction systems (Neut/Bio, Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox) considered in this EIS.

The closure and decommissioning of an ACWA pilot facility would require compliance with the provisions of any permits issued by regulatory agencies for the construction and operation of the facility. Thus, compliance with RCRA requirements for the closure of a hazardous waste TSDF would be required. In addition, DA and DOD requirements for the management and disposition of facilities involved in the handling of chemical warfare materials would also have to be met by the PMACWA and other parties involved in the closure and decommissioning of ACWA pilot facilities.

8.1 CLOSURE AND DECOMMISSIONING ACTIVITIES

The closure and decommissioning of an ACWA facility would be likely to be similar to the closure of baseline incineration facilities (such as JACADS and TOCDF) and the closure of destruction facilities that use alternative technologies (located at Aberdeen Proving Ground in Maryland and Newport Chemical Depot in Indiana). General concepts for facility closure and decommissioning are available in the JACADS site closure plan (Washington Demilitarization Company 2000) and the Aberdeen and Newport RCRA permit applications (Aberdeen Proving Ground 1997; Kimmell et al. 2001).

On the basis of (1) general requirements for a TSDF under RCRA, (2) DA and DOD policies and regulations, and (3) general concepts for the decommissioning of chemical destruction facilities, the following steps would be likely to be involved in the closure and decommissioning of an ACWA pilot facility:

- Removal of all hazardous wastes from the demilitarization site;
- Decontamination of the structures and equipment (including piping and tankage) to allow safe handling;
- Removal of all or part of the remaining equipment;
- Demolition of all or part of the facility;
- Removal or abandonment of all or part of the supporting infrastructure; and
- Grading and revegetation of the areas, as needed, after removal of structures and infrastructure.

These actions would generate wastes similar to the wastes created during the operation of the facility: (1) decontamination solutions consisting of water or caustic solutions containing agent and energetic by-products (similar to agent and energetic hydrolysates), (2) contaminated and uncontaminated debris (such as, metals, wood, and concrete, which are similar to dunnage and maintenance wastes), (3) protective clothing, (4) wastes from administrative and maintenance areas, (5) petroleum products, and (6) industrial chemicals. To the degree feasible, these materials would be processed through the ACWA facility in the same manner as like materials were processed during the pilot testing. Once the facility was rendered nonoperational, these materials would be collected, put in containers, and treated or disposed of in accordance with environmental regulations.

Equipment removed from the facility would be decontaminated and reused or recycled where possible. Structures would be decontaminated to the degree required by DA and DOD regulations to allow either their reuse or their demolition. Demolition debris would be disposed of in accordance with environmental, DA, and DOD regulations.

Removal, demolition, grading, and revegetation activities would be similar to the activities that took place during construction. Disassembly of the facility would involve equipment and actions very much like those used to prepare the site and erect the facility. Materials used in the construction of the facility would be conveyed out of the area in a manner similar to that used to bring them into the area (e.g., concrete and steel would be taken away from the site in trucks). The size of the area required to support removal and demolition operations would not exceed that needed for material staging and facility construction.

8.2 IMPACTS OF CLOSURE AND DECOMMISSIONING

8.2.1 Land Use

Closure and decommissioning would not require any added restrictions on the use of adjacent land areas. At the conclusion of closure and decommissioning of an ACWA pilot facility, the land area encompassed by the facility, supporting operations, and buffer zones would be available for other uses, ranging from restoration of natural habitat to support of other installation operations.

8.2.2 Infrastructure

Utility requirements during closure and decommissioning would be similar to those during construction and operation and would therefore have impacts similar to pilot facility operations. No construction of infrastructure would be necessary for closure and decommissioning. After closure and decommissioning, the utilities used by ACWA would be available for other uses by the installation. The impacts from removing utilities (e.g., ground disturbance) would be the same or similar to those impacts that resulted from the initial installation of those utilities.

8.2.3 Waste Management

During closure and decommissioning, wastes would consist of process materials remaining after the last pilot test, treatment by-products resulting from closure and decommissioning activities, and wastes generated by equipment removal and demolition. Initially, the level of waste by-product generation would be at the same level that existed during plant operations, but it would diminish to zero when closure and decommissioning were complete. The wastes would be of the same type as those generated by pilot facility operations but would be less in quantity. Demolition activities and removal of equipment would increase the off-site shipment of debris to a level equivalent to the shipment level of materials into the site during construction. The impacts from the disposal of nonhazardous debris at off-site waste management facilities would be the same as those from any large structural demolition project and would be within industrial capacity. The impacts from the disposal of hazardous waste at off-site facilities would depend on the quantity of material from the ACWA facility to be treated or disposed of. This quantity would vary, depending on the degree of decontamination applied to the material before, during, and after the demolition process. Just as the degree of waste treatment could be adjusted, so too could the available off-site hazardous waste treatment and disposal capacities be adjusted for by the responsible DA and DOD parties at the time of closure and decommissioning. After closure and decommissioning, there would be no further need for waste management.

8.2.4 Air Quality — Criteria Pollutants

Air quality impacts during the initial phases of closure and decommissioning, when residues would be treated and material decontaminated, would be the same as those that occurred during plant operations. During demolition, standard construction industry practices would be used to control fugitive dust emissions to meet air quality standards (Hansen 1992).

8.2.5 Air Quality — Toxic Air Pollutants

HAP emissions and toxic materials from the decontamination and treatment of residues would be similar to those present during ACWA pilot facility operations. The HAP emissions and toxic materials present during demolition would be similar to those present during construction. Therefore, the impacts from air emissions during closure and decommissioning would be the similar to those during plant construction and operation.

8.2.6 Human Health and Safety — Routine Operations

During the initial stages of closure and decommissioning, all engineering controls and safeguards would be in place and would continue to function until decontamination and treatment of residue treatment were complete. The impacts from any premature breach or deactivation of controls and safeguards would pose less risk than the risks during actual plant operations, since no large untreated quantities of chemical agents and energetics would be at the facility. During demolition, incomplete decontamination could pose some additional risk over that posed during construction. However, this risk could be mitigated by using QC measures and monitoring similar to those used in plant operations and at environmental cleanup sites. Risks to facility workers, on-post workers, and the off-post public would be the same as, or less than, the corresponding risks during plant operations and construction. No residual risk from ACWA pilot plant operations would exist after closure and decommissioning.

8.2.7 Noise

Equipment removal and facility demolition during closure and decommissioning would involve the use of heavy construction equipment and demolition processes. However, the overall expected sound levels and vibrations would not exceed those generated during construction, with the possible exception of the noise associated with the short-term, energy-intensive demolition of concrete and steel structures (e.g., the use of crushers and wrecking balls). Such activities could be audible off the site, but because of the distances from the sites to local residences,the noise would be at such a low level as to be acceptable within a residential community on the basis of regulatory limitations (Hansen 1992). Though it is possible that explosives could be used during demolition, it is probable that their use would be an infrequent and highly controlled event and not have a significant impact on or off site other than a startle effect.

8.2.8 Visual Resources

The removal of the ACWA pilot plant would return the visual setting to that of the existing environment or that altered by actions not related to the proposed action. If ACWA facilities would not be removed, the visual setting would remain as it was during ACWA operations.

8.2.9 Geology and Soils

No underlying natural resources would be consumed or made unavailable as a result of closure and decommissioning. Soil disturbance would be limited to those areas already affected by the ACWA pilot plant and supporting infrastructure. The only potential new impact would be the use of soil to backfill areas that had been excavated to remove facilities. This soil would be obtained from within the site or from a previously designated area selected to minimize impacts on the environment.

8.2.10 Groundwater

Groundwater impacts from decontamination and treatment of residuals would be similar to impacts from operations, and groundwater impacts from equipment removal and demolition would be similar to impacts from construction. There would be a small positive impact on groundwater due the increase in the groundwater recharge area after the removal of parking lots and other structures.

8.2.11 Surface Water

Surface water impacts from decontamination and treatment of residuals would be similar to impacts from operations, and surface water impacts from equipment removal and demolition would be similar to impacts from construction. Storm water management would be needed to prevent erosion from the site during demolition. There would be a positive impact on surface waters after closure and decommissioning, since the potential for petroleum contamination associated with vehicles on parking lots and other paved areas would be reduced. In addition, the risk of petroleum refueling spills and hazardous material (e.g., sodium hydroxide) spills would be eliminated.

8.2.12 Terrestrial Habitats and Vegetation

Closure and decommissioning would include the restoration of areas from which structures were removed; restoration would have beneficial impacts on terrestrial habitats and wildlife. During demolition activities, minor adverse impacts on terrestrial habitats and wildlife would occur during the stockpiling and removal of materials, similar to the impacts that occurred during construction. Good management practices would serve to limit potential impacts to areas previously disturbed. As a result of closure and decommissioning, there would be no new loss of terrestrial habitat, and there would be a potential increase of habitat after site restoration.

8.2.13 Wildlife

Impacts on wildlife from closure and decommissioning would be limited to impacts caused by demolition activities. These impacts would be similar to the impacts that resulted from construction. They would include disturbance during the transportation of materials and annoyance caused by noise during building removal. The short-term, energy-intensive demolition of concrete and steel structures (e.g., the use of crushers and wrecking balls) might startle wildlife or lead them to avoid the demolition site.

8.2.14 Aquatic Habitats and Fish

Impacts on the aquatic habitat and fish during closure and decommissioning would be the same or similar to the impacts that occurred during construction and operation. Good construction practices would be used to reduce sedimentation and runoff from the site during demolition. Revegetation of the site would reduce the potential for soil erosion into surface water bodies after the end of closure and decommissioning. After the completion of closure and decommissioning, the aquatic environment would return to that of the existing environment, barring other actions that might take place independent of the proposed action.

8.2.15 Protected Species

Closure and decommissioning would not have any impacts on protected species beyond those incurred during construction and operations. Habitat would be decreased for these species for a short while after closure and decommissioning until vegetation fully recovered.

8.2.16 Wetlands

Any impacts from closure and decommissioning would be limited to temporary changes in water flow and sediment transport from the site during demolition. Good management practices would reduce or eliminate drainage from the demolition site into wetlands. Any impacts would be minor and temporary and similar to the impacts from construction of the pilot test facilities.

8.2.17 Cultural Resources

No additional impacts on cultural resources would occur during or after closure and decommissioning.

8.2.18 Socioeconomics

Closure and decommissioning would result in a loss of jobs related to the operation and maintenance of the ACWA pilot facility. However, this loss would be partially compensated for by jobs created by the closure and decommissioning activities. During closure and decommissioning, persons in trades similar to those used during the construction of the facility would be employed for roughly the same or a shorter period of time. Recovered and recycled materials and equipment would be available for use by the local community. After completion of the closure and decommissioning, monies associated with the pilot plant would cease to be spent in the surrounding community. However, positive impacts would also be realized. For example, traffic flow to and from the ACWA facility would cease, land use restrictions on the installation associated with the ACWA facility would end, and support facilities and resources consumed by the ACWA facility (electricity, water, natural gas) would be available for other uses.

8.2.19 Environmental Justice

The closure and decommissioning requirements for an ACWA pilot facility would be based on state and federal laws and regulations, including DA and DOD regulations. Impacts from closure and decommissioning would be similar to or less than impacts from facility construction and operations, and these impacts would not disproportionately affect the health or environment of minority or lower-income populations.

8.2.20 Accidents Involving Assembled Chemical Weapons

Closure of an ACWA pilot test facility would eliminate the possibility of a highly unlikely accident involving release of agent from the container handling building, as described in Sections 4.21.3, 5.21.3, 6.21.3, and 7.21.3, since no chemical munitions would be present in the facility. Risk of an accident releasing chemical agent from a chemical munitions storage area is independent of the closure and decommissioning of an ACWA pilot test facility. However, destruction of some part of the chemical munitions stockpile during ACWA pilot testing would somewhat reduce the risk of a storage accident in proportion to the amount of the stockpile remaining.

8.3 REFERENCES FOR CHAPTER 8

Aberdeen Proving Ground, 1997, *Application for Permit to Construct the U.S. Army Aberdeen Proving Ground Chemical Agent Disposal Facility,* May.

Hansen, T.C., 1992, *Recycling of Demolished Concrete and Masonry*, E&FN Spon/Chapman and Hall, London, England.

Kimmell, T.A., et al., 2001, *Technology Resource Document for the Assembled Chemical Weapons Assessment Environmental Impact Statement*, ANL/EAD/TM-101, Vols. 1–5 and errata, Argonne National Laboratory, Argonne, Ill.

Washington Demilitarization Company, 2000, *JACADS Closure Campaign*, *Facility Closure Plan,* Oct.

9 ENVIRONMENTAL PERMITS AND OTHER COMPLIANCE REQUIREMENTS

9.1 INTRODUCTION

This chapter identifies the major laws, regulations, Executive Orders, and compliance instruments that apply to the Army ACWA activities under the no action and other alternatives. It covers various federal environmental statutes that impose environmental protection and compliance requirements upon the Army. It also assesses federal authorities to determine whether the enforcement and implementation of any environmental protection programs have been delegated to the states, and it covers these regulations as well. It is the Army's policy to conduct its operations in an environmentally safe manner in compliance with all applicable statutes, regulations, and standards (Army Regulation [AR] 200-1). The Army has established an extensive system of standards and requirements through its regulations and guidance to ensure the safe operation of its facilities. Although this section does not address pending legislation or regulations that may become effective in the future, the Army recognizes that the regulatory environment is rapidly changing and that the construction and operation of any future ACWA facilities must be conducted in compliance with the applicable statutes, regulations, and standards that are in effect at that time.

Under the *National Environmental Policy Act of 1969* (NEPA) (*United States Code,* Volume 42, Section 4321 and following sections [42 USC 4321 et seq.]), federal agencies are required to prepare an environmental impact statement (EIS) for proposed major federal actions that might significantly affect the quality of the human environment. Such major federal actions may include:

> "broad Federal actions such as the adoption of new agency programs or regulations. Agencies shall prepare statements on broad actions so that they are relevant to policy and are timed to coincide with meaningful points in agency planning and decision making." (*Code of Federal Regulations*, Title 40, Section 1502.4(b) [40 CFR 1502.4(b)]).

The Army has determined that the development of a program for the pilot study for ACWA technologies would be such a major federal action. Therefore, this EIS has been prepared in accordance with Council on Environmental Quality regulations (40 CFR Parts 1500–1508) and the Army NEPA implementing regulations (32 CFR Part 651; AR 200-2).

Executive Order 12088, *Federal Compliance with Pollution Control Standards,* requires federal agencies (including the U.S. Army) to comply with applicable administrative and procedural pollution control standards established by, but not limited to, the *Resource Conservation and Recovery Act* (RCRA) and *Toxic Substances Control Act* (TSCA) (Section 9.1), *Clean Air Act* (CAA) (Section 9.2), *Noise Control Act* (Section 9.3), and *Clean*

Water Act (CWA) and *Safe Drinking Water Act* (SDWA) (Section 9.5). Section 9 also covers other compliance requirements, including the *Emergency Planning and Community Right-to-Know Act of 1986* and *Hazardous Material Transportation Act* (Section 9.4), ecological resources requirements (e.g., *Endangered Species Act*) (Section 9.6), cultural and paleontological resources requirements (Section 9.7), Executive Orders (Section 9.8), Army regulations (Section 9.9), and the Chemical Weapons Convention (CWC) (Section 9.10).

9.2 WASTE MANAGEMENT

9.2.1 Requirements under Various Laws

9.2.1.1 Requirements of the *Solid Waste Disposal Act*, as Amended by the *Resource Conservation and Recovery Act* and *Hazardous Solid Waste Amendments of 1984*

The generation, accumulation, treatment, storage, and disposal of nonhazardous and hazardous wastes are regulated under the *Solid Waste Disposal Act* (SWDA), as amended by the *Resource Conservation and Recovery Act* (RCRA) (42 USC 6901 et seq.) and the *Hazardous Solid Waste Amendments of 1984* (HSWA). Under Section 3006 of the SWDA, any state that seeks to administer and enforce a hazardous waste program pursuant to RCRA may apply for U.S. Environmental Protection Agency (EPA) authorization of such a program. Approved state programs are not static, and as new federal regulations, limitations, and restrictions are promulgated by the EPA, state programs must be revised in response to such changes. Prior to HSWA, changes to the federal requirements were not enforced in an authorized state until the state's program was appropriately modified and approved by the EPA. Now, the EPA enforces HSWA requirements in authorized states until the state receives approval under RCRA (Section 3006(g)). Alabama, Arkansas, Colorado, and Kentucky have EPA-approved state RCRA programs and are responsible for RCRA regulation and enforcement in their states.

9.2.1.2 *Toxic Substances Control Act* Requirements

TSCA provides for the regulation of polychlorinated biphenyls (PCBs) (15 USC 2605(e)). The EPA has promulgated regulations governing the use, marking, storage, and disposal of wastes containing or contaminated with PCBs (40 CFR Part 761). The EPA has exclusive jurisdiction over PCB disposal, although some states also regulate the storage of TSCA PCB wastes as hazardous wastes. Wastes containing more than 50 parts per million (ppm) of PCBs generated during the construction or operation of a facility must be stored and disposed of properly. Storage facilities must meet certain standards (40 CFR Part 761, Subpart D). PCB wastes must be labeled and marked properly (40 CFR Part 761, Subpart C). PCB-contaminated waste must be disposed of in a licensed incinerator, in a chemical waste landfill, or by an alternative method approved by the EPA (40 CFR 761, Subpart D). Off-site shipments of waste PCBs must be manifested to an EPA-approved TSCA disposal facility, and the generator must receive a Certificate of Destruction from the disposal facility upon completion of destruction or disposal (40 CFR 761, Subpart K). Any contamination from a spill of PCB wastes must be remediated in accordance with specific requirements (40 CFR 761, Subpart G).

BGAD, ANAD, and PBA currently store M55 rockets containing nerve agents. M55 rocket shipping/firing tubes contain PCBs. A “PCB article” is any manufactured article, other than a PCB container, that contains PCBs and whose surface(s) has (have) been in direct contact with PCBs. PCB articles with PCB concentrations of 500 ppm or more must be disposed of in an EPA-approved TSCA incinerator, an EPA-approved TSCA chemical landfill, or an EPA-approved alternative treatment facility (40 CFR 761.60(b)(6) and 761.60(e)).

PCB articles that are no longer intact may be disposed of as “PCB bulk product waste” (40 CFR 761.50(b)(2)). PCB bulk product waste is defined as waste in a nonliquid state containing PCBs at any concentration that was derived from manufactured products in which the PCB concentration at the time of designation for disposal was more than 50 ppm. Bulk product waste can be disposed of (1) through decontamination using EPA-approved methods (applicable only to water, organic liquids, nonporous surfaces, and concrete), (2) in an EPA-approved TSCA incinerator, (3) on an EPA-approved TSCA chemical waste landfill, (4) in a state-permitted RCRA landfill, (5) in an EPA-approved alternative TSCA treatment facility, or (6) under an EPA-issued TSCA PCB Coordinated Approval Order (applicable only to facilities already holding TSCA approval or equivalent) (40 CFR 761.62(a)(1)). Disposal of PCB bulk product waste is based on the risk from the waste once it is disposed of (40 CFR 761.50(4)).

If M55 rocket tubes, as PCB articles, are to be treated in an ACWA facility, the facility would have to obtain approval from the EPA. (Note: M55 rockets contain nerve agent only and therefore would not be treated in a Neut/Bio facility.) Since none of the proposed ACWA pilot facilities are incinerators or chemical landfills, the facilities would require EPA approval as alternative treatment facilities. A written request to use an alternative method for destroying PCBs must be made to the EPA Regional Administrator or, if disposal is to occur in more than one EPA Region, the EPA Director of National Program Chemicals Division. If it can be shown that the alternative method does not present an unreasonable risk of injury to health or the environment and provides PCB destruction equivalent to disposal in an EPA-approved incinerator or high-efficiency boiler, the Director, at his or her discretion, may approve the use of the alternative method (40 CFR 761.60(e)). Similarly, if the shredded firing tubes are considered PCB bulk product waste, any facility that would treat this waste by using an alternative method must apply in writing to the EPA Regional Administrator or, for disposal occurring in more than one EPA Region, the EPA Director of National Program Chemicals Division (40 CFR 761.62(a)(4)). If the EPA finds that the alternative method will not pose an unreasonable risk of injury to health or the environment, it may issue a written decision approving the alternative disposal method.

Alternatively, an ACWA facility could receive EPA approval to operate as a research and development (R&D) facility for PCB disposal technologies (40 CFR 761.60(i)(2) or 761.60(j)). R&D activities include demonstrations for commercial PCB disposal approvals, predemonstration tests, tests of major modifications to previously approved PCB disposal technologies, treatability studies for PCB disposal technologies that have not been approved, development of new disposal technologies, and research on chemical transformation processes including, but not limited to, biodegradation (40 CFR 761.3). A "treatability study" is a study in which PCB waste is subjected to a treatment process to determine (1) whether the waste is amenable to the treatment process, (2) what pretreatment (if any) is required, (3) the optimal process conditions needed to achieve the desired treatment, (4) the efficiency of a treatment process for a specific type of waste, or (5) the characteristics and volumes of residuals from a particular treatment process (40 CFR 761.3). Treatment is a form of disposal, and a treatability study may not be used to commercially treat or dispose of PCB waste (40 CFR 761.3). An application for authorization for R&D using 500 lb (266.8 kg) or more of PCB material (regardless of PCB concentration) must be submitted to the Director of National Program Chemicals Division (40 CFR 761.60(i)(2)).

R&D for PCB disposal may be conducted without prior written approval from the EPA if the amount of PCB-containing material treated annually by the facility during R&D for PCB disposal activities does not exceed 500 gal or 70 ft^3 of liquid or nonliquid PCBs and if the PCB concentration does not exceed a maximum of 10,000 ppm (40 CFR 761.60(j)). These self-implementing R&D disposal activities may not exceed the above limits or last longer than one calendar year, unless specific EPA approval has been granted.

9.2.2 Types of Waste That Would Be Generated

9.2.2.1 ACWA Facility Construction

During construction of an ACWA facility, nonhazardous wastes (e.g., construction debris, nonhazardous paint waste) and hazardous wastes (e.g., hazardous paint, waste, solvent waste) would be generated. No wastes contaminated with chemical agents would be generated.

9.2.2.2 ACWA Facility Operations

Neutralization/SCWO. Solid wastes would be generated during the operation of the pilot Neut/SCWO process. They would include decontaminated scrap metal and brine salts that could contain metals. Nonprocess wastes would also be generated, including personal protective equipment (PPE), spent carbon filters, spent carbon abrasive grit, dunnage, pallets, and decontamination water. These wastes could be hazardous or nonhazardous, depending on the ultimate RCRA characterization. In addition, wastes generated during the Neut/SCWO process at ANAD, BGAD, or PBA (PCD does not have M55 rockets) could be contaminated with PCBs. Currently, the Army does not intend to dispose of any waste materials generated by the treatment process on site (Kimmel et al. 2001).

The decontaminated scrap metal would be recycled. Under RCRA, scrap metal that is going for recycling is not a solid waste, and therefore it is not a hazardous waste by definition. If the metals could not be recycled, depending on their ultimate RCRA characterization, they would be disposed of off site in a nonhazardous (RCRA Subpart D) waste landfill or in a hazardous (RCRA Subpart C) waste landfill. Before disposal, the decontaminated scrap metal would also have to meet Army regulations for decontamination and disposal (see Section 9.9).

Only a small quantity of liquid wastes will be generated during the operation of the pilot Neut/SCWO process. Brine liquids from the Neut/SCWO units would be recirculated after the salts were extracted. Other liquids, such as spent decontamination solutions and laboratory wastes, would be fed to the SCWO units. Those liquid wastes that would be generated from the treatment process would be contained and managed as hazardous or nonhazardous waste, as applicable. The only liquid waste stream directly discharged at the Neut/SCWO ACWA facility would be sanitary waste.

Neutralization/Biotreatment. Solid wastes would be generated during the operation of the pilot Neut/Bio process. They would include decontaminated scrap metal, compacted biosolids from the bioreactor system (i.e., biomass, absorbed metals, grit, dirt), and brine salts containing metals. (See Sections 4.4, 5.4, 6.4, and 7.4.) Similar to scrap metal from the pilot Neut/SCWO facility, scrap metal would be recycled if possible.

Nonprocess wastes would also be generated, including PPE, spent carbon filters, spent carbon abrasive grit, dunnage, pallets, and decontamination water. These wastes could be either hazardous or nonhazardous, depending on the ultimate RCRA characterization. Currently, the Army does not intend to dispose of any waste materials generated by the treatment process on site (Kimmell et al 2001).

Only a small quantity of liquid wastes would be generated during the operation of the pilot Neut/Bio process. The liquids from biotreatment would be evaporated, condensed, and recirculated. Other liquids, such as spent decontamination solutions and laboratory wastes, would be fed back into the Neut/Bio system. Those liquid wastes that would be generated from the treatment process would be contained and managed as hazardous or nonhazardous waste, as applicable. The only liquid waste stream directly discharged at the Neut/Bio facility would be sanitary waste.

Neutralization/GPCR/TW-SCWO. Solid wastes would be generated during the operation of the pilot Neut/GPCR/TW-SCWO process. They would include decontaminated scrap metal and brine salts that could contain metals. (See Sections 4.4, 5.4, 6.4, and 7.4.) Nonprocess wastes would also be generated, including PPE, spent carbon filters, spent carbon abrasive grit, dunnage, pallets, and decontamination water. These wastes could be either hazardous or nonhazardous waste, depending on the ultimate RCRA characterization. In addition, wastes generated during the Neut/GPCR/TR-SCWO process at ANAD, BGAD, or PBA could be contaminated with PCBs. Currently, the Army does not intend to dispose of any waste materials generated by the treatment process on site (Kimmell et al. 2001).

The decontaminated scrap metal would be recycled. Under RCRA, scrap metal that is going for recycling is not a solid waste, and therefore it is not a hazardous waste by definition. If the metals could not be recycled, depending on their ultimate RCRA characterization, they would be disposed of off site in a nonhazardous waste landfill or in a permitted hazardous waste landfill. Before disposal, the decontaminated scrap metal would also have to meet Army regulations for decontamination and disposal (see Section 9.9).

Only a small quantity of liquid wastes would be generated during the operation of the pilot Neut/GPCR/TW-SCWO process. Brine liquids from the Neut/GPCR/TW-SCWO units would be recirculated after the salts were extracted. Other liquids, such as spent decontamination solutions and laboratory wastes, would be fed to the SCWO units. Those liquid wastes that would be generated from the treatment process would be contained and managed as hazardous or nonhazardous waste, as applicable. The only liquid waste stream directly discharged at the Neut/GPCR/TW-SCWO facility would be sanitary waste.

The Neut/GPCR/TW-SCWO process treats dunnage and metal parts in a thermal reduction batch processor, which uses a flame-heated batch evaporator to volatilize organic materials to the main GPCR process. The technology provider indicates that recovered gaseous emissions from the GPCR might be able to be used as auxiliary fuel for the boiler that is used to produce the heated water and steam that is necessary for other components of the process. The re-use of these gaseous emissions as an auxillary fuel might require the boiler, depending on design and fuel characteristics, to be classified as a RCRA boiler or industrial furnace (BIF), which has additional regulatory operational and emission standards (40 CFR 266, Subpart H).

Electrochemical Oxidation. Solid wastes would be generated during the operation of the pilot Elchem Ox process. They would include decontaminated scrap metal, dilute nitric acid by-product, reclaimable silver, inorganic salts, and decontaminated dunnage (see Sections 4.4, 5.4, 6.4, and 7.4). Nonprocess wastes would also be generated, including PPE, spent carbon filters, spent carbon abrasive grit, pallets, and decontamination water. These wastes could be either hazardous or nonhazardous waste, depending on the ultimate RCRA characterization. In addition, wastes generated during the Elchem Ox process at ANAD, BGAD, or PBA could be contaminated with PCBs. Currently, the Army does not intend to dispose of any waste materials generated by the treatment process on site (Kimmell et al. 2001).

The decontaminated scrap metal would be recycled. Under RCRA, scrap metal that is going for recycling is not a solid waste, and therefore it is not a hazardous waste by definition. If the metals could not be recycled, depending on their ultimate RCRA characterization, they would be disposed of off site in a nonhazardous waste landfill or in a permitted hazardous waste landfill. Before disposal, the decontaminated scrap metal would also have to meet Army regulations for decontamination and disposal (see Section 9.9).

The slurry from an Elchem Ox unit is treated with HCl to precipitate silver as AgCl before being heated in the 5X evaporator oven. The material is then sent off site for reclamation. In addition, silver chloride is precipitated when mustard agent is exposed to the nitric acid and silver nitrate. A hydrocyclone is used to remove the silver chloride from the recirculating liquor. The silver chloride is accumulated in a settling vessel and discharged into an oven for 5X treatment. The silver chloride is then removed as a solid cake for silver reclamation off site. Under RCRA, recyclable materials that are reclaimed in order to recover economically significant amounts of gold, silver, platinum, iridium, osmium, rhodium, ruthenium, or any combination of these are not regulated as hazardous waste (except for notification requirements, manifesting, and maintaining records to demonstrate these materials are not being accumulated speculatively).

Only a small quantity of liquid wastes would be generated during the operation of the pilot Elchem Ox process. Liquid waste streams from the Elchem Ox units would be recirculated. Excess dilute nitric acid generated in the NO_X reformer circuit that could not be recirculated would be neutralized and disposed of off site. Concentrated nitric acid would either be recirculated or used commercially. Those liquid wastes that would be generated and removed from the treatment process would be contained and managed as hazardous or nonhazardous waste, as applicable. The only liquid waste stream directly discharged at the Elchem Ox facility would be sanitary waste.

9.2.2.3 No Action

Wastes generated during ongoing storage activities would include nonhazardous waste (e.g., pallets, nonhazardous cleaning solvents), hazardous waste (e.g., spent paints, hazardous cleaning solvents), and agent-contaminated waste (e.g., PPE, decontamination water). (See Sections 4.4, 5.4, 6.4, and 7.4.)

9.2.3 ANAD

Alabama has promulgated nonhazardous solid waste regulations (*Alabama Administrative Code Revised* [Admin. Code R.] 420-3-5 et seq.). Under these regulations, anyone operating a facility for solid waste disposal where processing, treatment, storage, or final disposal of solid waste is performed must obtain a permit from the Alabama Department of Public Health, State

Board of Health. No person may send nonhazardous solid waste to any site or facility other than one that has such a permit (Admin. Code R. 420-3-5-.02). All collection and transportation of solid nonhazardous waste must be in accordance with these regulations (Admin. Code R. 420-3-5-.11).

Alabama is a RCRA-authorized state and has promulgated hazardous waste regulations that basically reflect the federal standards. These regulations govern the generation and accumulation of hazardous waste (Admin. Code R. 335-14-3), transportation of hazardous waste (Admin. Code R. 335-14-4), storage of hazardous waste for more than 90 days, and ultimate treatment and disposal of hazardous waste (Admin. Code R. 335-14-5). Alabama has adopted the EPA military munitions rule, and any waste military munitions that are chemical agents or chemical munitions and that exhibit a hazardous waste characteristic or are listed as a hazardous waste are subject to all applicable regulatory requirements of RCRA, except for the one-year storage prohibition (Admin. Code R. 335-14-7-.13(6)(d)). The treatment and disposal of hazardous waste military munitions are subject to the applicable permitting, procedural, and technical standards (Admin. Code R. 335-14-7-.13(7)).

The regulations define hazardous waste on the basis of the waste's hazardous characteristics (i.e., characteristic hazardous wastes) or the specific regulatory listing of the waste (i.e., listed hazardous wastes) (Admin. Code R. 335-14-2). The Alabama Department of Environmental Management (ADEM) has not specifically designated chemical agents or munitions as listed hazardous wastes. Therefore, if a chemical agent or munition has hazardous waste characteristics, it must be managed as a hazardous waste. Hazardous waste characteristics include any waste that is ignitable, toxic (e.g., contains a set concentration of certain regulated toxic constituents), corrosive, or reactive. A characteristically reactive hazardous waste is a solid waste that (1) is normally unstable and readily undergoes violent change without detonating; (2) reacts violently with water; (3) forms potentially explosive mixtures with water; (4) when mixed with water, generates toxic gases, vapors, or fumes in a quantity sufficient to present danger to human health or the environment; (5) is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure; or (6) is a forbidden explosive as defined by the U.S. Department of Transportation (DOT). Chemical munitions could meet the reactive standard. Salts generated from the treatment process could contain metal contaminants and might meet the toxic hazardous characteristic. In addition, all M55 rockets have been declared to be hazardous waste by the U.S. Department of Defense (DOD). Under Alabama hazardous waste regulations, waste containing PCBs in excess of 50 ppm must be managed and disposed of in accordance with TSCA regulations (Admin.Code R. 335-14-2-.01(8); 40 CFR 761).

ADEM may issue a research, development, and demonstration (RD&D) permit for any hazardous waste treatment facility that proposes to use an innovative and experimental hazardous waste treatment technology or process for which permit standards for such experimental activity have not been promulgated (Admin. Code R. 335-14-8-.06(4)). Such a permit has a duration of no longer than one year, but it can be renewed three times for a period of not more than one year each. An RD&D permit provides for the receipt and treatment of only those types and quantities of hazardous waste that ADEM deems necessary for determining the efficacy and performance capabilities of the technology or process and the effects of such a technology or process on human health and the environment. Such an RD&D permit shall include such conditions as the ADEM deems necessary to protect human health and the environment, including, but not limited to, requirements regarding monitoring, operation, closure, and remedial action. In addition, the permit will contain conditions that ADEM deems necessary regarding testing and providing information to ADEM with respect to the operation of the facility. In granting an RD&D permit, ADEM may, consistent with the protection of human health and the environment, modify or waive permit application and permit issuance requirements, except for the procedures regarding public participation.

The *Alabama Chemical Weapons Destruction Limitation Act* (Code of Alabama, Sections 22-30C et seq.) requires that the Army process and destroy at ANAD only the stocks stored there as of the date of the Army's contract with a commercial company to do such destruction and will not allow other materials to be processed or destroyed there, except those materials used to demonstrate the performance of incinerators and pollution abatement systems during a trial burn demonstration. In addition, the Army must comply with its own written plan to close the demilitarization facility in accordance with RCRA, once the current stockpile at ANAD has been completely and safely destroyed.

9.2.3.1 ACWA Facility Construction

Under RCRA, all wastes generated during construction of an ACWA facility at ANAD (i.e., construction chemicals, adhesives, and solvents) would have to be characterized to determine if they were hazardous or nonhazardous (Admin. Code R. 335-14-3-.01(2)). If they were hazardous, they would have to be stored to comply with Alabama hazardous waste regulations, including specific container management and labeling requirements. If the hazardous construction wastes were kept on site for more than 90 days, they would have to be stored in an ADEM-permitted storage facility. ANAD has interim status for a number of hazardous waste storage facilities. A RCRA Part B application has been filed; however, no RCRA permit has been issued by ADEM. If the hazardous waste from the construction activities were to vary from those wastes currently listed in the ANAD RCRA Part A application, a modification of the application might be required. Shipments of hazardous wastes off site would have to be under a proper RCRA manifest to a properly permitted RCRA hazardous waste storage, treatment, and disposal facility (TSDF).

Nonhazardous solid wastes, including construction debris wastes, would have to be disposed of in disposal sites properly permitted under Alabama solid waste regulations (Admin. Code R. 420-3-5 et seq.). Since no nonhazardous wastes would be disposed of on the ANAD site (e.g., in a landfill), no Alabama State Board of Health approval would be required.

9.2.3.2 ACWA Facility Operations

In Alabama, wastes that are defined as hazardous, either by characteristic (e.g., corrosive decontamination water) or by listing (e.g., certain spent solvents), must be accumulated in accordance with the Alabama regulations for generators (Admin. Code R. 335-14-3). If these wastes are to be stored on site for more than 90 days, the storage facility must be permitted by ADEM and operated in accordance with Alabama regulations for permitted TSDFs (Admin. Code R. 335-14-5). If hazardous wastes are to be stored in existing, on-site storage facilities, the existing ANAD Part A application might need to be amended to allow for the storage of different types of waste or for storage in different configurations (e.g., pallet stacking height). In addition, the Part B application may have to be amended to reflect additional storage operations. Shipments of hazardous wastes off site must be under a proper RCRA manifest to a properly permitted RCRA TSDF.

Any ACWA facility constructed at ANAD would have to obtain a RCRA permit from ADEM, probably as a miscellaneous RCRA treatment unit (Admin. Code R. 335-14-5-.24). “Miscellaneous units” (also referred to a subpart X units) are permitted RCRA units that do not meet the definition of conventional RCRA units (e.g., tanks, land treatment, landfills, or incinerators). Regulations for Subpart X units are not technology specific; therefore, design standards, effluent/emission limitations, technical performance standards, and operational requirements are generally established in the specific permit conditions. The re-use of the gaseous emissions from the GPCR as an auxillary fuel might require the boiler/process heater, depending on design and fuel characteristics, to be classified as a RCRA BIF, which has additional regulatory operational and emission standards (Admin. Code R. 335-14-7-.08; 40 CFR 266, Subpart H).

ANAD currently holds interim status for a number of RCRA storage facilities, including facilities for storage of chemical agent containing M55 rockets and one treatment facility for the open burn/open detonation of conventional weapons. A Part B application has been filed, but no permanent RCRA permit has been issued by ADEM. (A separate RCRA Part B permit was granted to ANAD for the Anniston Chemical Agent Disposal Facility [ANCDF]; the administrative appeal of the ANCDF permit was denied by ADEM, and that decision was appealed to the appropriate State Circuit Court, which upheld the permit against all challenges, except one. ADEM, the Army, and Westinghouse have appealed that ruling to the Alabama Supreme Court. No decision has been issued to date.) Although RCRA permit applications for ANAD proper and the ANCDF were submitted separately, ADEM now requires that all operations located on ANAD (i.e., associated with the ANAD EPA ID Number) be conducted under one permit. The ANAD and ANCDF permit applications will be merged, both in format and content, to enable ADEM to issue a single permit. Therefore, any RCRA permit application for an ACWA facility would have to be prepared as a modification to the single ANAD permit application. Construction and operation of the new unit could not begin, however, until a RCRA permit was issued (Admin. Code R. 335-14-8-.02(f)). Alternatively, ADEM could issue an RD&D permit for an alternative technology facility, provided the facility would meet the regulatory time limitations and other ADEM conditions. If M55 rocket firing/shipping tubes were to be treated, the ACWA facility (SCWO and Elchem Ox technologies only) would also require approval from the EPA under TSCA (40 CFR 761).

Nonhazardous solid wastes, including operations and maintenance wastes, would have to be disposed of in disposal sites properly permitted under Alabama solid waste facilities regulations (Admin. Code R. 420-3-5). Since no nonhazardous wastes would be disposed of on the ANAD site (e.g., in a landfill), no Alabama State Department of Health approval would be required.

9.2.3.3 No Action

ANAD currently holds RCRA interim status for one conventional hazardous waste storage facility and 41 storage units for chemical weapon wastes (e.g., M55 rockets). In addition, an ACWA facility would be required to obtain a Certificate of Designation from Pueblo County (Colorado Revised Statues 25-15-201). The wastes generated during continued storage and maintenance activities are currently accumulated in accordance with the ANAD Hazardous Waste Management Plan and stored in the existing interim status units. Continued storage would have no impact on the existing RCRA interim status facility or RCRA generator activities. Currently, hazardous wastes are shipped to an off-site, RCRA-permitted TSDF under a proper RCRA manifest.

Similarly, solid wastes generated during storage and maintenance activities are currently accumulated, stored, and disposed of through existing solid waste collection and disposal practices. No additional solid wastes would be generated under the no action alternative at ANAD.

9.2.4 PBA

Arkansas has promulgated nonhazardous solid waste regulations (Arkansas Department of Environmental Quality [ADEQ] Regulation No. 22). Under these regulations, anyone operating a facility for solid waste disposal where processing, treatment, storage, or final disposal of solid waste is performed must obtain a permit from ADEQ. No person may send nonhazardous solid waste to any site or facility other than one that has obtained such a permit (*Arkansas Code Annotated* [ACA] 8-6-205(a)(3)). All collection and transportation of solid nonhazardous waste must be in accordance with these regulations (ADEQ Regulation No. 22, Section 22.203).

Arkansas is a RCRA-authorized state and has promulgated hazardous waste regulations that basically reflect the federal standards. ADEQ Regulation No. 23, Section 262, governs the generation and accumulation of hazardous waste. Section 263 governs the transportation of hazardous waste. Sections 264 through 270 govern the storage of hazardous waste for more than

90 days, the ultimate treatment and disposal of hazardous waste, and the closure of hazardous waste TSDFs. Arkansas has adopted the EPA military munitions rule, and any waste military munitions that are chemical agents or chemical munitions and that exhibit a hazardous waste characteristic or are listed as a hazardous waste are subject to all applicable regulatory requirements of RCRA, except for the one-year storage prohibition (ADEQ Regulation No. 23, Section 266.205(d)). The treatment and disposal of hazardous waste military munitions are subject to applicable permitting, procedural, and technical standards (ADEQ Regulation No. 23, Section 266.206).

The regulations define hazardous waste on the basis of hazardous characteristics (i.e., characteristic hazardous wastes) or the specific regulatory listing of the waste (i.e., listed hazardous wastes) (ADEQ Regulation No. 23, Section 261). ADEQ has not designated chemical agents or munitions as listed wastes in its regulations. Therefore, if a chemical agent or munition has hazardous waste characteristics, it must be managed as a hazardous waste. Hazardous waste characteristics include being ignitable, toxic (e.g., the waste contains a set concentration of certain regulated toxic constituents), corrosive, or reactive. A characteristically reactive hazardous waste is a solid waste that (1) is normally unstable and readily undergoes violent change without detonating; (2) reacts violently with water; (3) forms potentially explosive mixtures with water; (4) when mixed with water, generates toxic gases, vapors, or fumes in a quantity sufficient to present danger to human health or the environment; (5) is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure; or (6) is a forbidden explosive as defined by DOT. Most chemical munitions could meet the reactive standard. In addition, DOD has declared M55 rockets to be hazardous waste, and PBA has entered into a Consent Administrative Order with the ADEQ concerning the management and storage of M55 rockets as hazardous waste, including the explosive charges and the GB and VX contained within (Consent Administrative Order LIS 84-068). Salts generated from the treatment process could contain metal contaminants and might meet the toxic hazardous characteristic. Under Arkansas hazardous waste regulations, waste containing PCBs in excess of 50 ppm must be managed and disposed of in accordance with TSCA regulations (ADEQ Regulation No. 23, Section 261.8).

Under its regulations, the ADEQ may issue an RD&D permit for any hazardous waste treatment facility that proposes to use an innovative and experimental hazardous waste treatment technology or process for which permit standards for such experimental activity have not been promulgated (ADEQ Regulation 23, Section 270.65). Such a permit has a duration of no longer than one year, but it can be renewed three times for a period of not more than one year. An RD&D permit provides for the receipt and treatment of only those types and quantities of hazardous waste that ADEQ deems necessary for purposes of determining the efficacy and performance capabilities of the technology or process and the effects of such a technology or process on human health and the environment. Such an RD&D permit shall include such requirements as ADEQ deems necessary to protect human health and the environment, including, but not limited to, requirements regarding monitoring, operation, closure, and remedial action. In addition, the permit will contain requirements that ADEQ deems necessary regarding testing and providing information to ADEQ with respect to the operation of the facility. In granting an RD&D permit, ADEQ may, consistent with the protection of human health and the environment, modify or waive permit application and permit issuance requirements, except for the procedures regarding public participation.

9.2.4.1 ACWA Facility Construction

Under RCRA, all wastes generated during construction of an ACWA facility at PBA (i.e., construction chemicals, adhesives, and solvents) would have to be characterized to determine if they were hazardous or nonhazardous (ADEQ Regulation 23, Section 262.11). If they were hazardous, they would have to be stored according to Arkansas hazardous waste regulations, including specific container management and labeling requirements. If the hazardous construction wastes were kept on site for more than 90 days, they would have to be stored in an ADEQ-permitted storage facility. PBA has several RCRA permitted storage facilities and holds interim status for a number of hazardous waste storage facilities. If the hazardous wastes from the construction activities were to vary from those wastes currently listed in the PBA RCRA permit for existing storage areas, a modification of the permit or the Part A interim status application might be required to store the additional wastes generated during construction. Shipments of hazardous wastes off site would have to be under a proper RCRA manifest to a properly permitted RCRA hazardous waste TSDF.

Nonhazardous solid wastes, including construction debris wastes, would be disposed of in disposal sites properly permitted under Arkansas solid waste regulations (ADEQ Regulation No. 22). Since no nonhazardous wastes would be disposed of on the PBA site (e.g., in a landfill), no ADEQ approval would be required.

9.2.4.2 ACWA Facility Operations

In Arkansas, wastes that are defined as hazardous, either by characteristic (e.g., salts with metals), by listing, or pursuant to agreement with the ADEQ (Consent Administrative Order LIS 84-068), must be accumulated in accordance with the Arkansas regulations for generators (ADEQ Regulation No. 23, Section 262). If these wastes are to be stored on site for more than 90 days, the storage facility must be permitted by ADEQ and operated in accordance with Arkansas regulations for permitted TSDFs (ADEQ Regulation No. 23, Section 264 or 265). If hazardous wastes are to be stored in existing, on-site RCRA storage facilities, the existing PBA RCRA permit or Part A application might need to be amended to allow for the storage of different types of waste or for storage in different configurations (e.g., pallet stacking height). In addition, the pending Part B application might have to be amended to reflect additional storage operations. Shipments of hazardous wastes off site must be under a proper RCRA manifest to a properly permitted RCRA TSDF.

Any ACWA facility constructed at PBA would have to obtain a RCRA permit from ADEQ, probably as a miscellaneous RCRA treatment unit (ADEQ Regulation No. 23, Section 264.600). “Miscellaneous units” (also referred to a Subpart X units) are units that do not meet the definition of conventional RCRA units (e.g., tanks, land treatment, landfills, or incinerators). Regulations for Subpart X units are not technology specific; therefore, design standards, effluent/emission limitations, technical performance standards, and operational requirements are generally established in the specific permit conditions. The re-use of these gaseous emissions as an auxillary fuel in the Neut/GPCR/TW-SCWO process might require the boiler, depending on design and fuel characteristics, to be classified as a RCRA BIF, which has additional regulatory operational and emission standards (ADEQ Regulation 23; 40 CFR Section 266, Subpart H).

PBA currently holds a RCRA permit for a number of RCRA storage facilities and a hazardous waste landfill. PBA holds interim status (e.g., a Part A permit has been filed) for Subpart Y treatment facilities, including a waste volume incineration unit and an open burn/open detonation unit for processing hazardous wastes (e.g., off-specification conventional weapons). PBA has also filed a Part A application for additional storage facilities for chemical weapons (i.e., the M55 rockets). A Part B application has been filed for the interim status facilities, but no permanent RCRA permit has been issued by ADEQ. ADEQ issued a separate RCRA Part B permit to PBA for the Pine Bluff Chemical Demiliterization Facility. PBA also holds a RCRA permit for its Central Incinerator Complex, which includes a rotary deactivation furnace and a fluidized-bed incinerator (see Section 5.2.1.2). Although this unit was permitted to process RCRA hazardous wastes, it is currently only used intermittently to burn nonhazardous wastes. The existing Part B application could be amended to include the new ACWA treatment unit, or a separate Part A and Part B permit application could be filed. Construction and operation of the new unit could not begin, however, until a RCRA permit was issued (ADEQ Regulation 23, Section 270). Alternatively, ADEQ could issue an RD&D permit for an alternative technology facility, provided the facility could meet the regulatory time limitations and other ADEQ conditions. If M55 rocket firing/shipping tubes were to be treated, the ACWA facility would also require approval from the EPA under TSCA (40 CFR 761).

Nonhazardous solid wastes, including operations and maintenance wastes, would have to be disposed of in disposal sites properly permitted under Arkansas solid waste facilities regulations (ADEQ Regulation 22). Since no nonhazardous wastes would be disposed of on the PBA site (e.g., in a landfill), no ADEQ approval would be required.

9.2.4.3 No Action

PBA currently holds a RCRA permit for a number of conventional hazardous waste storage facilities and interim status for the additional storage units used to store chemical weapon wastes (i.e., M55 rockets). The wastes generated during storage and maintenance activities are currently accumulated in accordance with the PBA Hazardous Waste Management Plan and stored in the existing RCRA units. Continued storage would have no impact on the existing RCRA interim status facility or RCRA generator activities. Currently, hazardous wastes are shipped to an off-site, RCRA-permitted TSDF under a proper RCRA manifest.

Similarly, solid wastes generated during storage and maintenance activities are currently accumulated, stored, and disposed of through existing solid waste collection and disposal practices. No additional solid wastes would be generated under the no action alternative.

9.2.5 PCD

Colorado has promulgated nonhazardous solid waste regulations (6 *Code of Colorado Regulation* [CCR] 1007-2). Under these regulations, anyone operating a facility for solid waste disposal where processing, treatment, storage, or final disposal of solid waste is performed must obtain a Certificate of Designation from the local governing authority, in coordination with the Colorado Department of Public Health and Environment (CDPHE).

Colorado is a RCRA-authorized state and has promulgated hazardous waste regulations that basically mirror the federal standards (6 CCR 1007-3). Part 262 of 6 CCR 1007-3 governs the generation and accumulation of hazardous waste. Part 263 governs the transportation of hazardous waste. Part 264 governs the permitted storage of hazardous waste. Parts 264 and 268 govern the ultimate treatment and disposal of hazardous waste and closure of hazardous waste TSDFs. CDPHE regulations incorporate some special provisions concerning military munitions (6 CCR 1007-3 Part 267, Subpart M). However, other than off-range used or fired military munitions, which are automatically defined as solid waste, all other military munitions are governed by conventional hazardous waste regulations on the basis of the definition of a solid waste and the definition of a hazardous waste.

The regulations define hazardous waste on the basis of the waste's hazardous characteristics (i.e., characteristic hazardous wastes) or the specific regulatory listing of the waste (i.e., listed hazardous wastes) (6 CCR 1007-3 Part 261). Under these regulations, the CDPHE has designated the following wastes as listed hazardous wastes. Mustard, mustard agent, mustard gas, H, and HD (bis(2-chloroethyl)sulfide) are designated as Hazardous Waste No. P909. Mustard, mustard agent, mustard gas, and HT (bis(2-chloroethyl)sulfide) and bis[2(2-chloroethylthio)ethyl]ether) are designated as Hazardous Waste No. P910 (6 CCR 1007-3, Section 261.33(e)). On June 19, 2001, the CDPHE adopted amendments to its hazardous waste regulations to add Waste Chemical Weapons (Hazardous Waste No. K901) and environmental media, debris, and containers contaminated through contact with Waste Chemical Weapons (Hazardous Waste No. K902) to the list of hazardous wastes from specific sources. The regulatory analysis specifically refers to these secondary wastes (i.e., contaminated media, debris, and containers) as solid wastes generated as a result of the treatment, storage, or disposal of Waste Chemical Weapons. In addition, the regulatory analysis states that wastes that meet the listing description for secondary wastes (Hazardous Waste No. K902) would not carry the listing for Waste Chemical Weapons (Hazardous Waste No. K901), a listing that might otherwise be applied to these wastes on the basis of their mixture and derived rules.

Further, the regulatory analysis accompanying the proposed amendments states:

> "Components that are removed from a Waste Chemical Weapon and that can be demonstrated to not be contaminated by chemical agent need not be managed as Waste Chemical Weapons. Also, chemical weapons that undergo baseline reconfiguration before they become wastes do not meet the listing description for Waste Chemical Weapons."

Appendixes VII and VIII to Part 261 of the CDPHE regulations have also been amended to add Sarin, mustard agent, and mustard HT agents as the specific chemical agents that are the basis of the listing (Appendix VII) and as hazardous constituents (Appendix VIII). In addition, the definition of "chemical weapons" in Section 260.10 was amended to read,

> "…agent or munition that, through its chemical properties, produces lethal or other damaging effects on human beings, except that such term does not include riot control agents, chemical herbicides, smoke and other obscuration materials."

These amendments will become effective on July 30, 2001 (CDPHE 2001). Therefore, treatment of mustard agent, mustard gas, H, HD, or HT can only be accomplished at a CDPHE-permitted TSDF. In addition, any solid waste generated from the treatment, storage, or disposal of a listed hazardous waste (including any sludge, spill residue, ash, emission control dust, or leachate) is also a listed hazardous waste, bearing the same hazardous waste number as the original waste to be treated (e.g., P909 or P910) (6 CCR 1007-3, Section 261.3), unless specifically delisted by the CPPHE (6 CCR 1007-3, Section 261.22). Therefore, any wastes generated from the chemical agent/weapon demilitarization/treatment process, regardless of whether they would demonstrate a hazardous characteristic, would continue to be listed as hazardous wastes and would have to be managed, stored, and disposed of in accordance with Colorado hazardous waste requirements. Under Colorado hazardous waste regulations, wastes containing PCBs in excess of 50 ppm must be managed and disposed of in accordance with TSCA regulations (6 CCR 1007-3, Section 261.8; 40 CFR 761).

9.2.5.1 ACWA Facility Construction

Under RCRA, all wastes generated during construction of an ACWA facility at PCD (i.e., construction chemicals, adhesives, and solvents), would have to be characterized to determine if they were hazardous or nonhazardous (6 CCR 1007-3, Section 262.11). If they were hazardous, they would have to be stored according to Colorado hazardous waste regulations, including specific container management and labeling requirements. If the hazardous construction wastes were kept on site for more than 90 days, they would have to be stored in a CDPHE-permitted storage facility. PCD holds a CDPHE-issued RCRA permit for four hazardous waste storage facilities; the permit delineates the exact waste codes that can be stored therein. If hazardous waste from the construction activities were to vary from those wastes currently listed in the PCD

RCRA permit, modification of the existing RCRA permit might be required. Shipments of hazardous wastes off site would have to be under a proper RCRA manifest to a properly permitted RCRA TSDF.

Nonhazardous solid wastes, including construction debris wastes, could be disposed of in disposal sites that hold valid Certificates of Designation issued by the local authority and the CDPHE.

9.2.5.2 ACWA Facility Operations

Wastes that are characterized as hazardous, either by characteristic (e.g., corrosive decontamination water) or by listing (e.g., brine salts generated during the treatment of mustard), must be accumulated in accordance with the CDPHE regulations for generators (6 CCR 1007-3 Part 262). If wastes generated during ACWA operations are to be stored on site for more than 90 days, the storage facility must have a RCRA TSDF permit and operate in accordance with the CDPHE regulations for permitted TSDFs (6 CCR 1007-3 Part 264). If hazardous wastes are to be stored in existing, on-site, CDPHE-permitted storage facilities, the existing PCD RCRA permit might need to be amended to allow for the storage of different types of waste or for storage in different configurations (e.g., pallet stacking height). Shipments of hazardous wastes off site would have to be under a proper RCRA manifest to a properly permitted RCRA TSDF.

Any ACWA facility constructed at PCD would have to obtain a RCRA permit from CDPHE, probably as a miscellaneous RCRA treatment unit (6 CCR 1007-3, Section 264.601, et seq.). “Miscellaneous units” (also referred to a Subpart X units) are units that do not meet the definition of conventional RCRA units (e.g., tanks, land treatment, landfills, or incinerators). Regulations for Subpart X units are not technology specific; therefore, design standards, effluent/emission limitations, technical performance standards, and operational requirements would be established in the specific permit conditions. Any re-use of gaseous emissions as an auxillary fuel might require the boiler, depending on design and fuel characteristics, to be classified as a RCRA BIF, which has additional regulatory operational and emission standards (40 CFR Section 266, Subpart H). In addition, an ACWA facility would be required to obtain a Certificate of Designation from Pueblo County (*Colorado Revised Statutes* 25-15-201).

CDPHE has indicated that it would consider issuing an RD&D permit for the alternative technology facilities (Schieffelin 1997). As indicated by CDPHE, some of the advantages of an RD&D permit include (1) a possible reduction in the amount of time and effort needed to prepare the application as (as opposed to the amount needed to prepare an application for a full RCRA Part B permit); (2) a reduction in the need to modify the existing PCD RCRA permit; (3) the permit’s allowance for full-scale testing of a unit to determine operating parameters, maintenance requirements, and any special controls necessary for a particular waste; and (4) the determination of equipment suitability without having to submit a full RCRA Part B permit application.

Nonhazardous solid wastes, including construction debris wastes, would have to be disposed of in disposal sites that hold valid Certificates of Designation issued by the local authority and CDPHE. Since no nonhazardous wastes would be disposed of on site at PCD (e.g., in a landfill), no PCD Certificate of Designation would need to be acquired from Pueblo County. However, sanitary wastes would be discharged to the existing evaporative lagoons for disposal (see Section 9.5.4).

9.2.5.3 No Action

PCD currently holds a CDPHE-issued RCRA permit for four hazardous waste storage facilities, including two facilities for the storage of chemical-agent-contaminated wastes. The wastes generated during storage and maintenance activities are currently accumulated in accordance with the PCD Hazardous Waste Management Plan and stored in the existing permitted units. Continued storage would have no impact on the existing PCD RCRA-permitted storage or RCRA generator activities.

Similarly, solid wastes generated during storage and maintenance activities are currently accumulated, stored, and disposed of through existing solid waste collection and disposal practices. No additional solid wastes would be generated under the no action alternative at PCD.

9.2.6 BGAD

Kentucky has promulgated nonhazardous solid waste regulations (401 *Kentucky Administrative Regulation* [KAR] Parts 47–49). Under these regulations, anyone operating a facility for solid waste disposal where processing, treatment, storage, or final disposal of solid waste is performed must obtain a permit from the Department of Environmental Protection (referred to as KDEP) in the Kentucky Natural Resources and Environmental Protection Cabinet (Cabinet). No person may send nonhazardous solid waste to any site or facility other than one that has obtained such a permit (*Kentucky Revised Statute* [KRS] 224.40-100).

Kentucky is a RCRA-authorized state and has promulgated hazardous waste regulations (401 KAR, Parts 32–38) that basically reflect the federal standards. Part 32 governs the generation and accumulation of hazardous waste. Part 33 governs the transportation of hazardous waste. Parts 34 through 38 govern the storage of hazardous waste for more than 90 days, the ultimate treatment and disposal of hazardous waste, and the closure of hazardous waste TSDFs.

The regulations define hazardous waste on the basis of the waste's hazardous characteristics (i.e., characteristic hazardous wastes) or the specific regulatory listing of the waste (i.e., listed hazardous wastes) (401 KAR 31). As directed by statute (KRS 224.50-130(2)), the Cabinet has designated the following wastes as listed hazardous wastes. GB (isopropyl methyl phosphonoflouridate) is designated as Hazardous Waste No. N001. VX (o-ethyl-s-(2-diisopropylaminoethyl)-methyl phosphonothiolate) is designated as Hazardous Waste No. N002. H (bis(2-chloroethyl)sulfide) and related compounds are designated as Hazardous Waste No. N003. Therefore, GB, VX, and H can be treated in Kentucky only at a Cabinet-permitted hazardous waste TSDF. Under the regulations, any waste derived from the treatment, storage, or disposal of a listed hazardous waste (including any sludge, ash, emission control dust, or leachate) is also a listed hazardous waste (i.e., bearing the code N001, N002, or N003) per 401 KAR 31:010, Section 3(3)(b)(1), unless specifically delisted by the Cabinet (401 KAR 31:070). Therefore, unless a delisting petition is granted by the Cabinet, any wastes generated from a chemical agent/weapon demilitarization/treatment process, regardless of their current hazardous characteristics, must continue to be identified as listed hazardous wastes and must be managed, stored, and disposed of in accordance with Kentucky hazardous waste requirements. In addition, all M55 rockets have been declared to be hazardous wastes by DOD. Under Kentucky hazardous waste regulations, waste containing PCBs in excess of 50 ppm must be managed and disposed of in accordance with TSCA regulations (401 KAR 31:010, Section 8; 40 CFR 761).

An amendment to the Kentucky statutes governing the management of chemical munition wastes (KRS 224.50-130) became effective on July 14, 2000 (Kentucky Legislature House Bill 579, Kentucky Acts, Chapter 482, Section 1). This amendment sets new criteria to be used by the Cabinet in making a determination to issue, deny, or condition a permit for treatment or disposal of chemical munitions waste. Under the amended statute, “treatment” includes:

> “the manual or mechanical handling of the chemical compounds listed in subsection (2) of this section [GB, VX, and H] and of any munitions containing the compounds during the processing of munitions to remove the compounds, to separate munitions compounds, and to otherwise prepare the components and compounds for destruction, neutralization, dismantling, or decommissioning.”

Treatment does not, however, include:

> “the handling, movement, or overpacking of containers or munitions containing a compound listed in subsection (2) of this section within the fenced boundaries of an area used for the storage of those munitions if:
>
> (a) A plan for the handling, movement or overpacking is submitted and approved by the cabinet, after public notice and opportunity to be heard, before the handling, movement, or overpacking occurs; or
>
> (b) An emergency has occurred and the handling, movement, or overpacking is necessary to protect human health, safety, or the environment, if a report describing the handling, movement, or overpacking is submitted to the cabinet as soon as possible after the emergency is abated.”

Under the amendment, before the issuance, conditional issuance, or denial of a permit, the applicant must affirmatively demonstrate and the Cabinet must find that the following has occurred:

> "The proposed treatment or destruction technology has been fully proven in an operational facility of scale, configuration, and throughput comparable to the proposed facility, or has been demonstrated as effective, within the chemical weapons disposal programs as directed in Pub.L. 104-208 and other applicable federal laws, sufficient to provide assurance of destruction or neutralization at an efficiency of ninety-nine and nine thousand, nine hundred, and ninety-nine ten thousandths percent (99.9999%) for each compound listed in subsection (2) of this section that is proposed to be treated or destroyed, with an efficiency to be demonstrated as achievable under all operating conditions. During the occurrence of malfunctions, upsets, or unplanned shutdowns, all quantities of any compound listed in subsection (2) of this section shall be contained, reprocessed or otherwise controlled so as to ensure that the required efficiency is attained prior to any release to the environment."

In addition, the amended statute provides:

> "An emergency response plan must have been submitted to the Cabinet and approved, after public notice and an opportunity to be heard, providing for sufficient training, coordination, and equipment for state and local emergency response personnel, including health, police, fire, and other responders, to assure the ability of the community to respond to releases from such a facility. The plan shall demonstrate the capability of evacuating prior to exposure, or otherwise mitigating exposure for all individuals that might be exposed to releases from the facility during a credible worst-case release. . . . If such plan has not been fully implemented at the time of permit approval, the Division of Emergency Management shall advise the cabinet of critical shortcomings. Any permit issued shall include, as conditions, the resolution of critical shortcomings in the implementation of the plan, and shall not allow actual destruction of any of the compounds identified in subsection (2) of this section to begin until those permit conditions have been met to the satisfaction of the Division of Emergency Management."

A draft plan will be submitted by each respective county, and the Division of Emergency Management will complete an assessment of that draft plan and approve or reject it, after public notice and an opportunity to be heard. The Cabinet can conduct no technical review of an application for a permit for treatment or disposal until notified in writing by the Division of Emergency Management that the draft plan has been approved.

In addition, the Cabinet must conduct an alternatives analysis and after public notice and an opportunity to be heard, make an affirmative finding, that no alternative method of treatment or disposal exists in an operational facility or alternative disposal program that creates less risk of release, acute or chronic health effect, or adverse environmental effect.

Current Cabinet regulations concerning the treatment of nerve and blister agents (401 KAR 34:350), effective November 22, 1989, have not yet been modified to reflect the new legislation. However, these regulations also require an affirmative demonstration that the proposed treatment or destruction technology is proven in an operational facility having a scale, configuration, and throughput comparable to those of the proposed facility for a period of time sufficient to provide assurance of 99.9999% destruction or neutralization of each substance proposed to be treated or destroyed. Monitoring data from the comparable facility must reflect the absence of emissions from stack or fugitive sources, including, but not limited to, the products of combustion and incomplete combustion, which alone or in combination present an adverse effect on human health or the environment. In addition, provisions must have been made for development and funding of sufficient training, coordination, and equipment for state and local emergency response personnel, including the health, police, fire, and emergency response fields, to assure the ability of the community to respond to releases from such a facility. This must include development and funding of an evacuation plan that demonstrates the capability of removing individuals from the largest area of risk from a worst-case release.

9.2.6.1 ACWA Facility Construction

Under RCRA, all wastes generated during construction of the ACWA facility at BGAD (i.e., construction chemicals, adhesives, and solvents) would have to be characterized to determine if they are hazardous or nonhazardous (401 KAR 32:010, Section 2). If they are hazardous, they would have to be stored according to Kentucky hazardous waste regulations, including specific container management and labeling requirements. If the hazardous construction wastes are kept on site for more than 90 days, they would have to be stored in a Cabinet-permitted storage facility. BGAD has interim status for two conventional hazardous waste storage facilities and 39 storage units for waste chemical weapons (M55 rockets that have been declared to be hazardous waste). A Part B application has been filed; however, no RCRA permit has been issued by the Cabinet. If hazardous waste from the construction activities were to vary from those wastes currently listed in the BGAD RCRA Part A application, a modification of the application might be required. Shipments of hazardous wastes off site would have to be under a proper RCRA manifest to a properly permitted RCRA TSDF.

Nonhazardous solid wastes, including construction debris wastes, would be disposed of in disposal sites properly permitted under Kentucky solid waste regulations (401 KAR 47). Since no nonhazardous wastes would be disposed of on site (e.g., in a landfill), no Cabinet approval would be required.

9.2.6.2 ACWA Facility Operations

Wastes that are defined as hazardous, either by characteristic (e.g., corrosive decontamination water) or by listing (e.g., brine salts generated during the treatment process), must be accumulated in accordance with the Kentucky regulations for generators (401 KAR 32). If these wastes are to be stored on site for more than 90 days, the storage facility must be permitted by the Cabinet and operate in accordance with the Kentucky regulations for permitted TSDFs (401 KAR 34). If hazardous wastes generated during the ACWA pilot facility operations would be stored in existing, on-site storage facilities, BGAD's Part A application might need to be amended to allow for the storage of different types of waste or for storage in different configurations (e.g., pallet stacking height). In addition, the Part B application might have to be amended to reflect additional storage operations. Shipments of hazardous wastes off site would have to be done under a proper RCRA manifest to a properly permitted RCRA TSDF.

Any ACWA pilot facility constructed at BGAD would have to obtain a RCRA permit from the Cabinet, probably as a miscellaneous RCRA treatment unit (401 KAR 34.250 et seq.). "Miscellaneous units" (also referred to a Subpart X units) are units that do not meet the definition of conventional RCRA units (e.g., tanks, land treatment, landfills, incinerators). Regulations for Subpart X units are not technology specific; therefore, design standards, effluent/emission limitations, technical performance standards, and operational requirements are generally established in the specific permit provisions. The re-use of gaseous emissions as an auxillary fuel in the Neut/GPCR/TW-SCWO process might require the boiler, depending on design and fuel characteristics, to be classified as a RCRA BIF, which has additional regulatory operational and emission standards (40 CFR Section 266, Subpart H).

Kentucky hazardous waste regulations provide for the issuance of RD&D permits for alternative technology facilities (401 KAR 31:038 Section 6). To expedite the review and issuance of an RD&D permit, the Cabinet may, consistent with the protection of human health and the environment, modify or waive permit application and permit issuance requirements. An RD&D permit is for a period of one year and may be renewed not more than three times, each time for a period of not more than one year.

BGAD currently holds interim status for certain RCRA storage facilities. A Part B application has been filed; however, no permanent RCRA permit has been issued by the Cabinet. The Part B application could be amended to include the new treatment unit, or a separate Part A and Part B application could be filed. Construction and operation of the new ACWA unit could not begin, however, until a RCRA permit was issued. Alternatively, the Cabinet could issue an RD&D permit for an alternative technology facility, provided the facility would meet the regulatory time limitations and other Cabinet conditions.

Nonhazardous solid wastes, including operations and maintenance wastes, must be disposed of in disposal sites properly permitted under Kentucky solid waste facilities regulations (401 KAR 47). Since no nonhazardous wastes would be disposed of on site (e.g., in a landfill), no Cabinet approval would be required.

9.2.6.3 No Action

BGAD currently has interim status for two conventional hazardous waste storage facilities and 39 storage units for chemical weapon wastes (e.g., M55 rockets). The wastes generated during storage and maintenance activities are currently accumulated in accordance with the BGAD Hazardous Waste Management Plan and stored in the existing interim status units. Continued storage would have no impact on the existing Cabinet-permitted RCRA facility or RCRA generator activities.

Similarly, solid wastes generated during storage and maintenance activities are currently accumulated, stored, and disposed of through existing solid waste collection and disposal practices. No additional solid wastes would be generated under the no action alternative.

9.3 AIR QUALITY

9.3.1 *Clean Air Act* Requirements

Any emissions from ACWA activities would be subject to the *Clean Air Act* (CAA) (42 USC 7401 et seq.), as amended. The CAA requires the EPA to establish national primary and secondary ambient air quality standards as necessary to protect public health and provide the public with an adequate margin of safety from any known or anticipated adverse effects of a pollutant. The CAA also requires promulgation of national standards of performance for new major stationary sources. These national standards set emission limits for any new or modified building, structure, facility, or installation that emits or may emit an air pollutant (42 USC 7411), and they set emission standards for hazardous air pollutants (HAPs) (42 USC 7412). The CAA also requires that specific emission increases from major sources be evaluated to prevent significant deterioration in air quality (42 USC 7470). In addition, the CAA requires the EPA to promulgate rules to ensure that federal actions conform to the appropriate state implementation plans (SIPs)(42 USC 7506).

Pursuant to such direction, the EPA promulgated (1) primary and secondary National Ambient Air Quality Standards (NAAQSs) for criteria pollutants, including standards for emissions of sulfur oxides (measured as sulfur dioxide [SO_2]), nitrogen dioxide (NO_2), carbon monoxide (CO), coarse inhalable particulate matter less than or equal to 10 μg (PM_{10}), fine inhalable particulate matter less than or equal to 2.5 μg ($PM_{2.5}$), ozone (O_3), and lead (Pb) (40 CFR Part 50); (2) New Source Performance Standards (NSPS) applicable only to specific source categories (40 CFR Part 60); (3) National Emission Standards for Hazardous Air Pollutants (NESHAP) applicable to only specific source categories (40 CFR Part 63); and Prevention of Significant Deterioration (PSD) regulations (40 CFR 52.21). The CAA provides that each state must develop and submit for approval to the EPA a SIP for controlling air pollution and air quality in that state and that each state must develop its own regulations to monitor, permit, and control air emissions within its boundaries.

Under Title V of the *Clean Air Act Amendments of 1990* (CAAA), all states must adopt an operating permit program to control emissions within that state. The program must contain at least the minimum elements set forth in the EPA permitting requirements (40 CFR Part 70). Under these requirements, a state must issue a permit to (1) all major sources; (2) any source, including an area source, subject to HAP regulations (CAA Section 111); and (3) any source regulated under NSPS provisions (CAA Section 112). All existing major sources must then apply to the state authority within a certain time after the state program has received interim or full approval from the EPA. A state program may provide for exemption of nonmajor sources. Under the regulations, such applications must include information on all sources (not just major sources) of air pollutant emissions located within a facility, including all contiguous land under the control of one owner. However, under Title V permit regulations, insignificant activities and emission levels, as defined in the state program, do not need to be included in the permit application. States may adopt more or less stringent definitions for “insignificant” activities and emission levels than those set forth in the federal regulations.

Under Section 112(r) of the CAA, the EPA is to promulgate regulations to prevent the accidental release of any listed substance or any other extremely hazardous substance and to minimize the consequences of any such release. This section applies to owners and operators of facilities that produce, process, handle, or store a certain threshold quantity of such substances. The EPA has promulgated a list of regulated substances, threshold quantities for planning and reporting, and risk management planning requirements (40 CFR Part 68).

A federal agency must make a determination that a federal action conforms to the applicable SIP before such an action may be taken (CAA Section 176). Under the rule for determining conformity of general federal actions (40 CFR 51.850-860), federal agencies are subject to state SIPs. Until a state has revised its SIP to include Section 176 provisions, federal agencies are subject to EPA-promulgated conformity requirements (40 CFR 93.150-160). For federal actions, a conformity determination is required for each pollutant for which the total of direct and indirect emissions in a nonattainment or maintenance area caused by a federal action would equal or exceed certain limits (40 CFR 51.853). In addition, the total of direct and indirect emissions of any pollutant that would result from a federal action must not equal or exceed 10% of a nonattainment or maintenance area’s total emissions of that pollutant. If it does, it is defined as a regionally significant action, and a conformity determination is required.

Under Army policy, although the general conformity rule applies only to actions that generate emissions in nonattainment or maintenance areas, installations in attainment areas can generally meet the general CAA requirements for conformity with the appropriate SIP (CAA Section 176) by addressing conformity (e.g., compliance with state emission standards and permitting requirements) in the NEPA documentation (Finch undated).

9.3.1.1 ANAD

The ANAD facility is located in Calhoun County in the state of Alabama. Although located in the East Alabama Intrastate Air Quality Control Region (40 CFR 81.199), ADEM regulations would apply to air emissions from the ANAD facility (Admin. Code R. 335-3, et seq.). Calhoun County is in attainment or unclassified for all regulated criteria air pollutants (40 CFR 81.301).

Under ADEM regulations, any major source is subject to permitting requirements (Admin. Code R. 335-3-16-.03). ANAD is a major source and currently holds an operating permit issued by ADEM. A facility that holds an ADEM operating permit must submit an application for a permit modification application whenever there is a significant or major modification (Admin. Code R. 335-3-16-.13(4)). A "major modification" is any physical change in a major stationary source that would result in a significant net emissions increase of any regulated pollutant (Admin. Code R. 335-3-14-.04(2)(b)). In determining if a modification is major, the increase in emissions from the proposed modification can be offset by decreases in actual emissions at the source that are contemporaneous with the modification (Admin. Code R. 335-3-14.04(2)(c)). A "significant net emissions increase" occurs when a modification to the source produces emissions equal to or in excess of the rates shown in Table 9.1.

Under the Alabama PSD program, any major modification to a source in an attainment area is required to undergo a PSD review (Admin. Code R 335-3-14-.04). No major modification to an existing major source can begin operating until it has been shown that the source will meet each applicable emission limitation under the SIP and each applicable limitation standard and standard of performance under federal NSPS and NESHAP requirements. In addition, each major source or major modification with a significant net emissions increase must demonstrate that allowable emission increases from the proposed source, in conjunction with all other applicable emission increases or reductions (including secondary emissions), would not cause or contribute to air pollution in violation of any NAAQS or any applicable maximum allowable increase over the baseline concentration in any area. Such a demonstration is referred to as a "source impact analysis." Concentrations of PM_{10} attributable to an increase in emissions that would result from construction or from other temporary emission-related activities by a new or modified source are not included in determining compliance with a maximum allowable increase (Admin. Code R. 335-3-14-.04(6)). In Calhoun County, a Class II county,[1] increases in pollutant concentrations over the baseline must be limited to the maximum allowable increase shown in Table 9.2. Each application for a permit must also contain an analysis of ambient air quality in the area that would be affected by the proposed source. This "air quality analysis" must address each pollutant that the source could potentially emit in a significant amount. It must also address each pollutant

[1] In 1975, the EPA developed a classification system to allow some economic development in clean air areas while still protecting air from significant deterioration. These classes are defined in the *1977 Clean Air Act Amendments* (CAAA). Very little deterioration is allowed in Class I areas (e.g., larger national parks and wilderness areas). Class II areas allow moderate deterioration. Class III areas allow deterioration up to the secondary standard.

TABLE 9.1 Significant Net Emissions Increase

Pollutant	Emission Rate (tons/yr)
Carbon monoxide (CO)	100
Nitrogen oxides (NO_x)	40
Sulfur dioxide (SO_2)	40
Particulate matter (PM)	25
PM_{10}	15
Ozone (as VOCs)[a]	40
Lead (Pb)	0.6
Fluorides	3
Sulfuric acid mist	7
Hydrogen sulfide (H_2S)	10
Total reduced sulfur (including H_2S)	10
Reduced sulfur compounds (including H_2S)	10

[a] VOCs = volatile organic compounds.

for which a modification to the source would result in a significant net emissions increase. A significant net emissions increase is any rate of emissions that would equal or exceed the rates in Table 9.1.

However, if the allowable emissions of a pollutant that would result from a major modification would not affect a Class I area or any area where an applicable increment is known to be violated, and the emission would be temporary, the source would not need to conduct a source impact analysis or an air quality analysis. (The regulations do not contain a definition of "temporary.")

ADEM has a Title V permitting program that applies to all major sources. Under Title V permit regulations, all air emissions from a facility must be reported on the Title V application, except insignificant or trivial activities. "Insignificant or trivial activities" generally mean any air emissions or any air emission unit that has the potential to emit less than 5 tons/yr of any criteria pollutant or less than 1,000 lb/yr of any HAP. ANAD has submitted an application for a Title V permit.

Alabama has revised its SIP to require conformity determinations for federal actions. The regulations apply only to nonattainment and maintenance areas for the criteria pollutants for which the area is designated (Admin. Code R. 335-3-17-.02, incorporating 40 CFR 93, Subpart B).

TABLE 9.2 Alabama Ambient Air Increments

Pollutant	Maximum Allowable Increase ($\mu g/ft^3$)
PM_{10}	
Annual arithmetic mean	17
24-hour maximum	30
Sulfur dioxide (SO_2)	
Annual arithmetic mean	20
14-hour maximum	91
3-hour maximum	514
Nitrogen dioxide (NO_2)	
Annual arithmetic mean	25

ACWA Facility Construction. Air emission impacts would result from the initial construction activities for any of the proposed ACWA facilities at ANAD. Air emissions from construction activities would include SO_2, NO_x, CO, and volatile organic compounds (VOCs) as well as PM, exhaust, and fugitive emissions that would result from construction equipment and vehicles. Concentrations of PM_{10} attributable to the increase in emissions that would result from construction or other temporary emission-related activities being conducted by a new or modified source would not be included in determining compliance with a maximum allowable increase (Admin. Code R. 335-3-14-.04(6)). However, fugitive dust or visible emission standards and/or mitigation requirements might still be applicable (Admin. Code R. 335-3-4-.01 and 335-3-4-.02). Under those regulations, no person may discharge into the atmosphere, from any source of emissions, PM with greater than 20% opacity, as determined by a six-minute average. In addition, no person may allow any materials to be handled, transported, or stored without taking reasonable precautions to prevent PM from becoming airborne. Such precautions can include, but are not limited to, using water or chemicals to control demolition dust and installing hoods, fans, and fabric filters to enclose and vent dust from handling of dusty materials. No person may cause or permit the discharge of visible fugitive dust emissions beyond the lot line of the property from which the emissions originated.

ACWA Facility Operations. During normal operations of any of the proposed pilot facilities at ANAD, air emissions would be expected from (1) boiler operations (emissions could include SO_2, NO_2, hydrocarbons [HCs], CO, and PM_{10}), (2) process stacks, (3) emergency generators (diesel), and (4) vehicle/traffic emissions. Under Alabama permitting procedures, if air pollutant emissions from a stationary source exceed certain regulatory limits (more than 250 tons/yr of any criteria pollutant, more than 10 tons/yr of any HAP, or 25 tons/yr of any combination of HAPs), then the source is a "major source" and must obtain an air permit.

Tables 4.5-4, 4.5-5, 4.5-6, and 4.5-7 show the estimated emissions of criteria pollutants to the atmosphere that would result from the operation of a pilot Neut/Bio, Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox facility, respectively, in pounds per year. Tables 4.6-2, 4.6-3, 4.6-4, and 4.6-5 show the estimated toxic air pollutant emissions that would result from the operation of a pilot Neut/Bio, Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox facility, respectively, in micrograms per second.

The emissions from any ACWA pilot facility alone would not be a major source. Nor would these emissions exceed the criteria for a significant net emissions increase. Therefore, the emissions would not constitute a major modification according to ANAD's existing operating permit. However, if an ACWA facility would emit more than 5 tons/yr of criteria pollutants or 1,000 lb/yr of HAPs, ANAD's Title V application would have to be amended to include the emissions from that new pilot facility.

ADEM has adopted the federal NSPS in its entirety (Admin. Code R. 335-3-10; 40 CFR 60). The only potential ACWA pilot facility equipment that would appear to fall within the adopted federal NSPS program would be the steam generating units. Under these regulations, a "steam generating unit" is a device that combusts any fuel and produces steam or heats water or any other heat transfer medium. The term includes any duct burner that combusts fuel and is a part of a combined-cycle system but does not include process heaters. Process heaters are devices that are primarily used to heat a material to initiate or promote a chemical reaction in which the material participates as a reactant or catalyst. As long as boilers are operated as process heaters, they do not need to meet the federal NSPS as adopted by ADEM.

Certain HAPs would be emitted from any of the potential ACWA pilot facilities at ANAD. However, none of the pilot facilities would be a major source of HAP emissions or fall under any of the EPA NESHAP regulated source categories, as adopted by ADEM (Admin. Code R. 335-3-11; 40 CFR 61). Therefore, no regulatory action under NESHAP would be necessary.

None of the raw materials stored and used at a pilot Neut/SCWO or Neut/GPCR/TW-SCWO facility would be regulated toxic substances under Section 112(r) of the CAA. The pilot Neut/Bio facility would use regulated toxic substances in its processes, including ammonia. Ammonia in concentrations of 20% or more is a listed regulated toxic substance under Section 112(r) of the CAA and has a regulatory threshold storage quantity of 20,000 lb (9,100 kg). In addition, nitric acid in concentration of 80% or more used in the Elchem Ox process is a listed regulated toxic substance under Section 112(r) of the CAA and has a threshold storage quantity of 20,000 lb (9,100 kg). In addition, nitric acid in concentrations of 80% or more used in the Elchem Ox process is a listed regulated toxic substance under Section 112(r) of the CAA and has a threshold storage quantity of 15,000 lb (6,800 kg). If regulated toxic substances in excess of regulatory threshold quantities would be stored on site, ANAD would have to prepare and submit a risk management plan (RMP). The plan would have to include (1) a worst-case release scenario and an accident history for the process; (2) demonstrate coordination for response actions with local emergency planning and response agencies; and (3) certify that the distance to the specified endpoint for the worst-case accidental release scenario for the process is less than the distance to the nearest public receptor. Additional requirements would apply (1) if the site could not show that for the five years prior to the submission of the RMP, the process had not experienced an accidental release of a regulated substance that led to death, injury, response, or restoration activities for an exposure of an environmental receptor; and (2) if the site could not show that the distance to a toxic or flammable endpoint for a worst-case release assessment was less than the distance to any public receptor (40 CFR 68.12).

For construction of a facility in a nonattainment or maintenance area, a federal conformity determination is required if the total of direct and indirect emissions caused by construction of the facility would equal or exceed certain limits (40 CFR 51.853). However, since ANAD is located in an attainment area, and since any emissions from ANAD do not affect a Class I area, a separate federal conformity determination would not be required. Conformity with the Alabama air emissions regulations and SIP is a part of this EIS.

No Action. Continued storage at existing storage facilities is the no action alternative at ANAD. The principal sources of air emissions associated with continued storage would be exhaust emissions and road dust generated by vehicle movements. Potential air quality impacts from current storage activities would be expected to be minimal. Such emissions would have already been included in the total site calculation in the existing Title V permit application.

9.3.1.2 PBA

The PBA facility is located in Jefferson County in the state of Arkansas. ADEQ regulations apply to any air emissions from the PBA facility (ADEQ Regulations 18, 19, and 26). Jefferson County is in attainment or unclassified for all regulated criteria air pollutants (40 CFR 81.304).

Under ADEQ regulations, any major source is subject to permitting requirements (ADEQ Regulation No. 26, Section 26.302). A “major source” is any source that emits or has the potential to emit 100 tons/yr of any criteria pollutants, 10 tons/yr of any HAP, or 25 tons/yr of a combination of HAPs. PBA is a major source and currently holds an operating permit issued by ADEQ. A facility that holds an ADEQ operating permit must submit a permit modification application whenever there is a “significant modification” to an existing emission unit (ADEQ Regulation No. 26, Section 26.405). A “minor modification” is any change in a major stationary source that (1) increases emissions by less than 20% of the amount as given in the applicable definition of major source or 15 tons/yr of PM_{10} or 0.6 ton/yr of lead, whichever is less, or increases emissions of any regulated pollutant by less than 20% over any currently permitted emission rates; (2) does not violate any applicable requirement; (3) does not require significant changes to existing monitoring, reporting, or recordkeeping requirements in the permit; (4) does not require or change either a case-by-case determination of an emission limit or other standard, a source-specific determination for temporary sources of ambient impacts, or a visibility or increment analysis; and (5) does not seek to establish or change a permit term or condition for which there is no corresponding underlying applicable requirement but that the source has nevertheless assumed in order to avoid an applicable requirement to which it would otherwise be subject. (Two examples of such an applicable requirement are federally enforceable emission caps and alternative emission limits for HAPs.)

ADEQ also requires certain minor sources to obtain a permit. A hazardous waste TSDF is such a facility (ADEQ Regulation No. 18, Section 18.301). In granting a minor source permit, ADEQ requires the source to be constructed or modified so it can operate without resulting in a violation of applicable portions of Regulation No. 18 and without causing air pollution (ADEQ Regulation No. 18, Section 18.302), including visible emissions, odors, water vapor emissions, fugitive emissions, emissions from mobile sources, and open burning.

In Arkansas, the federal PSD program, with minor revisions and additional requirements, has been adopted as part of the SIP (ADEQ Regulation No. 19). Under those regulations, a major modification to an existing major source in an attainment area is subject to PSD review if the net emissions increase for any regulated pollutant exceeds the significant level for that pollutant (i.e., the level shown in Table 9.1). No major modification to an existing major source can begin until it has been shown the source will meet each applicable emission limitation under the SIP and each applicable limitation standard and standard of performance under federal NSPS and NESHAPs requirements. In addition, each major source must demonstrate that allowable emission increases from the proposed source, in conjunction with all other applicable emission increases or reductions (including secondary emissions), would not cause or contribute to air pollution in violation of any NAAQS or any applicable maximum allowable increase over the baseline concentration in any area. Such a demonstration is referred to as a “source impact analysis.” Each application for a permit must also contain an analysis of ambient air quality in the area that would be affected by the proposed source. This “air quality analysis” must address each pollutant that the source could potentially emit in a significant amount. It must also address each pollutant for which a modification to the source would result in a significant net emissions increase. A “significant net emissions increase” is any rate of emissions that would equal or exceed the rates in Table 9.1. In addition, in Jefferson County, a Class II county, increases in pollutant concentrations over the baseline must be limited to the maximum allowable increase shown in Table 9.2. Concentrations of PM_{10} attributable to an increase in emissions that would result from construction or other temporary emission-related activities by a new or modified source are not included in determining compliance with a maximum allowable increase.

However, if the allowable emissions of a pollutant that would result from a major modification would not affect a Class I area or any area where an applicable increment is known to be violated, and the emission would be temporary, the source would not need to conduct a source impact analysis or an air quality analysis. The regulations do not contain a definition of “temporary.”

ADEQ has a Title V permitting program that applies to all major sources. Under Title V permit regulations, all air emissions from a facility must be reported on the Title V application, except insignificant or trivial activities. “Insignificant or trivial activities” include a list of specific emission units, operations, or activities but generally mean any air emissions or any air emission unit that has the potential to emit less than 5 tons/yr of any criteria pollutant or less than 1 ton/yr of any HAP (ADEQ Regulation No. 19, Appendix A).

Arkansas has revised its SIP to require conformity determinations for federal actions. The regulations apply only to nonattainment and maintenance areas for the criteria pollutants for which the area is designated (40 CFR 51.853).

ACWA Facility Construction. Air emission impacts would result from the initial construction activities for any of the proposed ACWA facilities at PBA. Air emissions from construction activities would include SO_2, NO_x, CO, and VOCs as well as PM, exhaust, and fugitive emissions from construction equipment and vehicles. Fugitive dust or visible emission standards and/or mitigation requirements might be applicable to such activities (ADEQ Regulation No. 18, Chapters 5 and 9). Under those, no person shall cause or permit visible emissions (other than uncombined water vapor) from equipment to exceed an opacity greater than 20% (ADEQ Regulation No. 18, Section 18.501(A)). However, these emission limits do not apply to the use of mobile and portable equipment used to clear, grade, or plow land or to the application of base or surface materials to roads, runways, parking lots, and similar facilities (ADEQ Regulation No. 18, Section 501(D)). In addition, no person shall cause or permit the handling, transporting, or storage of any material to be done in a manner that allows or may allow unnecessary amounts of air contaminants to become airborne. Furthermore, no person may cause or permit any building to be constructed, altered, used, repaired, or demolished without applying all such reasonable measures as may be required to prevent unnecessary amounts of PM from becoming airborne (ADEQ Regulation No. 18, Section 18.901).

ACWA Facility Operations. During normal operations of any of the proposed ACWA pilot facilities at PBA, air emissions would be expected from (1) boiler operations (including SO_2, NO_2, HC, CO, and PM_{10}), (2) process stacks, (3) emergency generators (diesel), and (4) vehicle/traffic emissions. Under Arkansas permitting procedures, if a major air emission source is modified, an application for modification must be filed. Tables 5.5-4, 5.5-5, and 5.5-6 show the estimated emissions of criteria pollutants to the atmosphere that would result from operation of a pilot Neut/SCWO, Neut/GPCRC/TW-SCWO, or Elchem Ox facility, respectively, in pounds per year. Tables 5.6-1, 5.6-2, and 5.6-3 show the estimated toxic air pollutant emissions that would result from operation of a pilot Neut/SCWO, Neut/GPCRC/TW-SCWO, or Elchem Ox facility, respectively, in micrograms per second.

The emissions from any of the proposed ACWA pilot facilities alone would not be a major source. However, even though the emissions from an ACWA facility would not exceed 20% of the applicable definition of a major source (15 tons/yr of PM_{10} or 0.6 ton/yr of lead, whichever is less) or would not represent a 20% increase over currently permitted rates for any regulated air pollutant, construction of such a facility might constitute a “significant modification” under Arkansas regulations, because either (1) new applicable requirements might be required; (2) there could be a significant change to existing monitoring, reporting, or recordkeeping requirements under the existing permit; or (3) a case-by-case determination of an emission limit or other standard, a source-specific determination for a temporary source of ambient impacts, a visibility analysis, or an increment analysis could be required. In addition, even if a permit application as a major source or major modification was not required, a minor source permit application might be required because the ACWA facility would be a hazardous waste treatment facility (ADEQ Regulation No. 18, Section 18.301(B)). In addition, since the ACWA facility could emit more than 5 tons/yr of criteria pollutants or 1 ton/yr of HAPs, PBA's Title V application would have to be amended to include the emissions from the facility.

ADEQ has adopted the federal NSPS in its entirety (ADEQ Regulation No. 19, Section 19.304; 40 CFR 60). The only potential ACWA pilot facility equipment that would appear to fall within the adopted federal NSPS program would be the steam generating units. Under these regulations, a "steam-generating unit" is a device that combusts any fuel and produces steam or heats water or any other heat transfer medium. The term includes any duct burner that combusts fuel and is a part of a combined-cycle system but does not include process heaters. Process heaters are devices that are primarily used to heat a material to initiate or promote a chemical reaction in which the material participates as a reactant or catalyst. As long as boilers are operated as process heaters, they do not need to meet the federal NSPS as adopted by the ADEQ.

Certain HAPs would be emitted from any of the potential ACWA pilot facilities at PBA. However, none of the ACWA pilot facilities would be a major source of HAP emissions or fall under any of the EPA NESHAP regulated source categories, as adopted by ADEQ. Therefore, no regulatory action under NESHAP would be necessary. None of the raw materials stored and used at a pilot Neut/SCWO facility or Neut/GPCR/TW-SCWO facility would be regulated toxic substances under Section 112(r) of the CAA, so no RMP would be required to construct an ACWA facility. The pilot Elchem Ox facility would use hazardous chemicals in its processes, including nitric acid. Nitric acid in concentrations of 80% or more is a listed regulated toxic substance under Section 112(r) of the CAA. If 10,000 lb (4,530 kg) of anhydrous ammonia or 20,000 lb (9,070 kg) of ammonia at a concentration of 20% or more would be stored on site, PBA would have to prepare and submit an RMP. The plan would have to (1) include a worst-case release scenario and an accident history for the process; (2) demonstrate coordination for response actions with local emergency planning and response agencies; and (3) certify that the distance to the specified endpoint for the worst-case accidental release scenario for the process is less than the distance to the nearest public receptor. Additional requirements would apply (1) if the site could not show that for the five years prior to the submission of the RMP, the process had not experienced an accidental release of a regulated substance that led to death, injury, response, or restoration activities for an exposure of an environmental receptor; and (2) if the site could not show that the distance to a toxic or flammable endpoint for a worst-case release assessment is less than the distance to any public receptor (40 CFR 68.12).

For construction of a facility in a nonattainment or maintenance area, a federal conformity determination is required if the total of direct and indirect emissions caused by construction of the facility would equal or exceed certain limits (40 CFR 51.853). However, since PBA is located in an attainment area, and since any emissions from PBA do not affect a Class I area, a separate federal conformity determination would not be required. Conformity with the Arkansas air emission regulations and SIP is a part of this EIS.

No Action. Continued storage at existing storage facilities is the no action alternative at PBA. The principal sources of air emissions associated with continued storage would be exhaust emissions and road dust generated by vehicle movements. Potential air quality impacts from current storage activities would be expected to be minimal. Such emissions would have already been included in the total site calculation in the existing Title V permit application.

9.3.1.3 PCD

The PCD facility is located in Pueblo County in the state of Colorado. CDPHE, Air Pollution Control Division, regulations would apply to air emissions from the PCD facility (5 CCR 1001-1 et seq.).

Under CDPHE regulations, all air pollution sources must obtain a construction permit unless they are specifically exempted. The permitting process requires submission of an air pollutant emission notice (APEN) and an application for a construction permit for the proposed air emission source. No APEN is required for emission sources with uncontrolled actual emissions of less than 2 tons/yr of any criteria pollutant. If a source is exempt from filing an APEN, no construction permit application is required either. In addition, a number of specific sources and categories of sources are exempt from filing an application for a construction permit (e.g., facilities with total facility uncontrolled actual emissions of less 5 tons/yr of VOCs, 5 tons/yr of PM_{10}, 10 tons/yr of total suspended particulates, 10 tons/yr of CO, 10 tons/yr of SO_2, 10 tons/yr of NO_x, and 200 lb/yr of Pb; emergency power generators that operate no more than 250 hours per year). Under CDPHE regulations, APENs are required for each individual emission point with uncontrolled actual emissions of Colorado noncriteria reportable pollutants that exceed de minimis levels (5 CCR 1001-1, Regulation 3, Part, Section II.B.3.b and Appendixes A and C thereto).

PCD submitted an APEN and a permit application to the CDPHE, Air Pollution Control Division, for the construction and operation of a Pueblo Chemical Agent Disposal Facility (Pueblo Depot Activity 1995). PCD is currently classified as a synthetic minor source that is bound by federally enforceable pollution control and/or operational restrictions on PCD’s potential to emit from its various emission point categories (Fogleson 1997).

Under the Colorado PSD program, any major source or major modification to a source in an attainment area is required to undergo a PSD review. Under this program, a “stationary source” is defined as:

> “All of the pollutant-emitting activities that belong to the same industrial grouping, are located on one or more contiguous or adjacent properties, and are under the control of the same person.”

Therefore, in determining if a source at PCD is a major stationary source for the purposes of PSD review, all pollutant-emitting activities that (1) belong to the same industrial grouping, (2) are located within the site boundaries, and (3) are under the control of the Army would have to be considered. Since the source, for PSD purposes, is essentially the entire site facility, the emission increases that would result from pollutant-emitting activities associated with the construction or modifications would be allowed to be offset by emission reductions elsewhere within the facility. PSD review might thus be avoided.

Under PSD requirements, a new major stationary source or a major modification of an existing major source must apply best available control technology (BACT) for each regulated pollutant. For major modifications of an existing source, this requirement applies to each proposed emission unit at which a net emissions increase for a pollutant would result from either a physical change in the unit or a change in the unit’s method of operation. In addition, the owner of the proposed source or modification must demonstrate that allowable emission increases from the proposed source or modification, in conjunction with all other emission increases or reductions, will not cause or contribute to concentrations of air pollutants in the ambient air that would violate any state or national ambient air quality standard in the air quality control region or any applicable maximum allowable increase over the baseline concentration in any area. An analysis of ambient air quality must be performed for any area that would be affected by the proposed major stationary source or major modification and for each regulated pollutant that the source would emit or have the potential to emit. The analysis must be based on air quality monitoring data or existing representative air quality data. The objective of the analysis is to determine whether emissions of that pollutant would cause or contribute to a violation of an applicable standard or any maximum allowable increase. In addition, it must be determined the emissions would not affect a Class I PSD area. Great Sand Dunes National Monument, the Class I PSD area nearest to PCD, is 75 mi (121 km) away and is not located downwind of prevailing winds from PCD.

The PSD requirements, other than the use of BACT, do not apply to a major stationary source or a major modification if the emissions are from a temporary source and would not affect air quality in any Class I area or an area where an applicable increment is known to be violated (5 CCR 1001-1, Regulation 3, Part B, Section IV.D.3.b.(ii)). A “temporary source” is defined as a source that operates for no more than two years, unless the CDPHE Air Pollution Control Division determines that a longer time period is appropriate (5 CCR 1001-1, Regulation 3, Part A, Section I.B.59). Therefore, if a pilot ACWA facility at PCD would be designated as a temporary source by CDPHE, a full PSD review would not be necessary.

CDPHE has a Title V permitting program. PCD has submitted an application for a Title V permit; however, CDPHE has not issued one. Under Title V permit regulations, insignificant activities and emission levels do not need to be reported in the site's Title V permit application. These include any emission unit, including fugitive emissions, with the potential to emit 2 tons or less per year of any regulated air pollutant other than a HAP (5 CCR 1001-1, Regulation 3, Part C, Section II.E.3.a).

CDPHE has adopted the federal NESHAP and established its own requirements for asbestos and lead (5 CCR 1001-1, Regulation 8). The NESHAP apply only to sources of HAP emissions that are specifically regulated under the EPA NESHAP source categories (40 CFR 63) (e.g., gasoline distribution facilities, petroleum refineries).

Colorado has revised its SIP to require conformity determinations for federal actions (*Federal Register,* Volume 64, page 63206 [64 FR 63206]). The regulations apply only to nonattainment and maintenance areas for the criteria pollutants for which the area is designated (5 CCR 1001-1, Regulation 10).

ACWA Facility Construction. Air emission impacts would result from the initial construction activities for either of the proposed ACWA facilities at PCD (only Neut/Bio and Neut/SCWO are being considered). Air emissions from construction activities would include SO_2, NO_x, CO, and VOCs as well as PM and exhaust and fugitive emissions from construction equipment and vehicles. A permit is not required if a land development construction project involves less than 25 acres (10 ha) or takes less than six months to reach completion (5 CCR 1001-1, Regulation 3, Part A, Section II.D.1.j). If ACWA facility construction activities would disturb more than 25 acres (10 ha) at any one time, an APEN and construction permit application might have to be filed. In addition, fugitive dust emission standards and/or mitigation requirements would still apply (5 CCR 1001-1, Regulation 1). Emissions caused by indirect air pollution sources, emissions from internal combustion engines on any vehicle, and emissions resulting from temporary activities, such as construction or exploration, are not to be included in the basis calculation of emissions to determine if a source is a major source for permitting consideration (5 CCR 1001-1, Regulation 3, Part A, Section 59).

ACWA Facility Operations. During normal operations of either of the proposed ACWA pilot facilities at PCD (Neut/Bio or Neut/SCWO), air emissions would be expected from (1) boiler operations (including SO_2, NO_2, HC, CO, and PM_{10}), (2) process stacks, (3) emergency generators (diesel), and (4) vehicle/traffic emissions. Under Colorado permitting procedures, if air pollutant emissions from a stationary source exceed certain regulatory limits (more than 250 tons/yr of any criteria pollutant or 100 tons/yr of criteria pollutants from certain designated facilities; more than 10 tons/yr of any HAP or 25 tons/yr of any combination of HAPs), then the source is a "major source" and must obtain construction and operation permits. Tables 6.5-4 and 6.5-5 show the estimated emissions of criteria pollutants to the atmosphere that would result from operation of a pilot Neut/Bio and Neut/SCWO facility, respectively, in pounds per year. Tables 6.6-1 and 6.6-2 show the estimated toxic air pollutant emissions that would result from operation of a pilot Neut/Bio and Neut/SCWO facility, respectively, in micrograms per second.

The emissions from any ACWA facility alone would not exceed the criteria pollutant or HAP permitting thresholds. Therefore, an ACWA pilot facility itself would not be a major source, and no permit would be required. However, if the additional emissions of criteria pollutants from an ACWA facility would result in the PCD installation exceeding the "synthetic minor source" limitations on its existing permit, any future modifications would be treated as a "major modification" under the netting provisions, thus requiring a PSD review. In addition, emissions from the ACWA facility or PCD would not affect Great Sand Dunes National Monument, the Class I PSD area nearest to PCD, because it is located 75 mi (121 km) away and is not located downwind of prevailing winds from PCD. Therefore, no PSD review would be necessary. However, a modification to the site's Title V application might be necessary, since the emissions would be over the "insignificant source" limits for Title V inventory reporting (i.e., 2 tons/yr of criteria pollutants or 100 lb/yr of lead).

All new facilities belonging to one of the 60 categories regulated by the CDPHE must meet NSPS. The only potential ACWA pilot facility equipment that would appear to fall under the NSPS program would be the steam generating units. Under CDPHE's NSPS regulations (5 CCR 1001-1, Regulation 8), which adopt the federal regulations of 40 CFR Part 60, Subpart D, a "steam generating unit" is a device that combusts any fuel and produces steam or heats water or any other heat transfer medium. The term includes any duct burner that combusts fuel and is a part of a combined-cycle system but does not include process heaters. Process heaters are devices that are primarily used to heat a material to initiate or promote a chemical reaction in which the material participates as a reactant or catalyst. As long as boilers are operated as process heaters, the pilot Neut/SCWO facility would not need to meet NSPS.

Certain HAPs would be emitted from either of the proposed ACWA pilot facilities. However, none of the ACWA pilot facilities would be a major source of HAP emissions or fall under any of the EPA NESHAP regulated source categories, as adopted by CDPHE. Therefore, no regulatory action under NESHAP would be necessary. Certain air pollutants emitted from an ACWA pilot facility would be Colorado noncriteria reportable pollutants (e.g., arsenic compounds). Therefore, an APEN would have to be filed to reflect these emissions if they exceeded de minimis levels (5 CCR 1001-1, Regulation 3, Section II.B.3.b, and CCR Appendix A).

None of the raw materials stored and used at the pilot Neut/SCWO facility at PCD would be regulated toxic substances under Section 112(r) of the CAA. The pilot Neut/Bio facility, however, would use hazardous chemicals in its processes, including ammonia. Ammonia in concentrations of 20% or more is a listed regulated toxic substance under Section 112(r) of the CAA. If 20,000 lb (9,100 kg) of ammonia at a concentration of 20% or more was stored on site, the site would have to prepare and submit an RMP. Such a plan must (1) include a worse-case release scenario and an accident history for the process, (2) demonstrate coordination of response actions with local emergency planning and response agencies, and (3) certify that the distance to the specified endpoint for the worst-case accidental release scenario for the process is less than the distance to the nearest public receptor. Additional requirements would apply (1) if the site could not show that for the five years prior to submission of the RMP, the process did not experience an accidental release of a regulated substance that led to death, injury, response, or restoration activities for an exposure of an environmental receptor; and (2) if the site could not show that the distance to a toxic or flammable endpoint for a worst-case release assessment is less than the distance to any public receptor (40 CFR 68.12).

For construction of a facility in a nonattainment or maintenance area, a federal conformity determination is required if the total of direct and indirect emissions caused by construction of the facility would equal or exceed certain limits (40 CFR 51.853). However, since PCD is located in an attainment area, and since any emissions from PCD do not affect a Class I area, a separate federal conformity determination would not be required. Conformity with the Colorado air emission regulations and SIP is a part of this EIS.

No Action. Continued storage at existing storage facilities is the no action alternative at PCD. The principal sources of air emissions associated with continued storage would be exhaust emissions and road dust generated by vehicle movements. Potential air quality impacts from current storage activities would be expected to be minimal. Emissions caused by indirect air pollution sources, emissions from internal combustion engines on any vehicle, and emissions resulting from temporary activities, such as construction or exploration, are not to be included in the basis calculation of emissions to determine if a source is a major source for permitting consideration (5 CCR 1001-1, Regulation 3, Part A, Section 59). In addition, such emissions might be considered insignificant or might have already been included in PCD's Title V permit application.

9.3.1.4 BGAD

The BGAD facility is located in Madison County in the state of Kentucky. Cabinet regulations apply to any air emissions from BGAD (401 KAR 50 through 68). Madison County is in attainment or unclassified for all regulated criteria air pollutants (40 CFR 81.318).

Under Cabinet regulations, all new major air pollution sources, conditional major sources, and synthetic minor sources are required to use BACT, and minor sources that emit or have the potential to emit 25 tons/yr or more of regulated air pollutants without a specific method for achieving compliance are required to obtain a permit (401 KAR 50:035, Section 1). Minor sources that are not required to obtain a permit but that have the potential to emit more than 2 tons/yr of a HAP, 5 tons/yr of combined HAPs, or 10 tons/yr of any other regulated air pollutant are required to register with the Cabinet (401 KAR 50:035 Section 2(2)(a)). A "major source" is defined as a stationary source or a group of stationary sources, located on one property or contiguous or adjacent properties under the common control of the same person, belonging to a single industrial grouping (1987 Standard Industrial Classification [SIC]), that emits or has the potential to emit, in aggregate, 10 tons/yr or more of a HAP, 25 tons/yr or more of a combination of HAPs (including fugitive emissions), or 100 tons/yr of criteria pollutants (not including fugitive emissions) (401 KAR 50:035, Section 1).

The Cabinet has a Title V permitting program that applies to all major sources, sources subject to Kentucky New Source Standards, and sources subject to federal NSPS or NESHAP regulations. Under Title V permit regulations, insignificant or trivial activities do not need to be reported in a site's Title V permit application. "Insignificant or trivial activities" are emission sources, including fugitive emissions, with the potential to emit one-half ton or less per year of combined HAPs or 5 tons of any other regulated air pollutant (401 KAR 52:020, Section 6(1)(a)). Because it is a minor source, BGAD has not submitted a Title V application to the Cabinet.

Under the Kentucky PSD program, any major source or significant modification to a major source in an attainment area is required to undergo a PSD review [401 KAR 51:017, Section 2]. Under this program, a "major source" is defined as (1) any stationary source that emits, or has the potential to emit, 250 tons/yr or more of an air pollutant subject to regulation under the CAA or (2) any physical change that would occur at a stationary source not otherwise qualifying under this subsection as a major stationary source, if the change would constitute a major stationary source by itself. Fugitive emissions are not included in determining if the source is a major stationary source for PSD review, unless the emissions belong to a designated pollutant category. For PSD review, a "stationary source" is a building, structure, facility, or installation that emits or may emit an air pollutant subject to regulation under the CAA. Therefore, in determining if a source is a major stationary source for the purposes of PSD review, all pollutant-emitting activities that (1) belong to the same industrial grouping, (2) are located within the site boundaries, and (3) are under the control of the Army have to be considered. R&D activities are considered a separate industrial grouping (401 KAR 50:035, Section 1(23)). Therefore, in determining if an R&D activity is a major source, air emissions form any other sources located on the installation are not included.

All new facilities belonging to specific source categories must meet NSPS. The Cabinet has adopted the federal NSPS in its entirety (401 KAR 60; 40 CFR 60). In addition, all new facilities belonging to one of the specified source categories regulated by the Cabinet must meet Kentucky new source standards. The Cabinet has established requirements for approximately 27 new source categories (401 KAR 59). The Cabinet has also adopted the federal NESHAP (401 KAR 57) and established its own requirements for asbestos (401 KAR 58). NESHAP applies only to those HAP emission sources that are specifically regulated under the EPA NESHAP source categories as adopted by the Cabinet (40 CFR 63) (e.g., gasoline distribution facilities, petroleum refineries).

The Cabinet has also established regulations for emissions of potentially hazardous matter or toxic substances (401 KAR 63:020). Under these regulations, anyone responsible for a source from which hazardous matter or toxic substances might be emitted must, when handling these materials, provide the utmost care and consideration to the potentially harmful effects of the emissions that could result from such activities. No facility may emit potentially hazardous matter or toxic substances in quantities or for durations that could be harmful to the health and welfare of humans, animals, or plants. Evaluation of such facilities with regard to the adequacy of their emissions control measures and/or procedures and with regard to their emission potential is to be made on an individual basis by the Cabinet. "Potentially hazardous matter or toxic substances" are any matter that may be harmful to the health and welfare of humans, animals, and plants, including, but not limited to, antimony, arsenic, bismuth, lead, silica, and tin, and compounds of such materials.

ACWA Facility Construction. Air emission impacts would result from initial construction activities for any of the proposed ACWA pilot facilities at BGAD. Air emissions from construction activities would include SO_2, NO_x, CO, and VOCs as well as PM and exhaust and fugitive emissions from construction equipment and vehicles. Fugitive dust emission standards and/or mitigation requirements might apply to these emissions (401 KAR 63:010), and reasonable precautions to prevent PM from becoming airborne would have to be taken. Precautions would include, but not be limited to, using water or chemicals to control dust from demolition and construction operations, covering open-bodied trucks that transport materials likely to become airborne, and maintaining paved roadways in a clean condition. In addition, no person may cause or permit the discharge of visible fugitive dust emissions beyond the lot line of the property from which the emissions originate.

ACWA Facility Operations. During normal operations of a pilot Neut/Bio, Neut/SCWO, Neut/GPR/TW-SCWO, or Elchem Ox facility at BGAD, air emissions would be expected from (1) boiler operations (including SO_2, NO_2, hydrocarbons [HCs], CO, and PM_{10}), (2) process stacks, (3) emergency generators (diesel), and (4) vehicle/traffic emissions. Under Kentucky permitting procedures, if air pollutant emissions from a stationary source exceed certain regulatory limits (over 100 tons/yr of any criteria pollutant, 10 tons/yr of any HAP, or 25 tons/yr of any combination of HAPs), then the source is a "major source" and must obtain a permit. Tables 7.5-5, 7.5-6, 7.5-7, and 7.5-8 show the estimated emissions of criteria pollutants to the atmosphere that would result from operation of a pilot Neut/Bio, Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox facility, respectively, in pounds per year. Tables 7.6-2, 7.6-3, 7.6-4, and 7.6-5 show the estimated toxic air pollutant emissions that would result from operation of a pilot Neut/Bio, Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox facility, respectively, in micrograms per second.

Although BGAD currently emits less than 100 tons/yr of any regulated air pollutant and would not be required to obtain a permit as a major source, BGAD holds an operating permit issued by the Cabinet for certain older air sources. In addition, BGAD has registered certain minor air emission sources with the Cabinet over the years. None of the potential ACWA pilot facilities would emit air pollutants that alone would exceed the criteria pollutant or the HAP regulatory permitting thresholds. Therefore, none of the facilities would be a major source requiring a permit. Since BGAD is not a major source, construction of an ACWA facility would not constitute a significant modification to a major source. However, since any ACWA pilot facility would have the potential to emit more than 2 tons/yr of criteria pollutants, it might have to register as a minor source with the Cabinet (401 KAR 50:035 Section (2)(2)(a)). In addition, the emissions from any ACWA pilot facility would have to be included in any future Title V application unless they are considered insignificant under Cabinet Title V regulations (e.g., 0.5 ton/yr of HAPs or 5 tons/yr of other regulated pollutants). Since none of the proposed ACWA facilities would be a major source or a significant modification to a major source, and emissions from none of the facilities would affect Mammoth Cave National Park (the Class I PSD area nearest to BGAD), no PSD review would be necessary.

An ACWA pilot facility could be a “new process operation” under Kentucky New Source Standards (401 KAR 59). New process operation standards require the control of particulate emissions from new process operations that are not subject to another particulate standard. “New process operations” include any method, form, action, operation, or treatment of manufacturing or processing, and any storage or handling of materials or products, before, during, or after manufacturing or processing (401 KAR 59:010). Under this standard, no continuous or intermittent fugitive emissions that are equal to or greater than 20% opacity are allowed from a control device or stack into the open air.

In addition, the Cabinet has adopted the federal NSPS in its entirety. The only potential ACWA pilot facility equipment that would appear to fall under the adopted federal NSPS program would be the steam generating units. Under these regulations, a “steam generating unit” is a device that combusts any fuel and produces steam or heats water or any other heat transfer medium. The term includes any duct burner that combusts fuel and is a part of a combined-cycle system but does not include process heaters. Process heaters are devices that are primarily used to heat a material to initiate or promote a chemical reaction in which the material participates as a reactant or catalyst. As long as boilers are operated as process heaters, they do not need to meet federal NSPS, as adopted by the Cabinet.

Certain HAPs would be emitted from any of the proposed ACWA pilot facilities at BGAD. However, none of the facilities would be a major source of HAP emissions or fall under any of the EPA NESHAP regulated source categories, as adopted by the Cabinet. Therefore, no regulatory action under NESHAP would be necessary for any of the ACWA pilot facilities. However, the Cabinet regulates sources that emit or may emit potentially hazardous matter or toxic substances when such emissions are not subject to other provisions of the Kentucky air regulations (401 KAR 63:020). If an ACWA facility would emit potentially hazardous matter or toxic substances (e.g., antimony, arsenic, bismuth, lead, silica, tin, or compounds of such materials), BGAD would have to provide the utmost care when handling these materials and consider the potentially harmful effects of the emissions that would result from such activities. It could not allow the facility to emit potentially hazardous matter or toxic substances in such quantities or durations that could be harmful to the health and welfare of humans, animals, or plants. The Cabinet’s determination about the adequacy of controls and procedures and emission potential would be made on an individual basis.

None of the raw materials stored and used at the pilot Neut/SCWO facility or Neut/GPCR/TW-SCWO facility would be regulated toxic substances under Section 112(r) of the CAA. The pilot Neut/Bio facility would use hazardous chemicals in its processes, including ammonia. Ammonia in concentrations of 20% or more is a listed regulated toxic substance under Section 112(r) of the CAA and has a regulatory threshold storage quantity of 20,000 lb (9,100 kg). In addition, nitric acid in concentrations of 80% or more used in the Elchem Ox process is a listed regulated toxic substance under Section 112(r) of the CAA and has a threshold storage quantity of 15,000 lb (6,800 kg). If regulated toxic substances in excess of regulatory threshold quantities were stored on site, the site would have to prepare and submit an RMP. Such a plan must (1) include a worst-case release scenario and an accident history for the process, (2) demonstrate coordination of response actions with local emergency planning and response agencies, and (3) certify that the distance to the specified endpoint for the worst-case accidental release scenario for the process is less than the distance to the nearest public receptor. Additional requirements would apply (1) if the site could not show that for five years prior to the submission of the RMP, the process did not experience an accidental release of a regulated substance that led to death, injury, response, or restoration activities for an exposure of an environmental receptor; and (2) if the site could not show that the distance to a toxic or flammable endpoint for a worst-case release assessment is less than the distance to any public receptor (40 CFR 68.12, as adopted in 401 KAR 68).

For construction of a facility in a nonattainment or maintenance area, a federal conformity determination is required if the total of direct and indirect emissions caused by construction of the facility would equal or exceed certain limits (40 CFR 51.853). However, since BGAD is located in an attainment area, and since any emissions do not affect a Class I area, a separate federal conformity determination would not be required. Conformity with the Kentucky air emission regulations and SIP is a part of this EIS.

No Action. Continued storage at existing storage facilities is the no action alternative at BGAD. The principal sources of air emissions associated with continued storage would be exhaust emissions and road dust generated by vehicle movements. Potential air quality impacts from current storage activities would be expected to be minimal. Such emissions would be considered insignificant for inclusion in the site's Title V permit application.

9.3.2 *Emergency Planning and Community Right-to-Know Act of 1986* and *Hazardous Material Transportation Act* Requirements

Under the *Emergency Planning and Community Right-to-Know Act of 1986* (EPCRA or *Superfund Amendments and Reauthorization Act* [SARA] Title III) (42 USC 1101 et seq.), industrial facilities are required to provide information, such as inventories of the specific chemicals they use or store, to the appropriate State Emergency Response Commission and Local Emergency Planning Committee (LEPC) to ensure that emergency plans are sufficient to respond to accidental releases of hazardous substances. EPCRA originally did not appear to apply to federal agencies. However, on August 3, 1993, Executive Order 12856 was issued, making each federal agency and its jurisdictional facilities subject to the provision of EPCRA and the *Pollution Prevention Act of 1990*. The application of EPCRA requirements to federal agencies was reiterated and strengthened in Executive Order 13148 (April 21, 2000), which replaced and revoked Executive Order 12856.

Under EPCRA, facilities with more than a threshold quantity of an "extremely hazardous substance" (40 CFR Part 355, Appendixes A and B) must provide a representative to the LEPC, promptly inform the LEPC of any "relevant changes" at the facility, and upon request, promptly provide the LEPC with "information . . . necessary for developing and implementing the emergency plan." Also, all covered facilities that exceed certain volume thresholds must provide an inventory of the types and quantities of hazardous materials they store or use on site to the LEPC (40 CFR Part 370). In addition, any facility that has released one of the listed extremely hazardous substances (e.g., ammonia) must make notification to a LEPC.

Extremely hazardous materials that would be stored and used in the pilot Neut/Bio facility include sulfuric acid and hydrogen peroxide, which have a planning and reporting storage/use threshold of 1,000 lb (454 kg), and ammonia, which has a reporting threshold of 100 lb (45 kg) and a planning threshold of 500 lb (227 kg). Nitric acid, which has a planning and reporting storage/use threshold of 1,000 lb (454 kg), would be stored and used in the pilot Elchem Ox facility. Therefore, if these extremely hazardous materials were stored and/or used the site in excess of the established thresholds, the site would have to comply with the requirements of EPCRA.

9.4 NOISE

9.4.1 Federal Requirements

Section 4 of the *Noise Control Act of 1972* (42 USC 4901 et seq.) directs all federal agencies to carry out programs in a manner that furthers a national policy of promoting an environment that is free from any noise that jeopardizes health or welfare. The EPA has not published regulations on noise levels from construction operations. However, the agency has issued guidelines for outdoor noise levels that are consistent with the protection of human health and welfare against hearing loss, annoyance, and activity interference (EPA 1974). Such guidelines state that undue interference with activity and annoyance will not occur if outdoor levels of noise are maintained at an energy equivalent of 55 dB. These levels are not to be construed as legally enforceable standards, however. Any noise that would result from the construction or normal operations of any of the proposed ACWA facilities would have to meet these guidelines.

9.4.2 Alabama Requirements

Alabama has no specific statutory restrictions on noise, other than for motor vehicles and water craft. Noise and nuisance restrictions are delegated to the local county or municipal governments.

9.4.3 Arkansas Requirements

Arkansas has no specific statutory restrictions on noise, other than for sport shooting ranges. Noise and nuisance restrictions are delegated to the local county or municipal governments.

9.4.4 Colorado Requirements

The *Colorado Noise Abatement Law* establishes maximum permissible noise limits for various classes of source areas. These limits are listed in Table 3.3.-1. Any noise resulting from the construction or normal operations of any of the proposed ACWA facilities would have to meet these guidelines.

9.4.5 Kentucky Requirements

The *Kentucky State Noise Control Act* imposes noise prohibitions (KRS 224.30). It mandates that no person shall emit beyond the boundaries of his or her property or from any moving vehicle any noise that unreasonably interferes with the enjoyment of life or with any lawful business or activity in contravention of any rule or regulation adopted by the Cabinet (KRS 224.30-050). No maximum permissible noise limits have been established by the Cabinet; however, the *Noise Control Act* allows for local governments to adopt noise control plans and enforce local noise control ordinances (KRS 224.30-175).

9.5 WATER RESOURCES

9.5.1 *Clean Water Act* and *Safe Drinking Water Act* Requirements

The federal *Clean Water Act* (CWA) (33 USC 1251 et seq.) provides that it is illegal to discharge pollutants from a point source into navigable waters of the United States except in compliance with a National Pollutant Discharge Elimination System (NPDES) permit. According to administrative and judicial interpretation, the navigable waters of the United States encompass any body of water whose use, degradation, or destruction would or could affect interstate or foreign commerce. These bodies of water include, but are not limited to, interstate and intrastate lakes, rivers, streams, wetlands, playa lakes, prairie potholes, mudflats, intermittent streams, and wet meadows. On January 9, 2001, the Supreme Court held in Solid Waste Agency of Northern Cook County (SWANCC) v. U.S. Army Corps of Engineers that the COE had exceeded the authority granted in Section 404 of the CWA to interpret the definition of navigable waters of the United States as it applies to "isolated waters" [121 S.Ct. 675 (2001)]. This program is administered by the Water Management Division of the EPA pursuant to regulations found in 40 CFR Part 122 et seq. Any state may administer its own permit program for discharges into navigable waters within its jurisdiction by submitting the state program to the EPA for approval (33 USC 1342(b)).

Sections 401 and 405 of the *Water Quality Act of 1987* added Section 402(p) to the CWA, which requires the EPA to establish regulations for issuing permits for storm water discharges associated with industrial activity. The language of the *Water Quality Act of 1987* that requires an NPDES permit for storm water discharge was codified into EPA regulations in 40 CFR 122.26 (54 FR 246, effective January 4, 1989). Pursuant to revised 40 CFR 122.26(a)(1)(ii), any storm water discharge associated with industrial activity or construction activity affecting more than 5 acres (2 ha) of land requires a NPDES permit application.

Pursuant to Section 404 of the CWA (33 USC 1344), there may be no discharges of dredged or fill material into waters of the United States (including rivers, streams, wetlands, and playa lakes) by or on behalf of any federal agency other than the U.S. Army Corps of Engineers (COE), without a permit issued pursuant to COE rules and regulations (33 CFR Parts 320–328). These regulations prescribe special policies, practices, and procedures to be followed by the COE in reviewing applications for such permits to authorize such discharges (33 CFR Parts 320, 323, and 325). In addition, Executive Order 11988, *Floodplain Management* (May 21, 1977), requires federal agencies to establish procedures to ensure that any actions undertaken in a floodplain consider the potential effects of flood hazards and floodplain management and to ensure that floodplain impacts are avoided to the extent practicable. Executive Order 11990, *Protection of Wetlands* (May 24, 1977), requires all federal agencies to consider protection of wetlands when making a decision about a proposed action. In issuing any dredge/fill permits, the COE must consider the impact that such an activity would have on floodplains and wetlands in accordance with Executive Orders 11988 and 11990 (33 CFR 320.4).

The primary objective of the *Safe Drinking Water Act* (SDWA) (42 USC 300(f) et seq.) is to protect the quality of public water supplies, water supply and distribution systems, and all sources of drinking water. Sections of the SDWA address public water systems, protection of underground sources of drinking water, emergency powers, general provisions, and additional requirements to regulate underground injection wells. The National Primary Drinking Water regulations (40 CFR Part 141 et seq.), administered by the EPA, establish standards applicable to public water systems. The regulations include maximum contaminant levels, including radioactivity levels, for community and noncommunity water systems. The SDWA also grants emergency powers to the EPA Administrator to order immediate corrective action, including the provision of alternative sources of drinking water, upon discovering that a water system source has become contaminated enough to endanger human health and the environment (42 USC 300i).

9.5.1.1 ANAD

Alabama is an NPDES-delegated state with EPA-approved permitting authority. Any wastewater or storm water discharges from an ACWA facility at ANAD would have to comply with ADEM water discharge regulations (Admin. Code R. 335-6-6, et seq.). ANAD holds an ADEM-issued NPDES permit for the discharge of (1) treated water from its east area wastewater treatment plant (WWTP), (2) treated water from its industrial wastewater treatment plant (discharging through the same outfall as the WWTP), (3) treated groundwater from the plating shop building and remediation activities, and (4) storm water discharges from various areas on ANAD (NPDES Permit AL0002658). The permit allows the discharge of treated sanitary wastewater (combined with the treated industrial wastewater), treated groundwater, storm water, and noncontact cooling water to Choccolocco and Dry Cane Creeks.

A hazardous waste TSDF is an industrial facility under Alabama NPDES regulations. Storm water discharges from the ACWA site must be permitted, either under an individual facility permit or by submitting a notice of intent (NOI) to be included under one of ADEM's general permits for storm water discharge associated with an industrial activity.

ACWA Facility Construction. ADEM has established a general permit for storm water discharges associated with any construction activity that disturbs more than 5 acres (2 ha) of land. Construction of an ACWA facility at ANAD would disturb more than 5 acres (2 ha) of land. Applicants applying for coverage under this general permit must submit a NOI form to the Mining and Nonpoint Source Branch of the Field Operations Division. NOIs for the general permit for discharges from construction sites must be accompanied by a public notice in a newspaper having a local circulation. The Mining and Nonpoint Source Branch of ADEM also implements the Alabama regulations for controlling construction site sedimentation.

Construction of any of the proposed ACWA pilot test facilities at ANAD could affect wetlands in Site A. No wetlands occur in Sites B or C, although construction of utility corridors leading to these sites might affect wetlands where the corridors cross streams. A joint permit from the COE and ADEM is required if there is any discharge of dredged or fill material into wetlands or surface water (33 CFR 320). Certain activities are covered by COE nationwide permits and do not require an individual permit. These include utility line construction, road crossings, and outfall construction. If a nationwide permit applies and its conditions are met, no individual ADEM or COE permit is required.

Two sites (A and B) are located in the floodplains of streams crossing ANAD. Thus, construction of an ACWA facility could affect floodplains. COE regulations require consideration of impacts to floodplains before a permit can be issued for dredge and fill activities. Under Executive Orders 11988 and 11990, new construction cannot be located in wetlands or floodplains unless the head of the federal agency (in this case, the Army) finds (1) that there is no practicable alternative to such construction and (2) that the proposed action includes all practicable measures to minimize any harm to wetlands that might result from such use. In making this finding, the Army may take into account economic, environmental, and other pertinent factors.

In addition, if a RCRA TSDF is to be located in a 100-year floodplain, the facility must be designed, constructed, operated, and maintained to prevent washout of any hazardous waste by a 100-year flood, unless it can be demonstrated to ADEM that procedures are in effect that will cause the waste to be removed safely, before flood waters can reach the facility, to a location where the wastes will not be vulnerable to flood waters (Admin. Code. R. 335-14-5-.02(9)).

Although water usage during construction would increase over that under no action, it would not exceed the existing ANAD water supply system capacity; therefore, no SDWA regulatory action would be required.

ACWA Facility Operations. There would be no direct discharge of liquid process wastewater from any of the ACWA pilot facilities at ANAD. Almost all process waters would be recycled. However, sanitary wastewater associated with the ACWA facility would be discharged. It is anticipated that the capacity of the existing sanitary treatment plant is sufficient to accept these additional discharges and that only the addition of new sanitary sewer pipelines would be needed to accommodate the discharges. Therefore, no modification to the current NPDES permit should be necessary for ACWA facility-related sanitary wastewater. However, since storm water discharges are included in ANAD's existing NPDES permit, that permit might have to be amended to include new storm water discharges from the ACWA facility complex.

Although water usage by any of the proposed ACWA pilot facilities would involve an increase over existing water usage, usage would not exceed the capacity of the existing ANAD water supply system; therefore, no SDWA regulatory action would be required.

No Action. Storm water runoff from the existing storage areas is considered in the existing permit and associated storm water pollution prevention plan. The activities at the existing storage areas would not affect existing potable water consumption, and no additional water capacity would be required for continued storage.

9.5.1.2 PBA

Arkansas is an NPDES-delegated state with EPA-approved permitting authority. Any wastewater or storm water discharges from an ACWA facility at PBA would have to comply with ADEQ water discharge regulations (ADEQ Regulation No. 6). PBA holds an ADEQ-issued NPDES permit for discharges to surface water from the north area and south area sewage treatment plants. In addition, two industrial wastewater discharges are permitted: pretreated discharges from the National Center for Toxicological Research into the north area sewage treatment plant and pretreated discharges from the central wastewater treatment plant into a NPDES-permitted outfall (Outfall 011) (NPDES Permit AR0001678).

A hazardous waste TSDF is an industrial facility under Arkansas NPDES regulations. Storm water discharges from an ACWA facility would have to be permitted, either under an individual facility permit or by submitting an NOI to be included under one of ADEQ's general permits for storm water discharge associated with an industrial activity (ARR00A000). PBA's NPDES permit covers several specific storm water discharge outfalls. However, PBA has also filed an NOI to be included under the Arkansas general permit.

ACWA Facility Construction. ADEQ has established a general permit for storm water discharges associated with any construction activity that disturbs more than 5 acres (2 ha) of land. Construction of an ACWA facility at PBA would disturb more than 5 acres (2 ha) of land. Applicants applying for coverage under this general permit must submit an NOI to ADEQ's Water Division.

A large number of wetlands have been designated at PBA. Construction of any of the proposed ACWA pilot test facilities could affect wetlands. A joint permit from the COE and ADEQ is required if any dredged or fill material is discharged into wetlands or surface water (33 CFR 320). Certain activities are covered by COE nationwide permits and do not require an individual permit. These include utility line construction, road crossings, and outfall construction. If a nationwide permit applies and its conditions are met, no individual ADEQ or COE permit is required. The proposed ACWA construction sites are located above historical floodplains.

Although water usage during construction would increase over that under no action, it would not exceed the existing capacity of the PBA water supply system; therefore, no SDWA regulatory action would be required.

ACWA Facility Operations. There would be no direct discharge of liquid process wastewater from the pilot Neut/SCWO facility at PBA. Almost all process waters would be recycled. However, sanitary wastewater associated with the ACWA facility would be discharged. It is anticipated that the capacity of the existing sanitary treatment plant would be sufficient to accept these additional discharges and that only new sanitary sewer pipelines would need to be added. Therefore, no modification to the current NPDES permit should be necessary for ACWA facility sanitary wastewater. However, since storm water discharges are included in PBA's existing NPDES permit, that permit may have to be amended to include new storm water discharges from the ACWA facility complex.

Although water usage for any of the proposed ACWA pilot facilities would involve an increase over existing water usage, usage would not exceed the capacity of the existing PBA water supply system; therefore, no SDWA regulatory action would be required.

No Action. Storm water runoff from the existing storage areas is considered in the existing permit and associated storm water pollution prevention plan. The activities at the existing storage areas would not affect existing potable water consumption, and no additional water capacity would be required for continued storage.

9.5.1.3 PCD

Colorado is an NPDES-delegated state with EPA-approved permitting authority; however, Colorado has not been delegated authority over federal facilities. Therefore, any NPDES permit for discharges at PCD would be granted by EPA Region 8. PCD holds a NPDES permit for the discharge of treated water from the interim corrective action groundwater remediation system (ICAGRS) (NPDES Permit CO-0034673). PCD once held a NPDES permit for the sanitary treatment plant. This facility is no longer in service, however, and the permit was allowed to lapse in 1999 (Cain 1999).

Storm water discharges may be regulated under either an individual facility permit or by submitting an NOI to be included under the Colorado general permit for storm water discharge associated with an industrial activity. In 1996, PCD submitted an NOI for storm water discharges associated with industrial activity under the NPDES general permit. That permit and the facility's storm water pollution prevention plan determine the management, monitoring, and limits for the outfalls for storm water discharges. The permit requires best management practices to be used to control or abate the discharge of pollutants through storm water outfalls.

The CDPHE regulates the allowable rate of depletion of groundwater that can occur in designated groundwater basins (2 CCR 410-1). The Supreme Court, in *Kansas vs. Colorado* (May 15, 1995, 514 U.S. 673 (1995), found that excess groundwater wells in Colorado materially depleted usable water flows to a level that was in violation of the Arkansas River Compact, which established an equitable apportionment of the waters of the Arkansas River. Therefore, Colorado must limit pumping from post-Compact wells to the maximum amount that can be pumped by wells that existed prior to the Compact. This requirement limits the amount of water rights for pumping in the state of Colorado. PCD has negotiated to lease specific water rights (i.e., 1,000 acre-ft per year) for the 11 drinking water wells that support the site.

The CDPHE reviews and approves each application for using designated groundwater. It considers three criteria (the availability of water for appropriation, prevention of unreasonable impairment to the rights of other appropriators, and prevention of unreasonable waste) when deciding whether to grant or deny an application (2 CCR 410-1, Rule 5). Each well permit issued by the Colorado Division of Water Resources, Department of Natural Resources, indicates the well must be operated in accordance with established water rights, and no water rights are granted as a part of the granting of the permit. The well permits also indicate the specific use of the well (e.g., for drinking water or monitoring only). Therefore, any new drinking water wells or water usage in excess of the existing negotiated water rights would require the purchase or lease of additional water rights.

ACWA Facility Construction. The CDPHE, Water Quality Control Division, has established a general permit for storm water discharges associated with any construction activity that would disturb more than 5 acres (2 ha) of land (Permit COR-030000). Applicants applying for coverage under this general permit must submit an application 10 days before the anticipated date of discharge. If the applicant does not receive a request for additional information or a notification of denial from the division within 30 days of receipt of the application, authorization to discharge in accordance with the conditions of the permit is deemed to be granted.

Under the permit conditions, a storm water management plan must be prepared in accordance with good engineering, hydrologic, and pollution control practices. The plan must identify the best management practices that would be used to prevent or manage storm water runoff from the construction site (e.g., silt fences, strategically placed hay bales). The permit conditions also require final stabilization when all soil-disturbing activities at a site have been completed and reestablishment of uniform vegetation. Once the site has been stabilized, an Inactivation Notice must be submitted to the Water Quality Control Division.

Although water usage during construction of an ACWA facility at PCD would increase over the water usage under no action, usage would not exceed the existing PCD water rights or require the installation of additional wells; therefore, regulatory action would not be required.

ACWA Facility Operations. There would be no direct discharge of liquid process wastewater from either of the proposed ACWA pilot facilities at PCD. Almost all process waters would be recycled. However, sanitary wastewater associated with the ACWA facility would be discharged. It is anticipated that the additional sanitary wastewater would be discharged to the existing evaporative lagoon system. Since these lagoons do not discharge to surface waters, they do not require a water discharge permit. Although the lagoons are not regulated under the CWA, they might require a Certification of Designation as a solid waste disposal facility from the local governing body that authorizes the use of land for a solid waste disposal site or facility (e.g., Pueblo County) and a technical review by CDPHE (6 CCR 1007-2, Section 1.3.3). If the lagoon system would need to be enlarged, an amended Certification of Designation would have to be submitted to Pueblo County and CDPHE.

Although water usage by either of the proposed ACWA pilot facilities at PCD would involve an increase over existing water usage, usage would not exceed the existing PCD water rights or require the installation of additional wells; therefore, it would not require any regulatory action.

No Action. Storm water runoff from the existing storage areas at PCD is via open drainage ditches that discharge to Chico and Haynes Creeks only after substantial precipitation (see Section 3.6.1.2). These ditches and discharges are covered in the existing permit and associated storm water pollution prevention plan. The activities at the existing storage areas would not affect existing potable water consumption. No additional water use permit or water treatment would be required for continued storage.

9.5.1.4 BGAD

Kentucky is an NPDES-delegated state with EPA-approved permitting authority. Any wastewater or storm water discharges from an ACWA facility at BGAD would have to comply with Cabinet water discharge regulations (401 KAR 5). BGAD holds a KPDES permit for the discharge of treated water from WWTPs and for storm water discharges (KPDES Permit KY0020737). The permit allows the discharge of treated sanitary wastewater and storm water to Hays Fork of Silver Creek, an unnamed tributary of Otter Creek, and Muddy Creek.

A hazardous waste TSDF is an industrial facility under the Kentucky NPDES regulations. Storm water discharges from an ACWA facility would have to be permitted, either under an individual facility permit or by submitting an NOI to be included under the Kentucky general permit for storm water discharge associated with an industrial activity. Currently, storm water discharges are covered in BGAD's individual NPEDS permit.

Under Kentucky regulations, a water withdrawal permit is required for any facility with an average withdrawal rate of more than 10,000 gal/d (38 m^3) (401 KAR 4:010). At sites where withdrawals are made on an irregular basis and at an irregular rate, permits might be required if the Cabinet, Division of Water, determines that the water withdrawn represents a significant portion of the available water supply or that the collection of withdrawal data is necessary for water resource planning.

ACWA Facility Construction. The Cabinet has established a general permit for any storm water discharges associated with construction activity that would disturb more than 5 acres (2 ha) of land. Applicants applying for coverage under this general permit must submit an NOI form to the Cabinet, Division of Water, at least 48 hours before the anticipated date of discharge. NOIs for construction sites must include a brief description of the project, an estimated timetable for major activities, estimates of the number of acres of soil that would be disturbed, and certification that the storm water best management practice plan for the site provides for compliance with (1) state or locally approved sediment and erosion control plans, (2) state or locally controlled storm water management plans, (3) state or local sewer use ordinances, and (4) state or local septic system requirements, including stabilization practices.

Construction of any of the proposed ACWA pilot test facilities at BGAD could affect some palustrine wetlands located in the project area, including transportation and utility rights-of-way. No wetlands would be directly affected from construction of the 22-acre (9-ha) site needed for facilities in Area A. Area B, however, includes three small wetlands that could be adversely affected. Runoff from the construction sites would be directed to a sedimentation pond, thus reducing the potential for any adverse impact on wetlands located along tributaries to Muddy Creek (see Section 7.17.2.1). A permit from the COE is required if dredged or fill material is discharged into waters of the United States (33 CFR 320 et. seq.). Certain activities are covered by COE nationwide permits and do not require an individual permit. These include utility line construction, road crossings, and outfall construction. The Cabinet has adopted the COE nationwide permits, either as written or with conditions. If the nationwide permit is adopted as written, an individual application for water quality certification does not need to be filed. However, if the nationwide permit is adopted with conditions, the conditions must be met. If they are not met, an individual application for water quality certification has to be filed. If the activity is not covered by a COE nationwide permit and if more than 1 acre (0.4 ha) of wetland would be lost or filled, BGAD would have to submit an application for water quality certification to the Cabinet. Under the *Guidelines for Stream and Wetland Protection in Kentucky* (Kentucky Department of Natural Resources undated), activities involving physical disturbances to streams and wetlands must be mitigated when impacts cannot be avoided by the site-specific project. Mitigation must address restoration of an aquatic ecosystem that is similar to the ecosystem being affected.

Although water usage during construction would increase over that under no action, usage would not exceed the capacity of the existing BGAD water supply system; therefore, no SDWA regulatory action would be required.

ACWA Facility Operations. There would be no direct discharge of liquid process wastewater from any of the proposed ACWA pilot facilities at BGAD. Almost all process water would be recycled. However, sanitary wastewater would be associated with the ACWA pilot facility complex. It is anticipated that the additional sanitary wastewater would be discharged to a newly constructed WWTP. Under Kentucky regulations, a permit is required for construction of a new WWTP (401 KAR 5:005). When construction is complete, the owner must submit written certification to the Cabinet that the facility was constructed and tested in accordance with plans and specifications approved by the Cabinet, Division of Water, Facility Construction Branch. In addition, the existing NPDES permit has to be amended to include any new discharge from a new WWTP. Any storm water discharge from the ACWA facility complex could either be included in the existing NPDES permit or covered by filing an NOI under the Kentucky general permit for storm water discharges from industrial activities.

Although water usage by any of the ACWA pilot facilities would involve an increase over existing water usage, usage would not exceed the capacity of the existing BGAD water supply system; therefore, no SDWA regulatory action would be required.

No Action. Storm water runoff from the existing storage areas is included in the existing permit and associated storm water pollution prevention plan at BGAD. No additional regulatory action would be needed. The activities at the existing storage areas would not affect existing potable water consumption, and no additional water withdrawal permit or water treatment would be required for continued storage.

9.6 ECOLOGICAL RESOURCES

9.6.1 *Endangered Species Act* Requirements

The *Endangered Species Act* (16 USC 1531 et seq.) is intended to prevent the further decline of endangered and threatened species of animals and plants and to bring about the restoration of these species and their habitats. The act is jointly administered by the U.S. Department of Commerce (DOC) (which oversees marine species and their habitats under 50 CFR 223 and 224) and the U.S. Department of the Interior (DOI) (which oversees all other plant and animal species and their habitats). Section 16 of USC 1536 requires DOD to consult with the U.S. Fish and Wildlife Service (USFWS) in DOI, and/or the National Marine Fisheries Service in DOC, to determine whether endangered and threatened species are known to have critical habitats on or near any sites being considered for construction of an ACWA facility. Endangered and threatened species and their habitats are identified in 50 CFR Parts 17 and 402.

9.6.1.1 ANAD

The Alabama Department of Conservation and Natural Resources has implemented regulations for the protection of Alabama-designated protected species (Admin. Code R. 220-2-.92 and 220-2-.98). Under these regulations, it is unlawful to take, capture, kill, or attempt to take capture or kill specifically designated or federally protected nongame wildlife or invertebrate species (or any parts or reproductive products of such species) without a scientific collection permit or written permit from the Commissioner, Department of Conservation and Natural Resources.

There are two colonies of Tennessee yellow-eyed grass, a federally endangered species, on ANAD. No other state protected species or threatened endangered species under federal law are known to occur within the installation (see Section 4.15). If a state- or federal-listed threatened or endangered species would be affected by the construction of a new ACWA facility, appropriate consultation and mitigation would have to be undertaken. Appendix D contains the initial consultation letter and a Biological Assessment for ANAD.

9.6.1.2 PBA

The Arkansas Game and Fish Commission has implemented regulations for the protection of federal and Arkansas-designated endangered species. Under these regulations, it is illegal to import, transport, sell, purchase, take, or possess any endangered species of wildlife or parts thereof (*Game and Fish Commission Code Book,* Section 19.12).

No impacts on protected species are anticipated from the construction of any of the proposed ACWA facilities at PBA. No federal endangered or threatened species are known to occur at PBA (see Section 5.15). Species determined by the Arkansas Natural Heritage Commission as state threatened or endangered have not been documented from wildlife and plant surveys of PBA. If a state- or federal-listed threatened or endangered species would be affected by the construction or operation of a new ACWA facility, appropriate consultation and mitigation would have to be undertaken.

9.6.1.3 PCD

Colorado has implemented regulations for the protection of Colorado-designated endangered and threatened species (*Division of Wildlife Regulations,* Chapter 10, Section 1000). Under this regulation, designated threatened or endangered species are protected, and their harassment, taking, or possession is illegal.

No federal- or state-listed threatened or endangered species are known to occur at PCD, so none would be affected by construction activities. Three federal candidate species could be affected by construction and habitat loss. Federally sensitive species that could be affected by habitat loss as a result of construction include the loggerhead shrike and the northern plains leopard frog. The southern red bellied dace, a Colorado state endangered species, would not be affected by construction or operation of a pilot test facility. No other state sensitive species are known to occur in the area. Construction could have an impact on the northern sandhill prairie community, which is classified as a sensitive community type by the Colorado Natural Heritage Program (1999). The shortgrass prairie habitat that supports a colony of black-tailed prairie dogs, which is a candidate species being considered by the USFWS for listing as threatened, could be affected by construction activities. If a state- or federal-listed threatened or endangered species would be affected by the construction of a new ACWA facility, appropriate consultation and mitigation would have to be undertaken.

9.6.1.4 BGAD

Kentucky statutes prohibit the import, transport, and possession for resale of any endangered species (KRS 150.183). They define “endangered species” as any species of wildlife seriously threatened with worldwide extinction or in danger of being extirpated from the Commonwealth of Kentucky, including all species of wildlife designated as endangered species by the U.S. Secretary of the Interior on January 1, 1973. The Tourism Development Cabinet, Department of Fish and Wildlife Resources, issued regulations governing the possession, buying, and selling of endangered fish and wildlife (301 KAR 3:061). However, they govern species listed as endangered in DOI regulations (50 CFR 17) and do not govern species listed as threatened (301 KAR 3:061, Section 2). The Tourism Development Cabinet, Department of Fish and Wildlife Resources, has not established any state-designated endangered or threatened species. However, the Kentucky Nature Preserves Commission, in conjunction with the Natural Heritage Program, maintains a database of species classified as endangered, threatened, or of special concern. Remnants of two sensitive plan communities (the bluegrass mesophytic cane forest and calcareous mesophytic forest) occur on BGAD, along with a plant species of special concern (the spinulose wood fern).

The bald eagle and running buffalo clover are the only federally listed species known to occur at BGAD (see Section 7.16.1). The running buffalo clover could be adversely affected by construction of an ACWA pilot facility. Construction could also have a minor impact on bald eagle populations as a result of the increased amount of traffic at peak construction periods. If a federal-listed threatened or endangered species would be affected by the construction or operation of an ACWA facility, appropriate consultation and mitigation would have to be undertaken. Appendix E contains the initial consultation letter and a Biological Assessment for BGAD.

9.7 CULTURAL RESOURCES

Executive Order 11593, *Protection and Enhancement of the Cultural Environment* (May 15, 1971), requires federal agencies to locate, inventory, and nominate qualifying properties under their jurisdiction or control to the *National Register of Historic Places* (NRHP). This process requires federal agencies to provide the opportunity for the Advisory Council on Historic Preservation to comment on the possible impacts of alternative actions on any potentially eligible or listed resources.

9.7.1 *National Historic Preservation Act* and *Archaeological and Historic Preservation Act* Requirements

The *National Historic Preservation Act* (NHPA) (16 USC 470 et seq.) provides that places with significant national historic value be placed on the NRHP. No permits or certifications are required under this act. However, pursuant to regulations in 36 CFR Part 800 et seq., if a proposed action might affect a historic property resource, consultation with the State Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation is required. Such consultation generally results in execution of a memorandum of agreement that includes stipulations that must be followed to minimize adverse impacts.

The *Archaeological and Historic Preservation Act* (AHPA) (16 USC 469a et seq.) is directed at the preservation of historic and archaeological data that would otherwise be lost as a result of federal construction. It authorizes DOI to undertake recovery, protection, and preservation of archaeological and historic data. If the Army determines that a proposed action might cause irreparable damage to archaeological resources, it must notify DOI in writing. The Army may then undertake recovery and preservation or may request that DOI undertake preservation measures.

9.7.1.1 ANAD

The Alabama Historical Commission has implemented regulations on the management of historical properties and archaeological sites (Admin. Code R. 460-X-1 et seq.). Generally the commission has adopted by reference the federal regulations (36 CFR Part 60) as its rule for nominating properties to the NRHP and for the subsequent management of listed properties. The chairperson of the commission serves as the Alabama SHPO. The commission has a program to register Alabama Landmarks and Heritage Sites, including buildings, structures, sites, objects, and districts of historical, architectural, and/or archaeological significance. The commission also has regulations on conducting archeological investigations, surveying, and testing.

During a survey conducted in 1984 at ANAD, no structures were found that would meet Army criteria for designation as important historical structures or that would meet eligibility criteria for the NRHP. The potential for disturbance of archaeological resources at ANAD is limited (see Section 4.17). If cultural material is unexpectedly encountered during ground-disturbing activities at previously disturbed or surveyed areas, construction must cease immediately, and the SHPO and a qualified archaeologist must be consulted to evaluate the significance of the cultural artifacts.

9.7.1.2 PBA

The Arkansas Historic Preservation Program, a division of the Department of Arkansas Heritage under the SHPO, is to cooperate with federal, state, and local governmental agencies in (1) surveying the state for historic properties to be included in the State or National Register of Historic Places, or both; (2) planning and conducting specific undertakings affecting historic properties and preservation objectives; and (3) conducting general overall planning for the use of land (ACA, Section 13-7-106). The SHPO is the director of the Arkansas Historic Preservation Program. The Arkansas Archaeological Survey was established for the purpose of statewide archaeological investigation and preservation (ACA, Section 13-7-105).

No archaeological resources have been identified within the proposed alternative construction areas for an ACWA facility at PBA (see Section 5.17.1). However, Site A has not been surveyed for cultural resources, and an archaeological survey might be required if sufficient confirmation of the level of disturbance cannot be provided. If cultural material is unexpectedly encountered during ground-disturbing activities at previously disturbed or surveyed areas, construction must cease immediately, and the SHPO and a qualified archaeologist must be consulted to evaluate the significance of the cultural artifacts. No PBA structures have been found to meet Army criteria for designation as important historical structures or to meet eligibility criteria for listing on the NRHP (see Section 5.17.1).

9.7.1.3 PCD

The Colorado Historical Society, Office of Archaeology & Historic Preservation, is responsible for implementing the federal and state Historic Register in Colorado. The president of the Colorado Historical Society, which is a division of the Colorado Department of Higher Education, is the Colorado SHPO. Applications for eligibility are reviewed by the Colorado Historic Preservation Review Board. In addition, a state archaeologist has been appointed to consult with and advise state and local governmental agencies on archaeological problems, inventory and analyze Colorado archaeological resources, and act as liaison in transactions between state agencies and other states or state agencies and the federal government concerning archaeological resources (CRS 24-80-405).

At PCD, the area where the ACWA facility would be located (G-Block) is a historic district covered by a programmatic agreement (PA) between the SHPO and the Army, and all stipulations of that PA would apply. However, there would be no adverse effect on the G-Block historic district from the construction and operation of an ACWA facility.

Some of the areas being considered for construction at PCD were previously surveyed for archaeological resources, and although certain sites were recorded, none of them were eligible for listing on the NRHP. Other areas under consideration have not been surveyed but are within a deeply disturbed area where the potential for finding intact archaeological remains that would meet National Register eligibility criteria is low. Nevertheless, an archaeological survey of these areas might be required before the SHPO or state archaeologist would be able to concur with a determination of "no adverse effect."

9.7.1.4 BGAD

The Kentucky legislature established the State Heritage Council to preserve and protect Kentucky heritage, including buildings, structures, sites, and other landmarks associated with the archaeological, cultural, economic, military, natural, political, or social aspects of Kentucky's history (KRS 171.381). The executive director of the Kentucky Heritage Council is the Kentucky SHPO.

All the areas that could be affected by construction of an ACWA pilot facility at BGAD have not yet been surveyed for archaeological resources. Such surveys must be conducted before construction activities start. Upon completion of these surveys, the SHPO must concur with a determination of no adverse effect before construction can begin. At the sites that have been surveyed, no archaeological resources have been identified. If cultural material is unexpectedly encountered during ground-disturbing activities of previously disturbed or surveyed areas, construction must cease immediately, and the SHPO and a qualified archaeologist must be consulted to evaluate the significance of the cultural artifacts. The structures within the chemical storage area are potentially eligible as part of a BGAD historic district; however, none of these structures would be demolished or modified as a result of the construction of ACWA pilot facility (see Section 7.18.2.1).

9.7.2 *American Indian Religious Freedom Act* Requirements

The purpose of the *American Indian Religious Freedom Act* (AIRFA) (42 USC 1996) is to protect and preserve Native Americans' inherent right to believe, express, and protect their traditional religions, This right includes, but is not limited to, access to religious or traditional sites, use and possession of sacred objects, and freedom to worship through ceremonial and traditional rites. DOD would have to consult with all affected Native American groups should any cultural resources be identified at any proposed site under the alternative actions.

Also, the *Native American Graves Protection and Repatriation Act* (NAGPRA) and its corresponding regulations (43 CFR Part 10) require that whenever a person inadvertently discovers human remains, funerary objects, sacred objects, or objects of cultural patrimony on federal land, that individual must provide notification, with written confirmation, to the responsible Indian tribal official. Once an inadvertent discovery occurs, all activity must cease, and the area must be secured. Consultation between the responsible federal agency and the responsible Indian tribal officials must then occur.

9.7.2.1 ANAD

No traditional cultural properties are known to occur within the proposed construction areas at ANAD. Native American groups with historical interest in the Anniston area are being contacted as part of the NEPA analysis (see Section 4.17.1.2).

9.7.2.2 PBA

No traditional cultural properties are known to occur within the proposed construction areas at PBA. However, consultation with interested Native American governments regarding the proposed action might be necessary (see Section 5.17.1.2).

9.7.2.3 PCD

No traditional cultural properties are known to occur within the proposed construction areas at PCD. However, consultation with interested Native American governments regarding the proposed action might be necessary (see Section 6.17.1.2).

9.7.2.4 BGAD

No traditional cultural properties are known to occur within the proposed construction areas at BGAD. However, consultation with interested Native American governments regarding the proposed action might be necessary (see Section 7.17.1.2).

9.8 PRESIDENTIAL EXECUTIVE ORDERS

9.8.1 Environmental Justice

On February 11, 1994, President Clinton issued Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. This Executive Order, with its accompanying cover memo, calls on federal agencies to incorporate environmental justice as part of their missions, including decisions made in compliance with NEPA. Specifically, the President's cover memo mentions NEPA in two contexts:

> "Each Federal agency shall analyze the environmental effects, including human health, economic and social effects, of Federal actions, including effects on

> minority communities and low-income communities, when such analysis is required by the National Environmental Policy Act of 1969 (NEPA), 42 USC Section 4321 et seq. Mitigation measures outlined or analyzed in an environmental assessment, environmental impact statement, or record of decision, whenever feasible, should address significant and adverse environmental effects of proposed Federal actions on minority communities and low-income communities. And,
>
> Each Federal agency shall provide opportunities for community input in the NEPA process, including identifying potential effects and mitigation measures in consultation with affected communities and improving the accessibility of meetings, crucial documents, and notices."

In May 1995, the EPA issued a document entitled *Environmental Justice Strategy: Executive Order 12898.* It establishes the EPA's commitment to adhere to the Executive Order. The EPA's Office of Solid Waste and Emergency Response (OSWER) established the Environmental Justice Action Agenda, which outlines the EPA's strategy for (1) developing a partnership with the public; (2) supporting health and environmental research; (3) collecting and analyzing data; (4) forming partnerships, conducting outreach, and communicating with stakeholders during CERCLA and brownfield projects; (5) providing financial and technical assistance to Indian tribal governments and Native Alaskan villages; and (6) integrating environmental justice into all EPA activities. OSWER Directive No. 9200.3-17, *Integration of Environmental Justice into OSWER Policy, Guidance, and Regulatory Development,* was issued on September 21, 1994, and the OSWER Environmental Justice Task Force was formed.

The analysis of environmental justice issues presented in the this EIS is in response to the requirements of this Executive Order. No new environmental justice issues would arise from ongoing activities at existing storage areas, so no action would need to be taken. Construction of a new ACWA facility would not have a disproportionately high and/or adverse impact on low-income and minority populations (see Sections 4.21, 5.21, 6.21, and 7.21).

On December 18, 1997, a group called SAFE (Serving Alabama's Future Environment), Elsie Boateng, Jacqueline Garard, the Sierra Club, and the Chemical Weapons Working Group filed a Complaint of Discrimination against ADEM with the EPA. However, the filing reached the EPA after the 180-day filing deadline and was consequently rejected. On June 29, 1999, a similar Complaint of Discrimination was filed against ADEQ with the EPA by a group called Pine Bluff for Safe Disposal, the Chemical Weapons Working Group, Evelyn Elaine Yates, Dale Muhammad, and Brainard Bivens. No action has been taken on this complaint. The complaints allege that people of African-American ancestry and of low income would be disproportionately harmed as a consequence of ADEM and ADEQ authorizing the operation of a chemical weapons incinerator at ANAD and PBA, respectively. The complaints ask the EPA Office of Civil Rights, pursuant to its duty under Executive Order 12898 and its own regulations (40 CFR 7.120 and 7.130), to exercise its jurisdiction to receive, investigate, and remedy complaints of discrimination on account of race under its own regulations (40 CFR 7.120 and 7.130). The complaints ask that compliance be achieved through the denial of a permit for the chemical weapons incinerator.

9.8.2 Consultation and Coordination with Indian Tribal Governments

Executive Order 13084 (May 14, 1998) requires that federal agencies that formulate policies that significantly or uniquely affect Indian tribal governments be guided by principles of respect for Indian tribal self-government and sovereignty, for tribal treaty and other rights, and for responsibilities that arise from the unique legal relationship between the federal government and Indian tribal governments. The Executive Order requires each agency to have a process that permits elected officials and other representatives of Indian tribal governments to provide meaningful and timely input into the development of regulatory policies on matters that significantly or uniquely affect their communities.

Executive Order 13007 requires federal agencies, to the extent that is practicable and not inconsistent with essential agency functions, to accommodate access to sacred sites by Indian religious practitioners and to avoid adversely affecting sacred sites. Each federal agency must implement procedures to accommodate access, avoid adverse affects, facilitate consultation with religious leaders, and resolve disputes relative to sacred sites.

Should any of the activities arising from the construction and operation of an ACWA pilot facility significantly or uniquely affect an Indian tribal government, the process for permitting tribal government input would have to be employed.

9.8.3 Protection of Children from Environmental Health Risks and Safety Risks

Executive Order 13045 (April 21, 1997) requires each federal agency to make it a high priority to identify and assess environmental health risks and safety risks that might disproportionately affect children and to ensure that its policies, programs, activities, and standards address these disproportionate risks. For any substantive action in a rulemaking submitted to the Office of Management and Budget (OMB), Office of Information and Regulatory Affairs, for review pursuant to Executive Order 12866, the issuing agency must provide an evaluation of the environmental health or safety effects of the planned regulation and an explanation of why the planned regulation is preferable to other potentially effective and reasonably feasible alternatives considered by the agency. This Executive Order requires an evaluation only for agency rulemaking activities before the OMB.

9.9 ARMY REQUIREMENTS

9.9.1 Chemical Agent Safety Program and Chemical Safety

AR 385-61 prescribes Army safety policy, responsibilities, and procedures for the Army Chemical Agent Safety Program. The associated Pamphlet 385-61 contains technical safety and health requirements for operations involving chemical agents and associated weapons systems. Implementation of Pamphlet 385-61 is mandatory. The regulation applies to the blister agents H, HD, HT, and L; the nerve agents GA, GB, GD, and VX; and other experimental chemical agents exhibiting toxicity similar to that of nerve or blister agents. In addition to the specific provisions contained in Pamphlet 385-61, it is recommended that hazard analysis, standard operating procedures, and good laboratory practices should be used to ensure safe research, development, test, and evaluation materials.

The regulation establishes (1) maximum credible event criteria and explosive quantity distance criteria for chemical agent operations, (2) administrative and work practice controls, (3) use of PPE and workplace monitoring, (4) agent exposure limits and measurements, (5) site and general construction plans and safety submissions, and (6) transportation requirements for chemical agents and munitions. Site plans, construction plans, safety submissions, and hazard-zone calculations for all proposed chemical agent and munitions operations must be submitted according to the U.S. Army Explosive Safety Program (AR 385-64).

Pamphlet 385-61 also establishes specific decontamination limits (Section 5.1). These limits are designated with "X" labels. The "X" is used for items that have been decontaminated; however, further decontamination is required before the items can be moved or before maintenance or repair can be performed without the use of chemical-protective clothing and equipment. The symbol "XXX (3X)" is used for items that have been surface decontaminated by locally approved procedures and bagged or contained in an agent container, and for which it has been verified that no concentrations of agent exist above established airborne exposure limits for that agent. The symbol "XXXXX (5X)" is used for items that have been decontaminated of the indicated agent to a level at which the total quantity of agent is less than the minimal health effects dosage determined by the Surgeon General and that may be released for general use or sold to the general public in accordance with all applicable federal, state, and local regulations. Management and disposal requirements in Pamphlet 385-61 are established on the basis of decontamination levels of the items (Sections 5.1 and 5.2). On-post transportation requirements are also established in the pamphlet (Section 10.7).

AR 50-6, *Chemical Surety*, establishes a system of safety and security control measures designed to provide protection to the local population, workers, and the environment by ensuring that chemical agent operations are conducted safely, chemical agents are secure, and personnel involved in those operations meet the highest standards of reliability. This regulation is applicable to (1) any chemical surety activities that are conducted in compliance with AR 385-61; (2) the storage, handling, maintenance, transportation, and inventory of chemical agents; the treatment and disposal of chemical agent material; and (4) the emergency response to chemical agent incidents.

These regulations implement the Chemical Stockpile Emergency Preparedness Program (CSEEP), including the Chemical Accident or Incident Response and Assistance (CAIRA) program. Under these programs, each site that stores or handles chemical agent must have a CAIRA plan for providing an up-to-date, coordinated, and timely response for CAIRA operations. These emergency response plans cover on-site contingency planning and contingency operations for off-post/installation response coordinated with appropriate state and local government authorities and the Federal Regional Response Team. The construction of an ACWA facility at a site might require amendments to the CAIRA plan and hazard area response provisions.

9.9.2 Environmental Protection and Enhancement

AR 200-1, *Environmental Protection and Enhancement*, provides for the establishment of environmental programs and requirements at Army installations. It covers the implementation of federal, state, and local environmental laws and the integration of pollution prevention, natural and cultural resource management, and NEPA planning in installation activities. It provides for programs in water resources management, oil and hazardous substance spill prevention and response, hazardous materials management, hazardous and solid waste management, air emission controls, environmental noise management, asbestos management, radon reduction, pollution prevention, environmental restoration, environmental quality technology, and automated environmental management systems. Other environmental requirements and programs addressed include real property acquisition (e.g., outgranting and disposal transactions), construction site selection surveys, environmental training, and pest management.

9.9.3 Consideration of the Environmental Effects of Army Actions

AR 200-2 contains the Army's implementation requirements for NEPA. This regulation has been codified in its entirety in 32 CFR Part 651. It covers the integration of NEPA activities into Army planning, required records and documentation for Army actions, review categories for such actions (e.g., categorical exclusions, environmental assessments, EISs), and steps to be followed in preparing and processing an EIS.

9.10 CHEMICAL WEAPONS CONVENTION (CWC)

The CWC (the full title is *Convention on the Prohibition on the Development, Production, Stockpiling, and Use of Chemical Weapons and Their Destruction*) opened for signature on January 13, 1993, and entered into force on April 29, 1997. Each state party to the

CWC must undertake to destroy chemical weapons that it owns or possesses or that are located in any place under its jurisdiction or control (Article I). Under the CWC Annex on Implementation and Verification, each state party must submit to the Organization for the Prohibition of Chemical Weapons a detailed plan for destruction, covering the name and location of each existing or planned chemical weapons destruction facility and the types and approximate quantities of chemical weapons to be destroyed. Each state party must also provide the organization with information on the development of new methods for destroying chemical weapons and on the improvement of existing methods. Each state party must ensure that its chemical weapons destruction facilities are constructed and operated in a manner that ensures that the chemical weapons are destroyed and that the destruction process can be verified.

All locations at which chemical weapons are stored or destroyed are subject to systematic verification through on-site inspection and monitoring with on-site instruments, in accordance with the Annex on Implementation and Verification. Each state party must provide access to any chemical weapons destruction facility and its storage areas for the purpose of such verification inspection or monitoring (Article IV). Each state party must submit detailed plans for the destruction of chemical weapons no later than 60 days before each annual destruction period begins. Such plans must encompass all stocks to be destroyed during the next annual destruction period. In addition, each state party must certify, no later than 30 days after the destruction process has been completed, that all chemical weapons specified in the detailed plans for destruction have been destroyed. At the end of an active destruction phase, inspectors must take an inventory of the chemical weapons that have been removed from the storage facilities to be destroyed and verify the accuracy of the inventory of the chemical weapons remaining.

Each state party to the CWC must assign the highest priority to ensuring the safety of people and to protecting the environment during transportation, sampling, storage, and destruction of chemical weapons (Article IV).

All ACWA facilities would be designated as destruction facilities under the CWC and would have to comply with the requirements established therein.

9.11 REFERENCES FOR CHAPTER 9

Cain, K.R., 1999, letter on NPDES Permit CO0000931 from Cain (Department of the Army, Pueblo Chemical Depot, Pueblo, Colo.) to M. Reed (U.S. Environmental Protection Agency, Region VIII, NPDES Branch, Denver, Colo.), July 26.

CDPHE, 2001, “Statement of Basis and Purpose — Rulemaking Hearing of June 19, 2001,” statement by Colorado Department of Public Health and Environment regarding 6 CCR 1007-3, Parts 260 and 261, *Colorado Register*.

Colorado Natural Heritage Program, 1999, *Conservation Status Handbook, Colorado's Animals, Plants, and Plant Communities of Special Concern,* Vol. 3, No. 2, Colorado State University, Fort Collins, Colo., and The Nature Conservancy.

Consent Administrative Order LIS 84-068, 1985, Arkansas Department of Pollution Control and Ecology, Aug. 6.

EPA, 1974, *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, EPA-550/9-74-004, U.S. Environmental Protection Agency, Washington, D.C., March.

Finch, F.R., undated, *General Conformity under the Clean Air Act — Policy and Guidance*, memorandum from Finch (Assistant Chief of Staff for Installation Management, Department of the Army, Pentagon, Washington, D.C.), http://www.denix.osd.mil/denix/DOD/Working/CAASSC/Conform/doa1.html, accessed in Feb. 2001.

Fogleson, P.K., 1997, letter on restriction of PCD's potential to emit, from Fogleson (U.S. Army, Pueblo Chemical Depot, Pueblo, Colo.) to J. Dale (U.S. Environmental Protection Agency, Region VIII, Denver, Colo.), Jan. 8.

Kentucky Department of Natural Resources, undated, *Guidelines for Stream and Wetland Protection in Kentucky,* Division of Water, http://water.state.ky.us/dow/guide.htm, accessed in Feb. 2001.

Kimmell, T.A., et al., 2001, *Technology Resource Document for the Assembled Chemical Weapons Assessment Environmental Impact Statement*, ANL/EAD/TM-101, Vols. 1–5 and errata, Argonne National Laboratory, Argonne, Ill.

Pueblo Depot Activity, 1995, *Application for Air Pollution Emission Permit for the Department of the Army, Pueblo Depot Activity, Chemical Agent Disposal Facility,* submitted by Pueblo Depot Activity, Pueblo, Colo., to Colorado Department of Public Health and Environment, Air Pollution Control Division, Denver, Colo., Sept.

Schieffelin, J., 1997, letter on the Assembled Chemical Weapons Assessment Program from Schieffelin (Colorado Department of Public Health and Environment, Hazardous Materials and Waste Management Division, Denver, Colo.) to M. Parker (Program Manager, Assembled Chemical Munitions Demilitarization Alternatives, Aberdeen Proving Ground, Md.), March 4.

10 LIST OF PREPARERS

Name	Education/Experience	Contribution
Assembled Chemical Weapons Assessment, U.S. Department of Defense		
Jon Ware	M.S. Chemical Science/ Environmental Chemistry	Environmental Team Leader, ACWA
Argonne National Laboratory		
Joseph J. Adduci	B.A. Geography; 6 years of experience in geographic information system (GIS) applications	GIS data acquisition, integration, management, and analysis; preparation of figures
Timothy Allison	M.S. Mineral and Energy Resource Economics, M.A. Geography; 13 years of experience in regional analysis and economic impact analysis	Socioeconomics analysis; Technical Lead for chapter on Anniston Army Depot
Georgia A. Anast	B.A. Mathematics/Biology; 11 years of experience in environmental assessment	Comment/response management
Young-Soo Chang	B.S., M.S., Ph.D. Chemical Engineering; 19 years of experience in meteorology, air quality, and noise impact assessments	Air quality — criteria pollutants, noise analysis, chemical hazard accident modeling
Stephen Folga	Ph.D. Gas Engineering, 7 years of experience in technology assessment and waste management	Facility description, resource requirements, emissions, wastes
Marsha S. Goldberg	Ph.D. City and Regional Planning; 24 years of experience in environmental assessment, environmental planning, and guidance for impact assessment	Project Leader, introduction, purpose and need, alternatives, summary, comparison of alternatives

Name	**Education/Experience**	**Contribution**
Larry J. Gorenflo	Ph.D. Geography, M.A. Anthropology; 23 years of experience in anthropological and geographical research, 14 years of experience in environmental assessment	Land use, environmental justice
Rebecca A. Haffenden	B.A. Psychology, J.D.; 11 years of experience in environmental regulation and environmental impact assessment.	Environmental permits and other compliance requirements
Heidi M. Hartmann	M.S. Environmental Toxicology and Epidemiology; 14 years of experience in exposure and risk analysis and public health assessment	Human health and safety, accident risk assessment
Todd A. Kimmell	B.S. Biology, M.S. Environmental Science; 23 years of experience in environmental sciences and policy analysis	Descriptions of technologies
Michael Lazaro	M.S. Environmental Science (Atmospheric Physics), M.S. Nuclear Engineering; 29 years of experience in atmospheric modeling, environmental engineering, policy analysis, and environmental assessment	Chemical agent accident consequence/risk assessment, lead model simulation effort
Marita Moniger	B.A. English; 23 years of experience in editing and writing	Technical Editor
Leslie Nieves	B.A. Economics, M.S. Agricultural Economics; 20 years of experience in environmental sciences and economics	Summary of technology systems, infrastructure, agriculture
Edwin D. Pentecost	Ph.D. Zoology, M.S. Biology; 27 years of experience in environmental impact assessment, focusing on ecology, wetlands, ecological risk, and natural resources planning	Biological resources, terrestrial ecology, aquatic ecology, wetlands

Name	Education/Experience	Contribution
Albert E. Smith	Ph.D. Physics; 30 years of experience in air quality and environmental assessment	Cumulative impacts
Karen P. Smith	B.S. Anthropology, B.A., M.S. Geology; 12 years of experience in environmental sciences, with emphasis on policy and regulatory analysis	Geology and soils
Jan E. Stache	M.A. Geography and Environmental Studies; 10 years of experience in geographic information system (GIS) applications	GIS data acquisition, integration, management, and analysis; preparation of figures
Elisabeth A. Stull	Ph.D. Zoology; 34 years of experience in ecological research, 25 years of experience in environmental impact assessment	Document Manager
Bobby R. Templin	B.S. Civil Engineering, M.S. Environmental Engineering, Professional Engineer, American Academy of Environmental Engineers; 23 years of experience in environmental management, hazardous waste disposal, and weapons disposal	Program Manager, introduction, proposed action and alternatives, decommissioning, closure
David Tomasko	Ph.D. Civil Engineering; 23 years of experience in hydrogeology and fluid mechanics	Environmental fate of agent
Chih L. Tsao	B.A. Chemistry, MEM (Master of Environmental Management) in Environmental Toxicology; 4 years of experience in environmental impact assessment and research	Biological resources, ecological risk assessment
Robert VanLonkhuyzen	B.A. Biology; 9 years of experience in ecological research and environmental assessment	Biological resources

Name	**Education/Experience**	**Contribution**
Bruce Verhaaren	Ph.D. Archeology; 15 years of experience in archaeological analysis, 12 years of experience in environmental assessment and records management	Historic properties
Konnie L. Wescott	B.A. Mathematics and Sociology/Anthropology, M.A. Anthropology; 14 years of experience in archaeology, 12 years of experience in environmental assessment	Cultural and archeological resources; Technical Lead for chapter on Blue Grass Army Depot
Mandy Whorton	M.S. Environmental Management; 8 years of experience in environmental assessment	Mitigation, other impacts; Technical Lead for chapter on Pueblo Chemical Depot
Bruce Wilkins	Ph.D. Nuclear Chemistry; 9 years of experience in waste management analysis and environmental assessment	Waste management
Gustavious P. Williams	B.A. Asian Studies, B.S. Civil Engineering, Ph.D. Civil Engineering; 15 years of experience in environmental sciences, 10 years of experience in environmental impact assessment	Surface water, groundwater, geology, soils, fate and transport of agent; Technical Lead for chapter on Pine Bluff Arsenal

11 INDEX

12 DISTRIBUTION LIST

This list is maintained by the ACWA EIS Coordinator at (888) 482-4312.

ATTACHMENT 1:

NOTICE OF INTENT*

* *Federal Register,* April 14, 2000, Volume 65, Number 73, Pages 20139–20140 from the *Federal Register* online via GPO Access [wais.access.gpo.gov] [DOCID:fr14ap00-55]

DEPARTMENT OF DEFENSE

Department of the Army

Environmental Impact Statement for Follow-On Tests Including Design, Construction and Operation of One or More Pilot Test Facilities for Assembled Chemical Weapon Destruction Technologies at One or More Sites

AGENCY: Program Manager, Assembled Chemical Weapons Assessment, Department of Defense.

ACTION: Notice of intent.

SUMMARY: This announces the Army's intent to prepare an Environmental Impact Statement on the potential impacts of the design, construction and operation of one or more pilot test facilities for assembled chemical weapon destruction technologies at one or more chemical weapons stockpile sites, potentially simultaneously with any existing demilitarization programs and schedules at these sites. The size of the pilot tests and the location of the test facilities will be determined in this process.

DATES: Written comments must be received not later than May 30, 2000 in order to be considered in the Draft Environmental Impact Statement.

ADDRESSES: Written comments may be forwarded to the Program Manager Assembled Chemical Weapons Assessment, Public Affairs, Building E-5101, Room 219, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 21010-5424.

FOR FURTHER INFORMATION CONTACT: Ms. Ann Gallegos at 410-436-4345, by fax at 410-436-5297, or via email at ann.gallegos@sbccom.apgea.army.mil, or Program Manager Assembled Chemical Weapons Assessment, Public Affairs, Building E-5101, Room 212, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 21010-5424.

SUPPLEMENTARY INFORMATION: This proposed action continues the process that began when Congress established the Assembled Chemical Weapons Assessment Program through passage of Public Law 104-208. The authorizing legislation instructed the Department of Defense to identify and demonstrate alternatives to baseline incineration for the destruction of assembled chemical weapons. Baseline incineration is the technology and process in place at the Johnston Atoll in the Pacific and at Deseret Chemical Depot in Utah. Assembled chemical weapons are munitions containing both chemical agents and explosives that are stored in the United States unitary chemical weapons stockpile. This includes rockets, projectiles, and mines. Unitary agents include chemical blister agents (e.g., the mustard H, HD, and HT) and chemical nerve agents (e.g., GB (Sarin) and VX).

With the National Defense Appropriations Act for Fiscal Year 1999, Congress directed the Program Manager, Assembled Chemical Weapons Assessment to plan for the pilot testing of alternatives technologies.

While all of the chemical stockpile sites were initially believed to be potential test sites, Edgewood Chemical Activity in Maryland, Newport Chemical Depot in Indiana, and Johnston Atoll in the Pacific Ocean have been eliminated from any consideration. Chemical stockpile sites at Edgewood and Newport will not be considered because no assembled chemical weapons are at those locations. Johnston Atoll will not be considered because all chemical weapons at the site will be destroyed before the National Environmental Policy Act analysis can be completed.

Sites at Anniston Chemical Activity in Alabama, Pine Bluff Chemical Activity in Arkansas, Pueblo Chemical Depot in Colorado, and Blue Grass Chemical Activity in Kentucky are being considered. Deseret Chemical Depot in Utah and Umatilla Chemical Depot in Oregon are not currently being considered because the current schedule for those plants indicates that the assembled chemical weapons will be destroyed prior to the time that a pilot facility would be ready to operate. If new information indicates that assembled chemical weapons in sufficient quantity will remain at these sites, then placement of the pilot facility at those sites will be analyzed.

Technologies under consideration include a variety of processes, such as, chemical neutralization, biological treatment, and supercritical water oxidation. The Program Manager, Assembled Chemical Weapons Assessment pilot tests will not halt or delay the operation or construction of any baseline incineration facility currently in progress. Transportation of assembled chemical weapons between stockpile sites is precluded by public law and will not be considered.

Alternatives that will be considered in the Environmental Impact Statement are: (a) No action, (b) pilot test of chemical neutralization followed by super critical water oxidation, and (c) pilot test of chemical neutralization followed by biological treatment.

There is a second Notice of Intent, entitled "Notice of Intent to Prepare an Environmental Impact Statement for the Design, Construction, and Operation of a Facility for the Destruction of Chemical Agent at Pueblo Chemical Depot, Colorado." The focus of this complementary Environmental Impact Statement will be specifically on what technology should be used for the destruction of the chemical weapons stockpile at Pueblo Chemical Depot. The focus of the Assembled Chemical Weapons Assessment Environmental Impact Statement is on whether or not pilot testing of any Assembled Chemical Weapons Assessment technology should be conducted, and if so where, but it will leave to the Pueblo Chemical Depot Environment Impact Statement the question whether a full-scale facility operated initially as a pilot facility should be constructed to destroy the stockpile at that location. The emphasis for the Assembled Chemical Weapons Assessment document is to consider Assembled Chemical Weapons Assessment technologies and the various stockpile sites that may be suitable for conducting pilot tests, considering such factors as existing facilities, resource requirements for each technology and the ability of the site to provide those resources, munitions configurations and availability at each site at the time actual testing would begin. At the conclusion of both these Environmental Impact Statements, the same officials will issue The Records of Decision.

During scoping meetings, the Program Manager, Assembled Chemical Weapons Assessment is seeking to identify significant issues related to the proposed action. The Program Manager, Assembled Chemical Weapons Assessment desires information on: (1) The potential chemical weapons stockpile sites and surrounding areas, (2) concerns regarding the testing and/or operation of multiple technologies at these sites, (3) issues regarding the scale of the pilot test facilities, and (4) specific concerns regarding any potential technologies. Individuals or organizations may participate in the scoping process by written comment or by attending public meetings to be held in Alabama, Arkansas, Colorado, Kentucky and the Washington, DC metropolitan area. The dates, times, and locations of these meetings will be [[Page 20140]] provided at least 15 days in advance by public notices in the news media serving the regions where the meeting will be located. The public meeting in Colorado will be held in conjunction with the public meeting on the site-specific Environmental Impact Statement.

Dated: April 10, 2000.

Raymond J. Fatz,

Deputy Assistant Secretary of the Army, (Environment, Safety, and Occupational Health) OASA (I&E).

[FR Doc. 00-9336 Filed 4-13-00; 8:45 am]

BILLING CODE 3710-08-M

APPENDIX A:

ENVIRONMENTAL FATE AND TOXICITY OF ACWA VESICANTS, NERVE AGENTS, AND THEIR DEGRADATION PRODUCTS

APPENDIX A:

ENVIRONMENTAL FATE AND TOXICITY OF ACWA VESICANTS, NERVE AGENTS, AND THEIR DEGRADATION PRODUCTS

A.1 INTRODUCTION

This appendix discusses the fate and toxicity of ACWA chemical warfare agents (CWAs) and their degradation products. Two broad classes of CWAs are considered: vesicants (blister agents; i.e., compounds that cause blisters, such as mustard) and nerve agents (compounds that affect the nervous system). The vesicants discussed are HD, HT, and H; the nerve agents discussed are VX and GB. Data on the principal degradation products of the vesicants and nerve agents are also provided. The information presented is useful for impact analyses and covers both physical and chemical properties.

The fate of CWAs and their degradation products in the environment is discussed in terms of the following four processes: photolysis, hydrolysis, oxidation, and microbial degradation. Photolysis is the chemical decomposition of a CWA by sunlight. This process is relevant for surface spills. Hydrolysis is the decomposition of a CWA by its chemical reaction with water. Hydrolysis is pertinent to CWAs buried in moist soil, inadvertent releases or spills into surface water bodies, and surface spills that are exposed to precipitation (Munro et al. 1999). Oxidation is the decomposition of CWA by chemical interaction with oxygen. Oxidation also occurs when an agent's valence state (ionic charge) is increased positively (e.g., +1 to +2) or decreased negatively (e.g., –2 to –1) as a result of this interaction. Oxidation is relevant to chemical warfare (CW) compounds in contact with air or natural oxidants in the soil or water. Microbial degradation is decomposition of CWA by interaction with living microbes. This process is of interest when CW material is either on soil or buried in it and active communities of CWA-degrading microbes are present. CWAs that have low rates of photolysis, hydrolysis, oxidation, or microbial degradation are classified as persistent in the environment.

Even though a CWA may be persistent in the environment, its presence may not be significant if its toxicity (ability to harm humans, other animals, fish, and plants) is low. Toxicity depends on the exposure pathway (Munro et al. 1999). These pathways include oral (introduced through the mouth), inhalation (introduced by breathing), and dermal (introduced by skin contact). Lethal compounds that produce death to 50% of tested animals (lethal dose of 50%, or LD_{50}) or that produce death at a median concentration (lethal concentration of 50%, LC_{50}) at levels of less than 50 mg/kg (oral), less than 50 mg/m^3 (inhalation), and less than 200 mg/kg (dermal) after a single exposure are highly acutely toxic. Compounds with LD_{50} or LC_{50} values of 50–500 mg/kg (oral), 50–500 mg/m^3 (inhalation), or 200–500 mg/kg (dermal) are moderately toxic. Compounds with even higher values for LD_{50} and LC_{50} have a low toxicity. Toxic chronic (long-term) exposures are generally an order of magnitude lower than the above numbers. For aquatic organisms, LC_{50} values of less than 1 mg/L are highly acutely toxic, and LC_{50} values of less than 0.1 mg/L are chronically toxic.

The remainder of this appendix discusses the fate and toxicity of mustard (HD, HT, and H), the nerve agents VX and GB, and their major degradation products.

A.2 VESICANTS

Vesicants (blister agents) are CW compounds that produce blistering over the entire body, including the eyes and lungs. Although lethal, vesicants are designed to maim rather than kill. In World War I, mustard was a very effective incapacitating agent, despite producing only 1% fatalities among its casualties (Mitretek 2000a). Three vesicants are discussed in this appendix: HD, HT, and H. In the pure form, all are colorless and odorless. Agent-grade material is typically pale yellow to dark brown with a smell similar to burning garlic (Mitretek 2000b).

Chemical weapons disperse mustard as an aerosol, which then evaporates to produce contaminated vapor. After exposure to the vapor, delayed tissue damage occurs within minutes of contact. Clinical effects are not immediately evident; they are manifested 2 to 24 hours after exposure (Stimson Center 2000). Topical effects occur on the skin (blisters), in airways (coughing, lesions, and, in rare cases, respiratory failure), and in the eyes (itchiness, a burning sensation, and possible damage to the cornea). Nausea and vomiting can also result.

Most of the stored mustard for the ACWA program is in the distilled or purified form of sulfur mustard (HD). HT was made by an older manufacturing process and contains about 60% HD, less than 40% of the agent T (bis[2-(2-chloroethylthio)ethyl]ether), and a variety of sulfur contaminants and impurities (Munro et al. 1999). HT may have many of the same toxic effects as HD; however, very few studies on HT are available in the literature. H is an undistilled mustard that also contains impurities. H has the chemical name 1,1'-thiobis[2-chloroethane]. Its molecular formula is $C_4H_8Cl_2S$, and its formula weight is 159.08 g/mole. Its properties have not been reported in the literature; however, its toxic properties are believed to be similar to those of HD. A 1-ton container of HD manufactured after World War II contains approximately 89% HD. Older processes used prior to World War II (such as the Levinstein process) produced mustards that contained 62 to 64% HD. Chemical and physical properties of HD, HT, and H are given in Table A.1.

Sulfur mustard is considered to be fairly persistent in the environment (Munro et al 1999). At moderate temperatures (25°C), HD deposited on the surface of soil will evaporate within 30 to 50 hours, depending on weather conditions. Predicted persistence times for drops applied to soils at a rate of 50 g/m^2 for various conditions of wind and rain were 1,122 to 2,215 hours at 0°C and 30.5 to 51.2 hours at 25°C (Munro et al. 1999). At lower temperatures (less than 13 to 15°C, mustard freezes (Table A.1). Studies of the persistence of mustard performed at low temperatures (–1°C) in Norway show that small, solid particles formed on the surface of any snow that was present. The droplets disappeared fairly rapidly, primarily through evaporation. After two weeks, only 0.0001% remained (Munro et al. 1999). This rate of removal corresponds to an effective half-life (the amount of time needed for one-half of the mustard to decompose) of about 0.7 day.

TABLE A.1 Physical and Chemical Properties of CWAs

Property	HD/H	HT	VX	GB
Molecular weight	159.08	Nd[a]	267.4	140.1
Physical state	Oily liquid	Oily liquid	Oily liquid	Liquid
Color	Clear/pale yellow, black if impure	Amber/dark brown	Light amber/ amber	Colorless
Melting point (°C)	13–14	1	–39 (calculated)	–56
Boiling point (°C)	215–217	>228	298 (decomposes)	158
Density (g/mL)	1.27 at 20°C	1.27 at 20°C	1.008 at 20°C	1.102 at 20°C
Vapor pressure (mmHg at 20 or 25°C)	0.11	0.10	0.0007	2.10
Volatility (mg/m^3)	920	831	10.5	22,000
Solubility in water (g/L)	0.92	Almost Insoluble	30	Miscible
Hydrolysis half-life	8.5 min	ND	1,000 h (pH = 7)	39 h (pH = 7)
Henry's Law constant (atm × m^3/mol)	2.1×10^{-5}	ND	3.5×10^{-9}	5.4×10^{-7}
Log K_{ow}	1.37	ND	2.09	0.299
Log K_{oc}	2.12	ND	2.5	1.77

[a] ND = No data found.

Source: Munro et al. (1999).

Because mustard does not absorb ultraviolet radiation, photodegradation does not appear to be a significant degradation process (Munro et al. 1999). However, HD will decompose in the air by reaction with hydroxyl (OH^-) radicals. In the presence of hydroxyl radicals produced by sunlight in air containing water vapor, HD has an apparent half-life of about 1.4 days.

U.S. Army Center for Health Promotion and Preventive Medicine (2002) reported that HD spilled into seawater would probably sink because it is more dense than water. (HD has a specific gravity [ratio of compound density to the density of water] of 1.27 at 20°C.) Once in water, the mustard would dissolve. Compounds are considered to be moderately to highly soluble if their solubility is greater than 1 g/L. Because the solubility of mustard is about 0.8 g/L at 20°C

(Table A.1), the dissolution process would be slow (Munro et al. 1999). The dissolved mustard would mix with the surrounding water and undergo hydrolysis, which would quickly reduce its concentration.

If the mustard was buried in an unsaturated soil (i.e., one in which the pore spaces are not completely filled with water), the mustard could decompose by a combination of dissolution and vaporization. As mentioned above, dissolution would be slow. Vaporization, on the other hand, could occur at a moderate pace because its Henry's Law constant (ratio of the concentration in the vapor phase to the concentration in the liquid phase) is 2.4×10^{-5} atm $\times$ m^3/mol (Munro et al. 1999). Dissolution could reduce the rate of volatilization by causing intermediate hydrolysis products to form that would coat the surface of the mustard drop. The volatilization rate is further decreased at low temperatures (e.g., mustard freezes at temperatures less than 13 to 15°C). Under conditions of low relative humidity (27 to 35%) and temperatures ranging from 21 to 25.5°C, 7 to 32% of mustard experimentally applied to soils was recovered in the first 6 hours. By the time volatilization ended (15 to 55 hours), 12 to 66% had been recovered. The rate of mustard vapor generation and recovery depended on the soil pH, moisture content of the soil, and the chemical and physical properties of the soil (Munro et al. 1999).

The principal environmental degradation process for stored or buried HD is hydrolysis. Hydrolysis is controlled by surface reactions, with products formed at the HD-water interface and then diffused into the bulk-water phase. Once in the water phase, HD has an estimated hydrolysis half-life of 4 to 8 minutes (Munro et al. 1999). However, its rate is limited by the slow rate of dissolution. Mustard has been known to persist for decades under water (Mitretek 2000b). The rate of dissolution can be further reduced by the formation of intermediate hydrolysis products that coat the mustard droplets.

Mustard can be theoretically biodegraded in soil via the thioether oxidation pathway to form bis(2-chloroethyl)sulfoxide and a corresponding sulfone, both of which are soluble in water (Munro et al. 1999). Mustard can also be biodegraded by reductive dehalogenation and dehydrohalogenation; however, these pathways are predicted to be very slow. Although biodegradation of mustard has been predicted, it has not been demonstrated successfully in the laboratory, probably because of its toxicity to microorganisms.

Many organic compounds that are dissolved in water can be adsorbed onto solid surfaces through a process termed the hydrophobic effect (Fetter 1993). The partitioning of a solute onto mineral surfaces or organic carbon in a soil primarily depends on the fraction of organic material, f_{oc}, present. Under these conditions, a partition coefficient with respect to the organic fraction K_{oc} is defined as:

$$K_d = f_{oc} K_{oc} , \tag{1}$$

where K_d is the mass of solute on the solid phase per unit mass of solid phase divided by the concentration of solute in solution. As indicated in Table A.1, K_{oc} for HD is approximately 132. If organic matter is present in the soil at typical values (1 to 3%), the partition coefficient for HD would range from about 1 to 4 mL/g. If the partition coefficient were 0.0 mL/g, there would be no retardation of the mustard with respect to the velocity of the groundwater (i.e., the mustard would travel at the same velocity as the groundwater).

The amount of retardation, R, can be calculated by using the following relationship from Freeze and Cherry (1979):

$$R = 1 + (P_b K_d / \varphi), \tag{2}$$

where ρ_b is the bulk density of the soil and φ is its effective porosity (ratio of the volume of interconnected voids to the volume of the soil). For a bulk density of 1.7 g/cm^3 and an effective porosity of 0.3, mustard would travel up to about 20 times slower than the water in which it is dissolved.

Table A.1 also provides information on another physical parameter important for analyzing the impacts of the presence of mustard in water: K_{ow}, the octanol-water partition coefficient (Fetter 1993). This parameter provides an estimate of a chemical's tendency to bioaccumulate in organisms. High values of K_{ow} (or log K_{ow}) indicate that a substance will tend to concentrate in soil organic matter or in fatty tissue in the body (Rosenblatt et al. 1995).

For various organic materials, there is a relationship between the octanol-water partition coefficient and K_{oc}. For many organics, this relationship is given by the following equation from Fetter (1993): $K_{oc} = 0.63\ K_{ow}$.

$$K_{oc} = 0.63\ K_{ow}\ . \tag{3}$$

The principal degradation products of mustard undergoing hydrolysis are thiodiglycol (TDG) and hydrochloric acid (Munro et al. 1999). The major hydrolysis products of HT and T after overnight hydrolysis at 50°C were TDG, hemisulfurmustard, 2-chloroethyl(2-hydroxyethylthio)-ethyl ether, bis(2-hydroxyethylthio)ethane, mustard agent, and 1,4-dithiance (Munro et al. 1999). Table A.2 presents a list of mustard degradation products and their physical properties. TDG is stable in the absence of water, is miscible with water, and has a half-life in aqueous solution of about 6 weeks. No aqueous photolysis occurred when aqueous solutions of TDG were exposed to sunlight for 14 days. TDG can be possibly oxidized to TDG sulfoxide and TDG sulfone. TDG, 2-chloroethyl vinyl sulfone, and divinyl sulfone are essentially nonvolatile (will not form vapors). Divinyl sulfide and 1,2-dichloroethane rapidly form a gas phase. Hemisulfur is not expected to persist in the environment, and it decomposes rapidly by hydrolysis.

Two common degradation products of HD that are persistent in the environment are 1,4-oxathiane and 1,4-dithiane (Table A.2). 1,4-oxathiane is formed by dehyrohalogenation of partially

TABLE A.2 Physical Properties of Mustard Degradation Products[a]

Compound	Water Solubility (g/L)	Log K_{ow}	Log K_{oc}	Vapor Pressure (mmHg)
Sulfur mustard	1.0	1.37	2.12	0.1
Thidiglycol (TDG)	Miscible	–0.77	0.96	0.00002
2-Chloroethyl vinyl sulfide	1.4	1.11	1.98	5.8
Divinyl sulfide	2.5	–0.85	1.84	6.0
Mustard sulfoxide	93	–0.85	0.91	0.65
Mustard sulfone	11	–0.51	1.11	0.96
2-Chlorovinyl sulfoxide	160	–1.11	0.77	0.064
Vinyl sulfoxide	280	–1.37	0.63	0.92
2-Hydroxyethyl vinyl sulfide	5.0	0.53	1.66	3.8
2-Chloroethyl vinyl sulfone	78	–0.77	0.96	0.023
Divinyl sulfone	140	–1.03	0.82	0.09
1,4-Dithiane	3.0	0.77	1.80	0.80
1,4-Oxathiane	167	0.60	ND	3.9
1,2-Dichloroethane	11	1.48	2.18	8.5

[a]K_{ow} = Octanol water partition coefficient, an estimate of a chemical's tendency to bioaccumulate in organisms. High values of K_{ow} indicate that a substance will tend to concentrate in soil organic matter or in fatty tissue rather than in water (Rosenblatt et al. 1995).

K_{oc} = Organic carbon partition coefficient, an estimate of the tendency of a chemical to absorb to the organic carbon phase in soil or sediment. The greater the value of K_{oc}, the greater the tendency of a substance to stick to organic matter in soil and not migrate with water or vaporize into the air (Rosenblatt et al. 1995).

Source: Munro et al. (1999)

hydrolyzed mustard, whereas 1,4-dithiane is a thermal degradation product of mustard formed by dechlorination. Both compounds are contaminants in the Rocky Mountain Arsenal area near Denver, Colorado (Munro et al. 1999), and 1,4-dithiane has been identified in groundwater at Aberdeen Proving Ground, Maryland. 1,4-Dithiane readily vaporizes from both soil and surface water. It also photooxidizes to form sulfoxides and sulfones.

In addition to hydrolysis, TDG is also susceptible to biodegradation (Munro et al.1999). When mustard was hydrolyzed prior to inoculation with *Pseudomonas pickettii* (SH18) and *Alcaligens xylosoxidans* (ssp. *Xylosoxidans* strain SH42), up to 97% of the carbon-containing hydrolysis products were degraded. TDG was completely degraded by *A. xylosoxidans* strain SH91 in a laboratory-scale stirred-tank reactor. No associated rates of degradation are available.

Mustard has strong alkylating properties and consequently demonstrates systemic toxicity (i.e., affects the entire organism) in addition to its effects on skin, eyes, and the respiratory tract (Munro et al. 1999). Mustard is also considered to be a known human carcinogen. Its LD_{50} is reported to be 4,500 mg/kg of body weight and its LC_{t50} is reported to be 1,500 mg/min/m^3 (Stimson Center 2000). TDG, the principal hydrolysis degradation product, exhibits low to very slight toxicity and does not retain the vesicant properties of the parent. Oral doses in the range of 4 to 6 g/kg were required to produce 50% lethality in rodents.

Hemisulfur mustard is an intermediate degradation product formed in the course of HD hydrolysis to TDG. It retains some acute toxicity (0.1 to 0.25 times as toxic as HD in mice for dermal and intravenous pathways) (Munro et al. 1999). Acute toxicity data for 1,4-dithiane suggest low lethality; the oral LD_{50} value for rats is about 3.5 g/kg body weight. The acute toxicity of 1,4-oxathiane is also relatively low, with LD_{50} oral values in rats of about 3 g/kg body weight. A more complete summary of toxicity information for vesicant degradation products is provided in Munro et al. (1999).

In summary, the CW vesicants HD, HT, and H can persist in the environment. Agents on the soil will evaporate and then hydrolyze. Agents in surface water will volatilize and decompose by hydrolysis. Agents under water will dissolve slowly and then quickly hydrolyze. Agents buried in the unsaturated zone will vaporize, dissolve slowly, and hydrolyze quickly. Agents in the zone of saturated groundwater will dissolve slowly and then hydrolyze rapidly. Because the dissolution process for mustards is slow, agent can remain in place for a relatively long time. However, once dissolution has occurred, decomposition by hydrolysis is rapid, and advective transport in moving water is slower than the groundwater velocity. After decomposition, mustard degradation products can persist in the environment, although some of these degradation products will vaporize and hydrolyze readily. Identification of these products can indicate the presence of potential mustard sources.

The lethality of mustard and its associated degradation products is low, as indicated by the LD_{50} values. This finding is consistent with the understanding that vesicants are not designed for lethality. Rather, they are designed to be effective incapacitating agents.

A.3 NERVE AGENTS

All CW nerve agents are strong inhibitors of enzymes found in the body. In particular, nerve agents inhibit the enzyme acetylcholinesterase, therby allowing acetylcholine to build up at nerve synapses. The accumulation of acetycholine at these sites effectively prevents the transmission of nerve signals in the body (Mitretek 2000c).

After exposure to a CW nerve agent, incapacitating effects occur within 1 to 10 minutes; lethal effects occur within 2 to 15 minutes. Effects in the eyes include contraction of the pupils (meiosis), pain, and dim or blurred vision. A runny nose may occur, and there is a tightness in the chest. Nausea and vomiting are also possible. When skeletal muscle is reached by the agent, twitching and convulsions result. Fluctuations also occur in the heart. Loss of consciousness and seizure activity can occur within one minute of exposure to high concentrations. Eventual paralysis and death follow (Stimson Center 2000). The fate and toxicity of VX, GB, and their degradation products are discussed below.

A.3.1 VX

The CW nerve agent VX was first introduced in 1954 (Mitretek 2000d). It has the chemical name methylphosphonothioic acid, S-[2-[bis(1-methylethyl)amino]ethyl]-O-ethyl ester. It is a persistent, odorless, amber-colored liquid that has the molecular formula $C_{11}H_{26}NO_2PS$. It has a formula weight of 267.37 g/mole (Mitretek 2000e). VX is usually formulated with 1 to 3% stabliziers (e.g., diisopropyl carbodiimide) to protect it against decomposition by trace quantities of water.

VX is not very volatile (10.5 mg/m^3 at 25°C) and does not evaporate readily. Its Henry Law constant of 3.5×10^{-9} atm $\times$ m^3/mol indicates that it is essentially nonvolatile in water (Munro et al. 1999). VX is moderately persistent on the bare ground and may remain in significant concentrations for a period of two to six days, depending on the temperature, organic content of the soil, and moisture. The degradation results from a combination of evaporation, hydrolysis, and biodegradation. The effective half-life of VX in soil is considered to be about 4.5 days on the basis of estimates that show that 90% of initially applied VX in soil would be lost in less than 15 days.

VX is moderately to highly soluble in water, with a solubility of 30 g/L at 25°C (Munro et al. 1999). It is fairly resistant to hydrolysis. The reported half-life in water ranges from 17 to 42 days at a temperature of 25°C and a pH of 7. The rate of hydrolysis is temperature dependent (Kingery and Allen 1995). At lower temperatures, the degradation rate of VX decreases by a factor of ten for every 10°C. The degradation rate is also a function of the system pH. For slightly acidic conditions, the hydrolysis half-life is 100 days.

At neutral and alkaline pH values, the principal degradation product of VX is EA2192 (S-(2-diisopropylaminoethyl)methyl phosphonothioate), which is environmentally stable and infinitely soluble in water. Other VX hydrolysis degradation products include EMPA (ethyl methylphosphonic acid) and DESH (diisoproplyethyl mercaptoamine). The half-life of EMPA is 8 days (Munro et al. 1999), with degradation to MPA (methylphosphonic acid). MPA is stable in the environment because it is resistant to hydrolysis, photolysis, and thermal decomposition. It is also very soluble in water and has a low coefficient for sorption onto soil particles. Other physical properties of the degradation products of VX are given in Table A.3.

The LD_{50} via skin contact for VX is 10 mg/kg body weight (Stimson Center 2000). Via inhalation, the LCt_{50} is 50 mg/min/m^3. Little is known about the toxicity of most of the hydrolysis degradation products of VX, although EA2192 retains its anticholinesterase activities. In environmentally relevant situations, EA2192 is not absorbed through the skin and unlikely to be inhaled. Only the oral pathway remains a concern. Its intravenous toxicity is somewhat lower (0.24 to 0.825) than VX. Its oral lethality in rats (630 µg/kg) is about 0.1 to 0.2 that of liquid VX. A conservative proposed reference dose, RfD, calculated by the U.S. Environmental Protection Agency (EPA) for EA2192, is 0.0006 µg/kg per day, which is the RfD for the more potent parent, VX. Although information about other VX degradation products is limited, it appears that none of them display the high acute toxicity of EA2192. Most of this information indicates that the degradation products have low to moderate lethality. A more complete discussion on the lethality of VX degradation products can be found in Munro et al. (1999).

A.3.2 G Agents

There are three principal CW G agents: GA (Tabun), GB (Sarin), and GD (Soman). GA contains a cyanide group; GB and GD contain a fluoride substituent group. GB and GD are methylphosphonofluoridate esters (Munro et al. 1991). Unlike the V agents, the G agents are volatile and present a vapor hazard. GA (Tabun; ethyl dimethylphosphoramidocyanidate or $C_5H_{11}N_2O_2P$) was first prepared by Gerard Schrader in 1934. GB (Sarin; methylethyl methylphosphonofluoridate or $C_4H_{10}FO_2P$) was discovered a little later in 1938. GD (Soman; methylphosphonofluoridate or $C_7H_{16}FO_2P$) was developed in 1944. All of the agents are colorless, odorless liquids that readily volatilize.

All of the G agents have incapacitating effects that occur within 1 to 10 minutes. Lethal effects of GA occur within 10 to 15 minutes, lethal effects for GB occur within 2 to 15 minutes, and lethal effects for GD occur within 1 to 15 minutes (Munro et al. 1999). As does VX, G agents affect the eyes (meiosis, pain, and dim or blurred vision), nose (runny), and chest (tightness). Nausea and vomiting are also possible. When skeletal muscles are reached, twitching and convulsions can occur, followed by fluctuations in the heart rate. Loss of consciousness and seizures can occur within one minute of exposure to high concentrations. Eventual paralysis and death follow (Stimson Center 2000).

In the United States, GA was produced in much smaller quantities than GB and VX. Nonstockpile material in glass ampules (0.07 lb of total material) is stored in a drum at Tooele Army Depot. Stockpiled amounts include 1.41 tons of the agent in two 1-ton containers and 0.64 ton of the

TABLE A.3 Physical Properties of the Degradation Products of VX

Compound	Water Solubility (mg/L)	Log K_{ow}	Log K_{oc}	Vapor Pressure (mmHg)
Ethyl methylphosphonic acid (EMPA)	1.8×10^{-5}	–1.15	0.75	3.6×10^{-4}
S-(2-diisopropylaminoethyl) methylphosphonothioic acid	Infinitely soluble	0.96	1.90	ND
Bis(2-disopropylaminoethyl) sulfide	1.2	4.47	3.81	2.7×10^{-7}
Bis(2-diisopropylaminoethyl) disulfide	9.5	3.48	3.28	5.9×10^{-9}
Ethyl methylphosphonothioic acid	1,100	1.26	2.06	0.043
Diisopropylaminoethanol	1,500	1.08	1.96	1.8
Methylphosphonic acid (MPA)	$>1 \times 10^{6}$	–2.28	0.15	2×10^{-6}
Diethyl dimethylpyro-phosphonate	$>1 \times 10^{6}$	–2.12	0.23	ND

Source: Munro et al. (1999).

thickened agent in two 1-ton containers. GD was also produced in low quantities in the United Sates and is not relevant for the ACWA project. Because of the small quantities of GA and GD produced, and their lack of relevance to the ACWA project, they will not be discussed further in this appendix.

GB is the most volatile of all of the G agents. It has a vapor pressure of 2.10 mmHg and volatility of 22,000 mg/m^3 (Munro et al. 1999). Because it vaporizes so readily, GB is largely a vapor hazard rather than a contact hazard. Because GB is also completely miscible with water, it can pose a threat to water resources.

In the environment, GB is considered to be nonpersistent (Munro et al. 1999). It is volatile, soluble in water, and subject to acid and base hydrolysis. A calculated volatilization half-life for GB is 7.7 hours. The low calculated Henry's Law constant, 5.4×10^{-7} atm $\times$ m^3/mol indicates slow to practically no volatilization from water. At 20°C and a neutral pH, estimates of the hydrolysis half-life of GB range from 46 hours (pH of 7.5) to 461 hours (pH of 6.5). GB is more persistent at low temperatures; an effective hydrolysis half-life of 8,300 hours is estimated for a temperature of 0°C and pH of 6.5. GB hydrolyzes to form isopropyl methylphosphonic acid (IMPA) and hydrofluoric acid. A second, slower process produces MPA.

In soil, GB undergoes hydrolysis, evaporation, and leaching. The phosphonic acid hydrolysis products are subject to biodegradation (Munro et al. 1999). Studies indicate that 90% of GB is lost in the first five days. This loss rate corresponds to an effective half-life of 1.5 days. The half-life for hydrolysis depends on the pH of the receiving water. Measurements of its half-life at a pH of 6.5 range from 193 to 312 hours (Kingery and Allen 1995). GB is more persistent at low temperatures. Newly fallen snow in Norway protected GB droplets from evaporation for periods of two to four weeks. The hydrolysis product IMPA was present up to four weeks later.

The hydrolysis product IMPA is extremely stable. Its predicted half-life is longer than 1,900 years (Munro et al. 1999). Hydrolysis of IMPA produces MPA and isopropyl alcohol. The low vapor pressure of IMPA (0.0034 mmHg at 25°C) limits the possibility of atmospheric contamination. A moderate to high solubility (48 g/L) and a low organic distribution coefficient (K_{oc} = 12) indicate a high potential for migration to groundwater. Because of its low K_{oc} (Table A.3), MPA is also very mobile in the environment and can be readily transported by advection. Additional information on other degradation products of GB are found in Munro et al. (1999).

The LD_{50} for GB is 1,700 mg/kg body weight (Stimson Center 2000). Its LCt_{50} is 100 mg/min/m^3. IMPA has low oral toxicity in rats and mice; it produced only mild skin irritation and no eye irritation in rabbits (Munro et al. 1999). The EPA calculated oral RfD for the hydrolysis degradation product, IMPA, is 0.1 mg/kg/day. The EPA derived an adult lifetime drinking water health advisory value of 0.7 mg/L (Munro et al. 1999). MPA is considered to be a human skin and eye irritant with low to moderate toxicity. A calculated RfD for MPA is 20 μg/kg/day (Munro et al. 1999).

A.3.3 Nerve Agent Summary

Of the nerve agents included in this appendix, VX is environmentally persistent, whereas GB is not. VX is not very volatile, does not evaporate, and is nonvolatile when in water. However, it is moderately to highly soluble in water. VX on the soil degrades by dissolution, followed by hydrolysis. VX in water or underwater dissolves and then hydrolyzes. VX buried in the unsaturated zone or in the saturated groundwater zone dissolves with infiltrating precipitation. Hydrolysis of VX produces the stable and soluble degradation products EA2192 and MPA. Because EA2192 retains its anticholinesterase properties, it can be a potential threat to surface water and groundwater resources. The major pathway of concern for EA2192 is ingestion, since it is not absorbed through the skin and is not likely to be inhaled. As is EA2192, the degradation product MPA is stable and very mobile in the environment. However, MPA is a degradation product of low to moderate toxicity that is primarily a human eye and skin irritant.

GB is a nonpersistent CWA. It volatilizes readily, is miscible with water, and hydrolyzes. GB on the soil degrades by evaporation, dissolution, and hydrolysis. GB in water or underwater vaporizes, dissolves, and hydrolyzes. GB buried in the unsaturated zone or in the saturated groundwater zone vaporizes, dissolves with infiltrating precipitation, and hydrolyzes. The degradation products of GB include IMPA and MPA. IMPA is extremely stable in the environment, with a degradation half-life of about 1,900 years. In addition, it is transported readily by advecting groundwater. However, IMPA, like MPA, is not a major concern with regard to water contamination because of its low toxicity.

A.4 REFERENCES

Fetter, C.W., 1993, *Contaminant Hydrogeology*, MacMillan Publishing Company, New York, N.Y.

Freeze, R.A., and J.A. Cherry, 1979, *Groundwater*, Prentice-Hall, Inc., Englewood Cliffs, N.J.

Kingery, A.F., and H.E. Allen, 1995, "The Environmental Fate of Organophosphorous Nerve Agents: A Review," *Technological and Environmental Chemistry* 47:155–184.

Mitretek, 2000a, *Toxological Properties of Vesicants*, http://www.mitretek.org/mission/envene/chemical/vesicant.html, accessed Oct. 12, 2000.

Mitretek, 2000b, *Chemistry of H (Mustard)*, Mitretek Systems, Inc., McLean, Va., http://www.mitretek.org/mission/envene/chemicals/mustard.html, accessed Oct. 12, 2000.

Mitretek, 2000c, *Toxological Properties of Nerve Agents*, Mitretek Systems, Inc., McLean, Va., http://www.mitretek.org/mission/envene/chemical/toxic.html, accessed Oct. 13, 2000.

Mitretek, 2000d, *A Short History of the Development of Nerve Gases*, Mitretek Systems, Inc., McLean, Va., http://www.mitretek.org/mission/envene/chemical/history/nerve_history.html, accessed Oct. 16, 2000.

Mitretek, 2000e, *Chemistry of VX*, Mitretek Systems, Inc., McLean, Va. http://www.mitretek.org/mission/envene/chemical/agents/ vx.html, accessed Oct. 13, 2000.

Munro, N.B., et al., 1999, "The Sources, Fate, and Toxicity of Chemical Warfare Agent Degradation Products," *Environmental Health Perspectives* 107(12):933–974.

Rosenblatt, D.H., et al., 1995, *Agent Decontamination Chemistry Technical Report*, Phase 1 draft report, prepared for Environmental Quality Office, U.S. Army Test and Evaluation Command (TECOM).

Stimson Center, 2000, *Medical Characteristics of Chemical Warfare Agents*, The Henry L. Stimson Center, Washington, D.C., http://www.stimson.org/?SN=CB2001121893, accessed Oct. 11, 2000.

U.S. Army Center for Health Promotion and Preventive Medicine, 2002, *Detailed Facts about Sulfur Mustard Agent HT*, 218-09-1096, Aberdeen Proving Ground, Md., http://chppm-www.apgea.army.mil/dts/docs/detht.pdf.

APPENDIX B:

METHODOLOGY FOR ASSESSING IMPACTS ON AIR QUALITY FROM CONSTRUCTION AND OPERATION OF AN ACWA PILOT TEST FACILITY

APPENDIX B:

METHODOLOGY FOR ASSESSING IMPACTS ON AIR QUALITY FROM CONSTRUCTION AND OPERATION OF AN ACWA PILOT TEST FACILITY

Air quality modeling analysis consists of estimating emission rates and calculating concentration levels at receptor locations for a series of varying meteorological conditions. Air emissions from construction and operation of neutralization/biotreatment (Neut/Bio), neutralization/supercritical water oxidation (Neut/SCWO), neutralization/gas-phase chemical reduction/transpiring wall supercritical water oxidation (Neut/GPCR/TW-SCWO), and electrochemical oxidation (Elchem Ox) pilot facilities were estimated on the basis of available standard references and site-specific data. These estimates were used to model air concentrations that might occur at potential off-post (general public) and on-post (worker) receptor locations. Estimating emissions associated with construction and operation of an ACWA test facility is discussed in Section B.1, and the air model used, model input data, and assumptions are discussed in Section B.2.

B.1 EMISSION FACTORS AND ASSUMPTIONS USED IN ESTIMATING EMISSIONS

The selection of emission factors and the method of emissions estimating associated with construction and operation of an Assembled Chemical Weapons Assessment (ACWA) pilot test facility are briefly presented. Detailed background information is provided in Kimmel et al. (2001).

B.1.1 Construction-Related Emissions

To determine potential impacts on ambient air quality from fugitive dust emissions during earth-moving activities, emissions of PM_{10} and $PM_{2.5}$[1] were estimated by using an average fugitive dust emission factor of 1.2 tons/acre/month (Section 13.2.3 of EPA 2000a) and the acreage of land expected to be disturbed during construction.

For each ACW destruction system proposed for pilot testing, the land disturbance for construction of the proposed pilot facility and supporting infrastructure was estimated. Fugitive dust emissions were estimated on the basis of the assumption that a phased approach would be used for construction. Construction of utility lines would most likely occur during the first phase of construction, but only a small area would be worked on at any particular time. The construction of utility lines would be followed by the construction of the pilot test facility.

[1] PM = particulate matter. PM_{10} = coarse, inhalable PM with a mean aerodynamic diameter of 10 µm or less. $PM_{2,5}$ = fine, inhalable PM with a mean aerodynamic diameter of 2.5 µm or less.

Fugitive dust emissions during this latter period of construction, when more land surface would be disturbed at one time, were analyzed in the air quality modeling.

It was assumed that 30% of the estimated fugitive dust emissions would be PM_{10} (EPA 1988) and 15% would be $PM_{2.5}$ (Kinsey and Cowherd 1992). It was also assumed that conventional dust control measures (e.g., frequent sprinkling of water over disturbed areas) would reduce emissions by about 50% (EPA 2000a).

B.1.2 Operational Emissions

To determine potential impacts on air quality resulting from operation of the proposed ACWA pilot test facility, emissions of criteria pollutants and volatile organic compounds (VOCs) from boilers and emergency generators, along with those from the process gas burner in the case of Neut/GPCR/TW-SCWO, were estimated.

The emission rates of criteria pollutants and VOCs for the operational period were estimated on the basis of the estimated annual consumption rates of fuels. These annual consumption rates of fuel (assumed to be natural gas) required to operate the various ACWA technologies in turn were estimated on the basis of the unit quantity needed to dispose each munition type and agent, and annual throughput capacity of an ACWA facility at each site.

The emission rates of criteria pollutants and VOCs for normal boiler operations were estimated with the FIRE 6.22 emission factor program for large wall-fired boilers with greater than 100 million Btu/h of heat input (EPA 2000b).

The emission rates of criteria pollutants and VOCs for emergency generator operations were estimated with the FIRE 6.22 emission factor program for reciprocating diesel engines (EPA 2000b) and the fuel consumption rate. The annual consumption rate for emergency generators was estimated by assuming (1) 600 hours of generator operations per year and (2) the hourly consumption for actual generator operations at Aberdeen Proving Ground (1997).

In the case of Neut/GPCR/TW-SCWO, emissions of criteria pollutants and VOCs from the product gas burner were estimated on the basis of data on the flue gas composition measured during demonstration testing and data on the flow rate from the stack exit derived from the disposal rates of ACWs (Kimmel et al. 2001).

B.2 AIR QUALITY MODEL, MODEL INPUT DATA, AND ASSUMPTIONS USED IN AIR QUALITY IMPACT ANALYSIS

B.2.1 Air Quality Model

The Industrial Source Complex Short-Term 3 (ISCST3) model (version 00101; EPA 1995), a steady-state Gaussian plume dispersion model recommended by EPA for use in a wide range of regulatory applications, was used to estimate potential impacts on ambient air quality. All regulatory default options (e.g., stack-tip downwash, buoyancy-induced dispersion, final plume rise) were selected for the analysis. In accordance with EPA's requirements, direction-specific building dimensions were included for all building downwash algorithms using EPA's building profile input program (BPIP) (EPA 1993). Building information for a proposed facility was obtained from the technology provider report (Kimmel et al. 2001).

B.2.2 Meteorological Data

Meteorological data used in air quality modeling included surface data (wind direction and speed, ambient temperature, atmospheric stability) and twice-daily mixing-height data. These meteorological data were preprocessed with the EPA's PCRAMMET program for use in short-term dispersion models (EPA 1999).

On-site surface meteorological data were available for all four sites (Anniston Army Depot [ANAD], Blue Grass Army Depot [BGAD], Pine Bluff Arsenal [PBA], and Pueblo Chemical Depot [PCD]) from Demil and/or Chemical Stockpile Emergency Preparedness Program (CSEPP) towers (Rhodes 2000). The Demil towers meet U.S. Environmental Protection Agency (EPA) siting criteria, and their instrumentation and associated data were checked for quality assurance/quality control (QA/QC). The QA/QC procedures for the data from CSEPP towers are not as comprehensive as those for the Demil towers. Accordingly, Demil tower data collected at a 10-m level were used for the modeling analysis for ANAD, BGAD, and PCD. Because the PBA has no Demil tower, the surface meteorological data collected from the Little Rock/Adams Field Airport at the 6.1-m level were used for the analysis. The hourly surface data for the PBA used were those from the hourly U.S. weather observations (HUSWO) CD-ROM available from the National Climatological Data Center in Asheville, North Carolina.

The Demil tower data contain two types of stability class data — one using wind fluctuation statistics (σ_E) methodology and the other using solar radiation/delta-T (SRDT) methodology. The EPA has not expressed any preference between the two. To be consistent with previous studies, the former was used in the modeling analysis for this assessment.

Twice-daily mixing height data collected at the nearest station in a climatological regime similar to the site of concern were processed for the same period as surface meteorological data. Locations and years for mixing height and surface meteorological data used in the modeling analysis are presented in Table B.1.

B.2.3 Receptor Location Data

Three types of receptors were defined — on-site receptors, site boundary receptors, and off-site receptors. On-site receptors were established to assess air quality impacts for on-site workers resulting from routine emissions of hazardous air pollutants (HAPs). Site boundary and off-site receptors were established to assess air quality impacts to the general public from routine HAPs emissions and construction and operation emissions of criteria pollutants. Irregularly spaced Cartesian receptor grids were developed for on-site and off-site receptors up to 31 mi (50 km) from the center of the proposed pilot test facility. The grid intervals range from 164 ft (50 m) around the ACWA facility to 3.1 mi (5 km) outside the 6.2-mi (10-km) radius from the center of the ACWA facility (see Figures B.1 through B.4). In addition, receptors were set at 328 ft (100 m) apart along the site boundary near the ACWA facility and 984 to 1,640 ft (300 to 500 m) apart along the site boundary far from the ACWA facility.

B.2.4 Terrain Data

To reflect the effects of terrain features, the terrain data for the source and receptor locations were input to the model. Elevations for source and receptor locations were read from the electronic data in the U.S. Geological Survey (2001) 1:24,000 scale (7.5-minute series) digital elevation model (DEM).

TABLE B.1 Locations and Years of Surface Meteorological Data and Mixing Height Data Used in Air Quality Modeling

Location	Surface Data Site	Mixing Height Data Site	Year
ANAD	On site	Birmingham, Ala.	1999
BGAD	On site	Wilmington, Ohio	1999
PBA	Little Rock, Ark.	N. Little Rock, Ark.	1991–1995
PCD	On site	Denver Stapleton Int’l. Airport, Colo.	1998

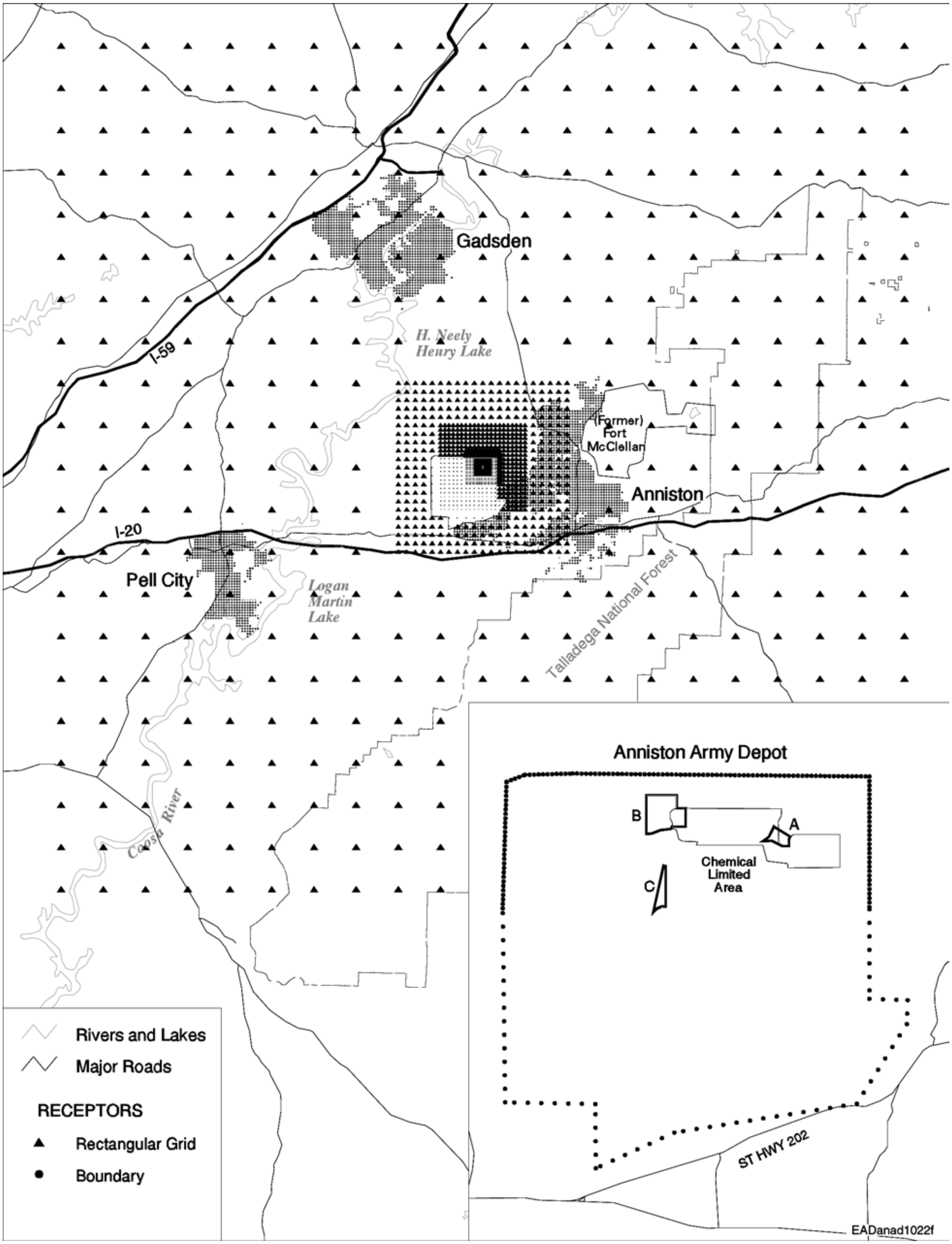

FIGURE B.1 Locations of Receptors Used in Air Quality Modeling at ANAD

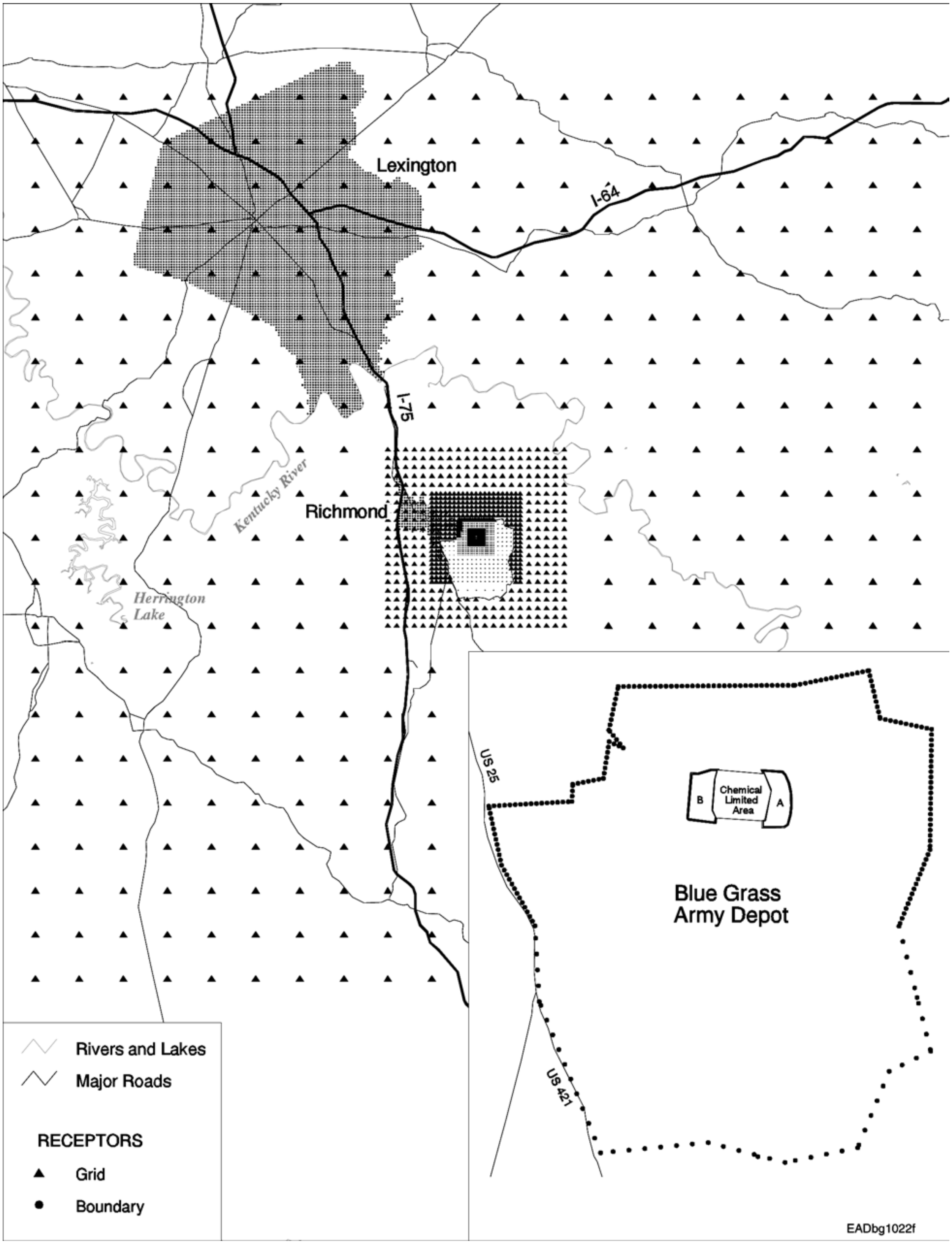

FIGURE B.2 Locations of Receptors Used in Air Quality Modeling at BGAD

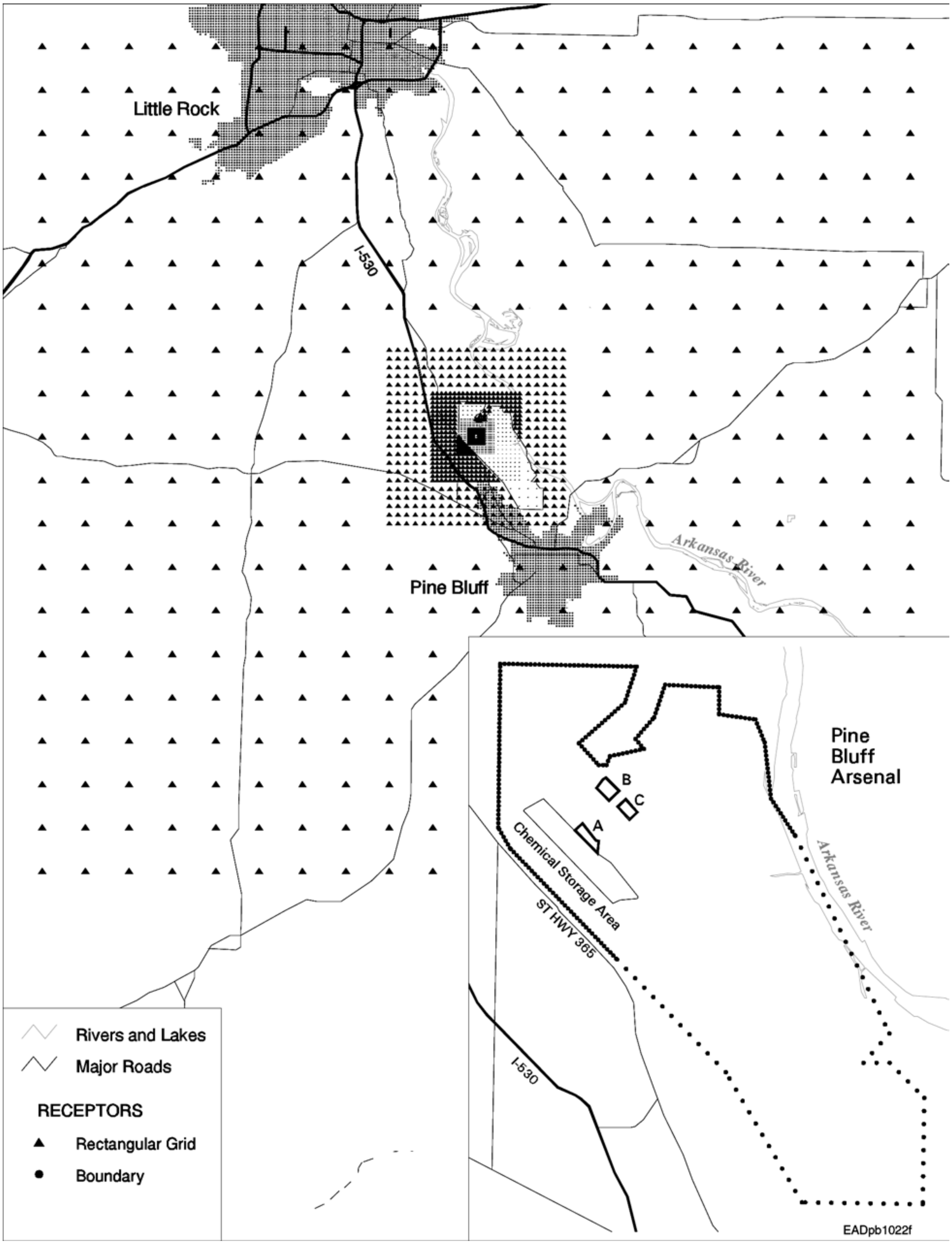

FIGURE B.3 Locations of Receptors Used in Air Quality Modeling at PBA

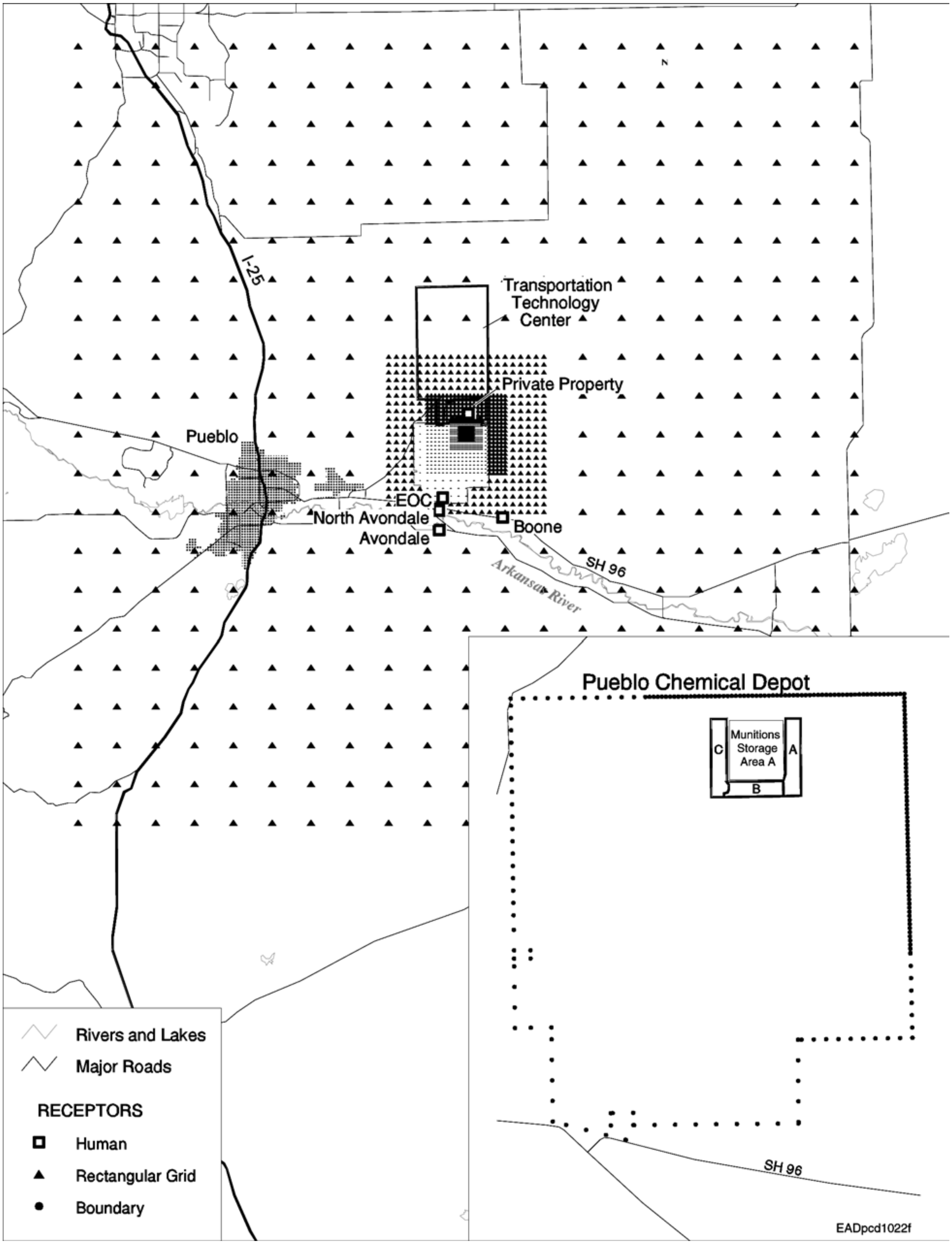

FIGURE B.4 Locations of Receptors Used in Air Quality Modeling at PCD

B.2.5 Other Assumptions

For modeling potential air quality impacts during construction and/or operational periods, the following assumptions were made:

- Construction activities would occur during one daytime 8-hour shift (8 a.m.–noon and 1 p.m.–5 p.m.).

- Rates of dust emissions from the construction site would be constant over the construction area and time.

- Settling of airborne particles due to gravity and removal by dry/wet deposition would be negligible.

- Areas between the pilot test facility site and receptor locations would be in a “rural” setting.

For the operational periods, short-term average (1-hour, 3-hour, 8-hour and 24-hour) pollutant concentrations were conservatively estimated by assuming that boiler and emergency diesel generators (and the process gas burner in case of the Neut/GPCR/TW-SCWO) would operate simultaneously at their peak load. For long-term (annual) average concentrations, annual average emission rates for these emissions sources were used.

B.3 REFERENCES FOR APPENDIX B

Aberdeen Proving Ground, 1997, *Application for Permit to Construct the U.S. Army Aberdeen Proving Ground Chemical Agent Disposal Facility*, May.

EPA: see U.S. Environmental Protection Agency.

Kimmell, T.A., et al., 2001, *Technology Resource Document for the Assembled Chemical Weapons Assessment Environmental Impact Statement*, ANL/EAD/TM-101, Vols. 1–5 and errata, Argonne National Laboratory, Argonne, Ill.

Kinsey, J.S., and C. Cowherd, Jr., 1992, “Fugitive Dust,” in *Air Pollution Engineering Manual*, A.J. Buonicore and W.T. Davis (editors), Van Nostrand Reinhold, New York, N.Y.

Rhodes, M., 2000, e-mail from Rhodes (University of Illinois, Urbana, Ill.) to Y.-S. Chang (Argonne National Laboratory, Argonne, Ill.), Sept. 1.

U.S. Environmental Protection Agency, 1988, *Gap Filling PM_{10} Emission Factors for Selected Open Area Dust Sources*, EPA-450/4-88-003, Office of Air Quality Planning and Standards, Research Triangle Park, N.C., Feb.

U.S. Environmental Protection Agency, 1993, *User's Guide to the Building Profile Input Program*, EPA-454/R-93-038, Office of Air Quality Planning and Standards, Research Triangle Park, N.C., Oct.

U.S. Environmental Protection Agency, 1995, *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models*, EPA-454/B-95-003a and updated model (Version 00101), Office of Air Quality Planning and Standards, Research Triangle Park, N.C., Sept.

U.S. Environmental Protection Agency, 1999, *PCRAMMET User's Guide*, EPA-454/B-96-001, Office of Air Quality Planning and Standards, Research Triangle Park, N.C., June.

U.S. Environmental Protection Agency, 2000a, *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources*, Office of Air Quality Planning and Standards, Clearinghouse for Inventories and Emission Factors (CHIEF), TTNWeb, http://www.epa.gov/ttn/chief/ap42/index.html.

U.S. Environmental Protection Agency, 2000b, *Factor Information REtrieval (FIRE) Data System*, version 6.23, http://www.epa.gov/ttn/chief/software/fire/index.html.

U.S. Geological Survey, 2001, *USGS Digital Elevation Models (DEM)*, 7.5-Minute Models, http://data.geocomm.com/dem.

APPENDIX C:

METHODOLOGY FOR ASSESSING IMPACTS ON HUMAN HEALTH FROM AIR EMISSIONS DURING ROUTINE OPERATIONS

APPENDIX C:

METHODOLOGY ASSESSING IMPACTS ON HUMAN HEALTH FROM AIR EMISSIONS DURING ROUTINE OPERATIONS

Air emissions from operating the neutralization/biotreatment (Neut/Bio), neutralization/supercritical water oxidation (Neut/SCWO), neutralization/gas-phase chemical reduction/transpiring wall SCWO (Neut/GPCR/TW-SCWO), and electrochemical oxidation (Elchem Ox) pilot facilities were estimated on the basis of demonstration test data (Mitretek 2001a–d). These estimates were used to model air concentrations of contaminants that might occur at potential off-post (general public) and on-post (worker) receptor locations (Section C.1). Estimated inhalation exposures of receptors to these contaminants in air were then combined with chemical-specific toxicity data to estimate the potential for adverse health impacts (Section C.2) The potential impacts of chemicals for which no quantitative toxicity estimates were available are also discussed (Section C.3).

C.1 ESTIMATED TOXIC AIR POLLUTANT EMISSIONS AND CONCENTRATIONS

For each of the technology systems evaluated, emissions from diesel generators and boilers were estimated on the basis of standard algorithms that used estimated fuel consumption as input (Kimmell et al. 2001). For the destruction facility stacks (i.e., filter farm stack, SCWO vent, biotreatment vent, product gas burner vent, catalytic oxidation [CatOx] unit/filter farm stack vent), emission estimates were based on post-specific munitions inventories and demonstration test data compiled by Mitretek Corp. (2001a–d). However, demonstration testing was not conducted for each system component (e.g., for baseline reverse assembly). Furthermore, in some instances, demonstration configurations differed significantly from the likely configuration of a full-scale unit, so certain demonstration test data were not considered useful in predicting emissions for specific process components (e.g., fluid abrasive cutting, fluid mining, and energetics hydrolysis processes for Neut/Bio [Mitretek 2001a]; projectile rotary hydrolyzer and dunnage shredder/hydropulper system for Neut/SCWO [Mitretek 2001b]). Therefore, the estimated emissions for each technology should be considered only indicative of potential emissions from the complete system. Estimates may be revised as facility designs are finalized and more system testing is conducted.

Estimated daily emission rates of toxic air pollutants for each technology system are provided in the Technology Resource Document (TRD; Kimmell et al. 2001). The emissions were estimated by dividing the maximum concentration of each substance detected during demonstration testing by the estimated total air flow for the stack (Mitretek 2001a–d). For organic emissions, these before-treatment estimates were then multiplied by a reduction factor to account for passing the effluent through a series of six carbon filters, each with a removal efficiency of 95%. For inorganic substances (e.g., metals, dioxins, furans), it was assumed that two high-efficiency particulate air (HEPA) filters with removal efficiencies of 99.97% would be used for treatment.

For a Neut/Bio facility, it is not known whether the emissions from the biotreatment vent would require further treatment. The provider of the equipment used during the technology demonstrations for Neut/Bio has stated that further treatment would not be necessary. In this assessment, both treatment and no treatment of biotreatment vent stack emissions were assessed. For a Neut/GPCR/TW-SCWO facility, it was assumed that emissions from the product gas burner vent would not be further treated after release from the facility's scrubber system.

Polychlorinated biphenyls (PCBs) have been identified as a constituent in the firing tubes of M55 rockets. However, PCBs were not tested as part of the ACWA demonstration project, because doing so would have triggered regulatory requirements under the *Toxic Substances Control Act* (TSCA). Meeting those requirements would have added considerably to the cost and difficulty of the demonstration (PMACWA 1999). Instead, demonstration tests were conducted with wood spiked with pentachlorophenol (PCP, a chlorinated substance similar to PCBs). Results showed degradation of the PCP in the test systems, indicating that PCBs would also likely be destroyed. Pilot testing of M55 rocket destruction systems would be conducted to comply with appropriate TSCA regulations on PCB monitoring and control. For the purposes of this assessment, it was assumed that the technology systems evaluated would achieve a PCB destruction efficiency of 99.9999%. For filtered stacks (i.e., CatOx/filter farm stack, SCWO stack, but not the product gas burner vent), further removal by carbon filtration was also assumed. These assumptions were not applicable for the Neut/Bio technology system, which only addresses ACW containing mustard (M55 rockets do not contain mustard).

For each emission source for each installation, the maximum on-post and off-post concentration locations were identified through air modeling. At each of the four stockpile locations, the proposed location for the ACWA facility that would result in the largest off-post concentrations was selected as the source location for modeling. This location was Area A for Anniston Army Depot (ANAD), Pine Bluff Arsenal (PBA), and Pueblo Chemical Depot (PCD) and Area B for Blue Grass Army Depot (BGAD). The Industrial Source Complex Short-Term 3 (ISCST3) model (U.S. Environmental Protection Agency [EPA] 1995) was used in conjunction with location-specific meteorological and topographical data and facility footprint information to generate on-post and off-post multipliers for each ACWA facility emission source (e.g., diesel generators, filter farm stack). The installation- and inventory-specific emission estimates were then multiplied by these factors to generate estimates of on-post and off-post maximum annual average concentrations attributable to each emission source for each ACWA technology system.

As a simplification useful for generating exposure estimates, it was assumed that the chemical-specific on-post and off-post air concentration estimates from each source (i.e., generators, boilers, and destruction facility stacks) could be added together to yield one maximum annual average on-post or off-post concentration. This procedure is equivalent to assuming that the stacks for each of these sources would be in the same location. This assumption would result in somewhat overestimated air concentration estimates. In actuality, the concentrations would be lower than estimated, because the fact that emissions would be from sources that are close together, but not at exactly the same location, would result in some dilution.

To account for possible fluctuating conditions that could occur during operations, it was assumed that for 5% of the time the levels of organic compounds would be 10 times higher than the estimated annual average, and that for 20% of the time the levels of inorganic compounds would be 10 times higher than the estimated annual average. These assumptions were based on EPA guidance (EPA 1994, as cited in National Research Council 1997). The maximum annual average levels, increased to take fluctuating operations into account, were used as the input levels for exposure and risk assessment (see Section C.2).

No estimates of potential emission levels of the agents GB, VX, and mustard were available from demonstration testing. To assess potential impacts from low-level agent emissions during routine operations, it was assumed that an agent could hypothetically be continuously emitted from the stacks at the detection limits (0.06 $\mu g/m^3$ for GB and VX and 6 $\mu g/m^3$ for mustard; Kimmell et al. 2001). In practice, the facility stacks would be equipped with continuous agent-monitoring devices that would sound if any agent were detected. The source would then be identified and eliminated. If agent were released from pilot facility processes, it is highly unlikely that it would be present continuously at a level just below the detection limit. A more likely scenario would be the occurrence of a short-term release at a level above the detection limit that could be detected and corrected.

A complete compilation of the estimated maximum annual average on-post and off-post concentrations of the various detected compounds associated with pilot testing of the four ACWA technology systems is provided in backup documentation for this environmental impact statement (Hartmann and Nieves 2001).

C.2 EXPOSURE AND RISK ESTIMATION

The estimated maximum annual average on-post and off-post contaminant air concentrations (Section C.1) were used to estimate exposures (intakes) by inhalation for hypothetical “maximum exposed individuals” (MEIs). Estimates for on-post exposures assumed the receptor would be a worker. The rationale for this assumption was that even though some residences are located on-post at the ACW storage locations, the maximum on-post airborne contaminant concentrations would occur quite close to the proposed pilot facility sites, where no residences are located. MEI worker exposure parameters assumed that the receptor was present at the location of maximum on-post air concentration for 8 hours per day, 250 days per year. For off-post general public exposures, the MEI receptor was assumed to be a resident present at the off-post location of maximum air concentration for 24 hours per day, 365 days per year. For cancer risk calculations, the number of years of exposure is used in estimating the total excess cancer risk. Since the length of pilot testing operations is unknown for each of the storage locations and technology systems evaluated, a worst-case assumption was made that the exposure could occur for the length of time required to process the entire inventory. Specifically, the exposure duration assumptions were 9.1 years for ANAD, 1.8 years for PBA, 1.6 years for BGAD, and 2.7 years for PCD. These assumptions resulted in overestimates of cancer risk from the inhalation pathway for each technology at each site, since pilot testing would certainly occur over a shorter length of time.

This assessment was limited to the estimation of risks associated with inhalation of emitted substances. For some of the emitted substances (e.g., dioxins and furans, PCBs), exposure through other pathways, such as food-chain pathways or incidental soil ingestion, could be as large or larger than exposure through inhalation. Estimates of exposure through these other pathways can be highly uncertain and are beyond the scope of this evaluation. However, for all the technologies, the estimated emission rates for these substances are quite low (less than 0.00001 lb/yr for all forms of dioxins and furans and about 0.005 lb/yr or less for PCBs). For the purposes of this assessment (i.e., to compare the risks associated with pilot testing of the alternate ACWA technology systems), estimation of the risk associated with inhalation should be indicative of risk from all pathways.

The equation used to estimate inhalation intakes is as follows:

$$\text{Intake (mg/kg/d)} = (CA \times IR \times ET \times EF \times ED)/(BW \times AT),$$

where

CA = contaminant concentration in air (mg/m^3),

IR = inhalation rate (m^3/hr),

ET = exposure time (h/d),

EF = exposure frequency (d/yr),

ED = exposure duration (yr),

BW = body weight (70 kg), and

AT = averaging time (ED × 365 d/yr for noncarcinogenic effects; 70 × 365 d/yr for carcinogenic effects.

Exposure (intake) estimates were compared with cancer and noncancer toxicity values to generate estimates of increased cancer risk and of the potential for noncancer health impacts to the receptors. Cancer toxicity values (termed slope factors, in units of $[mg/kg/d]^{-1}$) and noncancer toxicity values (termed references doses, in units of mg/kg/d) used in this assessment were obtained from the EPA's Integrated Risk Information System (IRIS) (EPA 2000) for those chemicals included in that system. However, no slope factor or reference dose was available from IRIS for many of the chemicals detected during demonstration testing. For those substances, other sources of quantitative toxicity data (Smith et al. 1999; EPA 1997) were used in an effort to thoroughly estimate the risk associated with ACWA facility emissions. Still, many substances did not have quantitative toxicity data available from any of these sources (see Section C.3).

Toxicity values are specific to either inhalation exposure or oral exposure, but significantly fewer values are available for inhalation than for oral exposure. Again, in an effort to thoroughly estimate risks, when inhalation toxicity values were not available for a given chemical, oral slope factors or reference doses were used.

Table C.1 gives the complete list of substances detected during ACWA demonstration testing for the four technology systems and lists toxicity values used for risk estimation. The sources of those values are also provided. The complete compilation of substance- and technology-specific intake and risk estimates for on-post and off-post MEI receptors for each of the four storage locations is provided in backup documentation for this EIS (Hartmann and Nieves 2001).

Mustard is the only chemical agent present in ACW that is considered to be a carcinogen; GB and VX are not. Mustard has been classified as a known carcinogen (Agency for Toxic Substances and Disease Registry [ATSDR] 1992). Evidence of its carcinogenicity is indicated by (1) increased cancer incidence among factory workers who made mustard gas and other chemical agents; (2) a slight, but statistically significant, increased incidence of lung cancer deaths among World War I veterans exposed to mustard during combat (those studies did not control for cigarette smoking); and (3) two animal studies showing increased incidence of pulmonary tumors (ATSDR 1992). None of those studies was sufficiently extensive to establish a dose/response relationship for mustard-induced cancers.

The available data have generally been considered inadequate to estimate the carcinogenic potency (i.e., carcinogenic risk) of mustard (CDC 1988; ATSDR 1992). Nonetheless, because of a need to estimate potential risks to populations residing near military sulfur mustard stockpile locations, the EPA did use the available (although inadequate) data to estimate a carcinogenic unit risk for mustard inhalation of 0.085 $(\mu g/m^3)^{-1}$ (EPA 1991). However, risk estimates generated from this value must be considered highly uncertain.

The typical benchmark indicator for a significant noncarcinogenic health risk is a hazard index (HI) greater than 1. The benchmark indicator for a significant increased lifetime carcinogenic risk is in the range of 1×10^{-6} and 1×10^{-4} (one in 1 million to one in 10,000), which is the target used by the EPA to determine whether cleanup of hazardous waste sites is warranted (EPA 1990). Any increased carcinogenic risk of less than 1×10^{-6} is generally

TABLE C.1 Toxicity Values for All Detected Substances for the Four Technology Systems

Chemical	Inhalation Unit Risk $(\mu g/m^3)^{-1}$	Inhalation Slope Factor $(mg/kg/d)^{-1}$	Notes[a]	Inhalation Reference Concentration (mg/m^3)	Inhalation Reference Dose (mg/kg/d)	Notes[a]	Technology System[b]
(R)-(-)-2,2-Dimethyl-1,3-dioxolane-4-methanol	-[c]	-		-	-	-	3
1,1,1-Trichloroethane	-	-	-	1	2.9×10^{-1}	J; CA	1, 3
1,1-Dichloroethene	-	-	-	2.0×10^{-2}	5.7×10^{-3}	J; CA	4
1,2,3,4,6,7,8,9-OCDD	3.3×10^{-2}	1.2×10^{2}	B	-	1.0×10^{-6}	B	1
1,2,3,4,6,7,8,9-OCDF	3.3×10^{-2}	1.2×10^{2}	B	-	1.0×10^{-6}	B	1
1,2,3,4,6,7,8-HpCDD	3.3×10^{-1}	1.2×10^{3}	B	-	1.0×10^{-7}	B	1, 3
1,2,3,4,6,7,8-HpCDF	3.3×10^{-1}	1.2×10^{3}	B	-	1.0×10^{-7}	B	1, 3
1,2,3,4,7,8,9-HpCDF	3.3×10^{-1}	1.2×10^{3}	B	-	1.0×10^{-7}	B	1
1,2,3,4,7,8-HxCDD	3.3	1.2×10^{4}	B	-	1.0×10^{-8}	B	1
1,2,3,4,7,8-HxCDF	3.3	1.2×10^{4}	B	-	1.0×10^{-8}	B	1, 3
1,2,3,6,7,8-HxCDD	3.3	1.2×10^{4}	B	-	1.0×10^{-8}	B	1, 3
1,2,3,6,7,8-HxCDF	3.3	1.2×10^{4}	B	-	1.0×10^{-8}	B	1, 3
1,2,3,7,8,9-HxCDD	3.3	1.2×10^{4}	B	-	1.0×10^{-8}	B	1, 3
1,2,3,7,8,9-HxCDF	3.3	1.2×10^{4}	B	-	1.0×10^{-8}	B	1
1,2,3,7,8-PeCDD	1.7×10^{1}	5.8×10^{4}	B	-	2.0×10^{-9}	B	1, 3
1,2,3,7,8-PeCDF	1.7	5.8×10^{3}	B	-	2.0×10^{-8}	B	1
1,2,4-Trimethylbenzene	-	-	B	-	-	-	3
1,2-Dichloroethane	2.6×10^{-5}	9.1×10^{-2}	-	8.1×10^{-1}	2.3×10^{-1}	J; AT	1
1,2-Dichloropropane	4.0×10^{-3}	14	-	4.0×10^{-3}	1.2×10^{-3}	-	1
1,3-Butadiene	2.8×10^{-4}	9.8×10^{-1}	-	8.0×10^{-3}	2.3×10^{-3}	J; CA	1, 2, 3, 4
1,4-Dichlorobenzene	-	-	-	8.0E-01	2.3×10^{-1}	-	1, 3
1,5-Pentanediol, dinitrate	-	-	-	-	-	-	4
1-Butanol, 3-methyl-, nitrate	-	-	-	-	-	-	4
1-Ethyl-2,2,6-trimethylcyclohexane	-	-	-	-	-	-	3
1-Hexanol, 2-ethyl-	-	-	-	-	-	-	3
1H-Indene	-	-	-	-	-	-	3
1H-Indene, 2,3-dihydro-	-	-	-	-	-	-	3
1-Propene, 3,3,3-trichloro-	-	-	-	-	-	-	3
2-(2-Butoxyethoxy) ethanol	-	-	-	-	-	-	3
2,3,4,6,7,8-HxCDF	3.3	1.2×10^{4}	B	-	1.0×10^{-8}	B	1
2,3,4,7,8-PeCDF	1.7×10^{-1}	5.8×10^{4}	B	-	2.0×10^{-9}	B	1, 3
2,3,7,8-TCDD	33	1.2×105	J; HE	-	1.0×10^{-9}	A	1
2,3,7,8-TCDF	3.3	1.2×10^{4}	B	-	1.0×10^{-8}	B	1, 3
2,4-Dimethylphenol	-	-	-	-	-	-	3
2-Butanone	-	-	-	1	2.9×10^{-1}	J	3
2-Heptanone	-	-	-	-	-	-	4
2-Hexanone	-	-	-	-	-	-	4
2-Methylnaphthalene	-	-	-	-	-	-	1, 2, 3, 4
2-Nitrophenol	-	-	-	-	-	-	3
2-Octanone	-	-	-	-	-	-	4
2-Pentanol, nitrate	-	-	-	-	-	-	4
3/4-Methy phenol	-	-	-	-	5.0×10^{-2}	A	1
3-Methylchloranthrene	2.1×10^{-3}	7.4	J; CA	-	-	-	1, 2, 3,4
4-Methyl-2-pentanone	-	-	-	-	-	-	4

TABLE C.1 (Cont.)

Chemical	Inhalation Unit Risk $(\mu g/m^3)^{-1}$	Inhalation Slope Factor $(mg/kg/d)^{-1}$	Notes[a]	Inhalation Reference Concentration (mg/m^3)	Inhalation Reference Dose (mg/kg/d)	Notes[a]	Technology System[b]
4-Octene, (E)-	-	-	-	-	-	-	4
9H-Fluoren-9-one	-	-	-	-	-	-	3
Acenaphthene	-	-	-	-	6.0×10^{-2}	A; J	1, 2, 3,4
Acenaphthylene	-	-	-	-	-	-	1, 2, 3, 4
Acetaldehyde	2.2×10^{-6}	7.7×10^{-3}	-	9.0×10^{-3}	2.6×10^{-3}	-	1, 2, 3, 4
Acetamide, N,N-dimethyl-	-	-	-	-	-	-	4
Acetic acid	-	-	-	-	-	-	3, 4
Acetone	-	-	-	-	1.0×10^{-1}	A; J	3, 4
Acrolein	-	-	-	2.0×10^{-5}	5.7×10^{-6}	-	1, 2, 3, 4
Aldehydes	-	-	-	-	-	-	1, 2, 3, 4
Aluminum	-	-	-	-	-	-	3
Anthracene	-	-	-	-	3.0×10^{-1}	A	1, 2, 3, 4
Antimony	-	-	-	2.0×10^{-4}	5.7×10^{-5}	-	2, 3
Arsenic	4.3×10^{-3}	1.5×10^{1}	-	3.0×10^{-5}	8.6×10^{-6}	J; CA	1, 2, 3, 4
Barium	-	-	-	-	7.0×10^{-2}	A	1, 2, 3, 4
Benz(a)anthracene	1.1×10^{-4}	4.0×10^{-1}	J; CA	-	-	-	1, 2, 3, 4
Benzaldehyde	-	-	-	-	1.0×10^{-1}	A; J	3
Benzaldehyde, 4-ethyl-	-	-	-	-	-	-	3
Benzaldehyde, ethyl-	-	-	-	-	-	-	3
Benzaldehyde, ethyl- benzenemethanol, 4-(1-methylethyl)	-	-	-	-	-	-	3
Benzene	7.8×10^{-6}	2.7×10^{-2}	-	6.0×10^{-2}	1.7×10^{-2}	-	1, 2, 3, 4
Benzene, 1,2,3-trimethyl-	-	-	-	-	-	-	3
Benzene, 1,2,4,5-tetramethyl-	-	-	-	-	-	-	3
Benzene, 1-methyl-2-propyl-	-	-	-	-	-	-	3
Benzene, 1-methyl-3-propyl-	-	-	-	-	-	-	3
Benzo(a)pyrene	1.1×10^{-3}	3.9	J; CA	-	-	-	1, 2, 3, 4
Benzo(b)fluoranthene	1.1×10^{-4}	4.0×10^{-1}	J; CA	-	-	-	1, 2, 3, 4
Benzo(g,h,i)perylene	-	-	-	-	-	-	1, 2, 3, 4
Benzo(k)fluoranthene	1.1×10^{-4}	4.0×10^{-1}	J; CA	-	-	-	1, 2, 3, 4
Benzyl alcohol	-	-	-	-	-	-	3
Beryllium	2.4×10^{-3}	8.4	-	2.0×10^{-5}	5.7×10^{-6}	-	1, 2, 3, 4
Bis (2-chloroethyl) ether	3.3×10^{-4}	1.2	-	NA[c]	-	-	1
Bis (2-ethylhexyl) phthalate	2.4×10^{-6}	8.4×10^{-3}	J; CA	1.0×10^{-2}	2.9×10^{-3}	J; CA	1, 3, 4
Bromomethane	-	-	-	5.0×10^{-3}	1.4×10^{-3}	-	1
Butanal	-	-	-	-	-	-	3
Butane	-	-	-	-	-	-	1, 2, 3, 4
C3-Alkyl benzenes	-	-	-	-	-	-	3
Cadmium	1.8×10^{-3}	6.3	-	1.0×10^{-5}	2.9×10^{-6}	J; CA	1, 2, 3, 4
Calcium	-	-	-	-	-	-	3
Carbon disulfide	-	-	-	7.0×10^{-1}	2.0×10^{-1}	-	1, 3, 4
Carbon tetrachloride	1.5×10^{-5}	5.3×10^{-2}	-	4.0×10^{-2}	1.1×10^{-2}	J; CA	1
Chlorobenzene	-	-	-	2.0×10^{-2}	5.7×10^{-3}	J; HE	1
Chloroethane	-	-	-	10	2.9	J	1, 4
Chloroform	2.3×10^{-5}	8.1×10^{-3}	J	1.0×10^{-1}	2.8×10^{-2}	J; AT	1, 3, 4

TABLE C.1 (Cont.)

Chemical	Inhalation Unit Risk $(\mu g/m^3)^{-1}$	Inhalation Slope Factor $(mg/kg/d)^{-1}$	Notes[a]	Inhalation Reference Concentration (mg/m^3)	Inhalation Reference Dose (mg/kg/d)	Notes[a]	Technology System[b]
Chloromethane	1.8×10^{-6}	6.3×10^{-3}	HE	1.0×10^{-1}	2.9×10^{-2}	J; AT	1, 4
Chromium	1.2×10^{-2}	4.2×10^{1}	-	1.0×10^{-4}	2.9×10^{-5}	-	1, 2, 3, 4
Chrysene	1.1×10^{-5}	3.9×10^{-2}	J; CA	-	-	-	1, 2, 3, 4
Cobalt	-	-	-	-	-	-	1, 2, 3, 4
Copper	-	-	-	-	-	-	1, 2, 3, 4
Cyclododecane	-	-	-	-	-	-	3
Cyclohexane, 1,2,3-trimethyl-	-	-	-	-	-	-	4
Cyclohexane, 2-butyl-1,1,3-trimethyl-	-	-	-	-	-	-	3
Cyclohexane, butyl-	-	-	-	-	-	-	3
Cyclohexane, hexyl-	-	-	-	-	-	-	3
Cyclohexane, propyl-	-	-	-	-	-	-	3
Cyclohexanol	-	-	-	-	-	-	3
Cyclohexanone	-	-	-	-	5.0	A; J	3
Cyclohexasiloxane, dodecamethyl-	-	-	-	-	-	-	3
Cyclotetrasiloxane, octamethyl-	-	-	-	-	-	-	3, 4
Decane	-	-	-	-	-	-	3, 4
Decane, 2,6,7-trimethyl-	-	-	-	-	-	-	3
Decane, 2-methyl-	-	-	-	-	-	-	3
Decane, 3-methyl-	-	-	-	-	-	-	3
Decane, 4-methyl-	-	-	-	-	-	-	3
Decane, 5-methyl-	-	-	-	-	-	-	3
Decanenitrile	-	-	-	-	-	-	4
Dibenz(a,h)anthracene	3.9×10^{-4}	1.4	J; CA	-	-	-	1, 2, 3, 4
Dibenzofuran	-	-	-	-	-	-	1, 3
Dichlorobenzene	-	-	-	8.0×10^{-1}	2.3×10^{-1}	-	1, 2, 3, 4
Diethylene glycol	-	-	-	-	-	-	3
Diethylphthalate		-	-	-	8.0×10^{-1}	A	1, 3
Dimethylbenz(a)anthracene	2.4×10^{-2}	8.4×10^{1}	J; CA		8.0×10^{-1}	A; J	1, 2, 3, 4
Dimethylphthalate	-	-	-	-	-	-	1
Di-n-butylphthalate	-	-	-	-	1.0×10^{-1}	A; J	3
Diphenylmethane	-	-	-	-	-	-	3
Dodecane	-	-	-	-	-	-	3, 4
Dodecane, 2,6,10-trimethyl-	-	-	-	-	-	-	3
Dodecane, 4-methyl-	-	-	-	-	-	-	3
Dodecane, 6-methyl-	-	-	-	-	-	-	3
Ethane	-	-	-	-	-	-	1, 2, 3, 4
Ethanol, 2-(2-butoxyethoxy)-, acetate	-	-	-	-	-	-	3
Ethanone, 1-(3-methylphenyl)-	-	-	-	-	-	-	3
Ethanone, 1-phenyl-	-	-	-	-	-	-	3
Ether	-	-	-	-	-	-	3
Ethyl benzene	-	-	-	1.0	2.9×10^{-1}	J	1, 2, 3, 4
Ethylene glycol	-	-	-	4.0×10^{-1}	1.1×10^{-1}	J; CA	3
Fluoranthene	-	-	-	-	4.0×10^{-2}	A	1, 2, 3, 4
Fluorene	-	-	-	-	4.0×10^{-2}	A	2, 3, 4
Formaldehyde	1.3×10^{-5}	5.0×10^{-3}	-	4.0×10^{-3}	1.1×10^{-3}	J; AT	1, 2, 3, 4

TABLE C.1 (Cont.)

Chemical	Inhalation Unit Risk $(\mu g/m^3)^{-1}$	Inhalation Slope Factor $(mg/kg/d)^{-1}$	Notes[a]	Inhalation Reference Concentration (mg/m^3)	Inhalation Reference Dose (mg/kg/d)	Notes[a]	Technology System[b]
GB	-	-	-	3.0×10^{-6}	8.6×10^{-7}	I	2, 3, 4
Glycol ethers (2-butoxy ethanol)	-	-	-	2.0×10^{-2}	5.7×10^{-3}	C	1
HCl	-	-	-	2.0×10^{-2}	5.7×10^{-3}	J	3
Heptadecane	-	-	-	-	-	-	3
Heptanal	-	-	-	-	-	-	3, 4
Heptane, 3-ethyl-2-methyl-	-	-	-	-	-	-	3
Heptanenitrile	-	-	-	-	-	-	4
Hexadecane	-	-	-	-	-	-	4
Hexadecane, 2,6,10,14-tetramethyl-	-	-	-	-	-	-	3
Hexanal	-	-	-	-	-	-	3
Hexane(n)	-	-	-	2.0×10^{-1}	5.7×10^{-2}	-	1, 2, 3, 4
Hexanenitrile	-	-	-	-	-	-	4
HF	-	-	-	3.0×10^{-2}	8.6×10^{-3}	J; CA	3
Hydrogen cyanide	-	-	-	3.0×10^{-3}	8.6×10^{-4}	J	3
Hydrogen sulfide	-	-	-	1.0×10^{-3}	2.9×10^{-4}	J	3
Indeno(1,2,3-cd)pyrene	1.1×10^{-4}	4.0×10^{-1}	J; CA	-	-	-	1, 2, 3, 4
Iron	-	-	-	-	-	-	3
Isobutyl alcohol	-	-	-	-	3.0×10^{-1}	A; J	3
Isopropyl nitrate	-	-	-	-	-	-	4
Lead	1.2×10^{-5}	4.2×10^{-2}	J; CA	1.5×10^{-3}	4.3×10^{-4}	D	1, 2, 3, 4
Magnesium	-	-	-	-	-	-	3
Malonic acid	-	-	-	-	-	-	3
Manganese	-	-	-	5.0×10^{-5}	1.4×10^{-5}	-	1, 2, 3, 4
Mercury	-	-	-	3.0×10^{-4}	8.6×10^{-5}	-	1, 2, 3, 4
Methyl ethyl ketone/butyraldehydes	-	-	-	1.0	2.9×10^{-1}	-	1, 2
Methylene chloride	4.7×10^{-7}	1.6×10^{-3}	-	3.0	8.6×10^{-1}	J; HE	1, 3, 4
Molybdenum	-	-	-	-	5.0×10^{-3}	A	1, 2, 3, 4
MPA	-	-	-	-	-	-	4
m-Tolualdehyde	-	-	-	-	-	-	3
Mustard	8.5×10^{-2}	3.0×10^{2}	G	1.0×10^{-4}	2.9×10^{-5}	I	1, 2, 3, 4
Naphthalene	-	-	-	3.0×10^{-3}	8.6×10^{-4}	-	1, 2, 3, 4
Naphthalene, 1,2,3,4-tetrahydro-	-	-	-	-	-	-	3
Naphthalene, 1,2,3,4-tetrahydro-6-methyl-	-	-	-	-	-	-	3
Naphthalene, 1,7-dimethyl-	-	-	-	-	-	-	3
Naphthalene, 1-methyl	-	-	-	-	-	-	3
Nickel	4.8×10^{-4}	1.7	H	2.0×10^{-4}	5.7×10^{-5}	J; AT	1, 2, 3, 4
Nitric acid esters	-	-	-	-	-	-	4
Nitric acid, butyl ester	-	-	-	-	-	-	4
Nitric acid, decyl ester	-	-	-	-	-	-	4
Nitric acid, ethyl ester	-	-	-	-	-	-	4
Nitric acid, hexyl ester	-	-	-	-	-	-	4
Nitric acid, nonyl ester	-	-	-	-	-	-	4
Nitric acid, pentyl ester	-	-	-	-	-	-	4
Nitric acid, propyl ester	-	-	-	-	-	-	4

TABLE C.1 (Cont.)

Chemical	Inhalation Unit Risk $(\mu g/m^3)^{-1}$	Inhalation Slope Factor $(mg/kg/d)^{-1}$	Notes[a]	Inhalation Reference Concentration (mg/m^3)	Inhalation Reference Dose (mg/kg/d)	Notes[a]	Technology System[b]
Nitrobenzene	-	-	-	-	5.7×10^{-4}	J; HE	3
Nonanal	-	-	-	-	-	-	4
Nonane, 2,6-dimethyl-	-	-	-	-	-	-	3
Nonane, 3,7-dimethyl-	-	-	-	-	-	-	3
Nonane, 3-methyl-	-	-	-	-	-	-	3
Nonanenitrile	-	-	-	-	-	-	4
n-Propylbenzene	-	-	-	-	-	-	3
OCDD	3.3×10^{-2}	1.2×10^{2}	B	-	1.0×10^{-6}	B	1
OCDF	3.3×10^{-2}	1.2×10^{2}	B	-	1.0×10^{-6}	B	1
Octanal	-	-	-	-	-	-	4
Octane, 2,6-dimethyl-	-	-	-	-	-	-	3
Octane, 3,6-dimethyl-	-	-	-	-	-	-	3
Octane, 3-methyl-	-	-	-	-	-	-	3
Octanenitrile	-	-	-	-	-	-	4
Particulates	-	-	-	1.5×10^{-2}	4.3×10^{-3}	E	1, 2
p-Creosol (4-methylphenol)	-	-	-	-	-	-	2
Pentadecane	-	-	-	-	-	-	3, 4
Pentanal	-	-	-	-	-	-	3
Pentane(n)	-	-	-	-	-	-	1, 2, 3, 4
Phenanthrene	-	-	-	-	-	-	1, 2, 3, 4
Phenol	-	-	-	6.0×10^{-1}	1.7×10^{-1}	J; CA	1, 3
Phosphorus	-	-	-	-	-	-	1, 2, 3
Polychlorinated biphenyls	1.0×10^{-4}	3.5×10^{-1}	-	-		-	2, 3, 4
Polycyclic aromatic hydrocarbons (PAHs)	1.1×10^{-3}	3.9	C	-	-	-	1, 2, 3, 4
Polycyclic organic matter (fluorene)	-	-	-	-	-	-	1
Potassium	-	-	-	-	-	-	3
Propanal (propionaldehyde)	-	-	-	-	-	-	1, 3
Propane	-	-	-	-	-	-	1, 2, 3, 4
Propylene	-	-	-	-	-	-	1, 2, 3, 4
Pyrene	-	-	-	-	3.0×10^{-2}	A	1, 2, 3, 4
Selenium	-	-	-	-	5.0×10^{-3}	A	1, 2, 3, 4
Silver	-	-	-	-	5.0×10^{-3}	A; J	3
Sodium	-	-	-	-			3
Styrene	-	-	-	1.0	2.9×10^{-1}	J	1, 3
Sulfur, mol. (S8)	-	-	J; CA	-	-	-	3
Tetrachloroethene	5.9×10^{-6}	2.1×10^{-2}	J; CA	3.0×10^{-1}	7.7×10^{-2}	J; AT	1, 3
Tetradecane	-	-	-	-	-	-	3, 4
Thallium	-	-	-	-	8.0×10^{-5}	A; J	3
Tin	-	-	-	-	-	-	3
Toluene	-	-	-	4.0×10^{-1}	1.1×10^{-1}	-	1, 2, 3, 4
Total HpCDD	3.3×10^{-2}	1.2×10^{2}	B	-	1.0×10^{-6}	A; B	1, 3
Total HpCDF	3.3×10^{-1}	1.2×10^{2}	B	-	1.0×10^{-7}	A; B	1, 2, 3
Total HxCDD	3.3	1.2×10^{5}	B	-	1.0×10^{-8}	A; B	1, 3
Total HxCDF	3.3	1.2×10^{5}	B	-	1.0×10^{-8}	A; B	1, 3

TABLE C.1 (Cont.)

Chemical	Inhalation Unit Risk $(\mu g/m^3)^{-1}$	Inhalation Slope Factor $(mg/kg/d)^{-1}$	Notes[a]	Inhalation Reference Concentration (mg/m^3)	Inhalation Reference Dose (mg/kg/d)	Notes[a]	Technology System[b]
Total PeCDD	1.7×10^{1}	5.8×10^{5}	B	-	2.0×10^{-9}	A; B	1, 3
Total PeCDF	1.7×10^{1}	5.8×10^{5}	B	-	2.0×10^{-9}	A; B	1, 3
Total TCDD	3.3×10^{1}	1.2×10^{6}	B	-	1.0×10^{-9}	A; B	1, 2, 3
Total TCDF	3.3	1.2×10^{5}	J; CA	-	1.0×10^{-8}	A; B	1, 3
Trichloroethene	2.0×10^{-6}	7.0×10^{-3}	J; CA	6.0×10^{-1}	1.7×10^{-1}	J; CA	3, 4
Tridecane	-	-	-	-	-	-	3, 4
Tridecane, 2-methyl-	-	-	-	-	-	-	3
Tridecane, 4-methyl-	-	-	-	-	-	-	3
Tridecane, 6-propyl-	-	-	-	-	-	-	3
Undecane	-	-	-	-	-	-	3, 4
Undecane, 2,10-dimethyl-	-	-	-	-	-	-	3
Undecane, 2,6-dimethyl-	-	-	-	-	-	-	3
Undecane, 2-methyl-	-	-	-	-	-	-	3
Undecane, 3,6-dimethyl-	-	-	-	-	-	-	3
Undecane, 4-methyl-	-	-	-	-	-	-	3
Vanadium	-	-	-	-	9.0×10^{-3}	A; F	1, 2, 3, 4
Vinyl chloride	8.6×10^{-5}	0.3	J; HE	5.0×10^{-3}	1.4×10^{-3}	J; CA	4
VX	-	-	-	3.0×10^{-6}	8.6×10^{-7}	I	2, 3, 4
Xylenes	-	-	-	-	2.0	A; J	3, 4
m-Xylene	-	-	-	4.3×10^{-1}	1.2×10^{-1}	-	2
m,p-Xylene	-	-	-	4.3×10^{-1}	1.2×10^{-1}	J; AT	1, 2, 3, 4
o-Xylene	-	-	-	-	2.0	A	1
p-Xylene	-	-	-	-	2.0	A; J	3
Zinc	-	-	-	-	3.0×10^{-1}	A	1, 2
Total = 245							

[a] Notes:

A = Oral RfD used as a surrogate for the inhalation RfD.
B = Toxicity equivalence factors for dioxins and furans obtained from EPA (2001).
C = Value for B[a]P assigned.
D = The quarterly average NAAQS for lead is used as the RfC.
E = RfD value for particulates is the NAAQS for $PM_{2.5}$.
F = IRIS value for vanadium pentoxide.
G = Unit risk for mustard given in EPA (1991).
H = IRIS value for nickel subsulfide is used.
I = Allowable 72-hour concentration for general public (CDC 1988).
J = As given in Smith et al. (1999).
AT = ATSDR minimum risk level.
CA = California EPA.
HE = Health Effects Summary Tables (EPA 1997).

[b] Indicates the technology system for which this substance was detected during demonstration testing: 1 = Neut/Bio; 2 = Neut/SCWO; 3 = Neut/GPCR/TW-SCWO; 4 = Elchem Ox.

[c] A hyphen means the substance was not detected.

Source: where not otherwise noted, values are from IRIS (EPA 2000).

considered negligible; even larger risks up to about 1×10^{-4} are often considered to be tolerable. The noncarcinogenic and carcinogenic risk estimates for ACWA facility emissions at the four storage locations are summarized in Table C.2. The risk estimates are all well below the benchmark indicators for significant risk (i.e., HIs considerably less than one and carcinogenic risks considerably less than 1×10^{-6}). Note that exposures and risks are slightly higher for the off-post MEIs than for the on-post MEIs because the annual exposure duration for the off-post MEI is assumed to be longer.

Much of the estimated noncarcinogenic and carcinogenic risk shown in Table C.2 is associated with boiler and diesel generator emissions rather than with destruction facility processes. For example, 90% of the HI of 0.002 calculated for the Neut/SCWO technology system at ANAD was contributed by five substances (acrolein, cadmium, chromium, formaldehyde, and nickel) that would be emitted primarily from the boilers and generators. Similarly, of the excess cancer risk of 3×10^{-8} reported, about 90% would be contributed by four substances primarily emitted from boilers (arsenic, cadmium, chromium, and nickel).

Some uncertainties in the demonstration test data used to estimate emissions of toxic air pollutants should be considered in interpreting the results. For example, some unit operations were not characterized in demonstration testing, so trace effluents were not estimated for all unit operations that would make up the complete systems. Generally, data were available for unit operations that would be expected to generate the most gaseous emissions during actual operations (Mitretek 2000a–d). However, the emission levels and health risk estimates provided here should be considered only indicative of likely levels. They may need to be revised as technology designs near completion and as estimates of process efficiencies become more reliable (Kimmell et al. 2001). Nevertheless, the values used for the risks from operations presented in this EIS were designed to be very conservative (i.e., potentially resulting in overestimates of risk) and to bound minor variations in the way that the ACWA destruction systems would be engineered.

C.3 SUBSTANCES FOR WHICH QUANTITATIVE TOXICITY DATA WERE UNAVAILABLE

Many of the substances detected in demonstration testing do not have established (i.e., peer-reviewed) toxicity benchmark levels available to allow quantitative risk of exposures (see Table C.3). For Neut/Bio operations, 17 of the 107 detected chemicals (16%) did not have established noncarcinogenic or carcinogenic toxicity benchmark levels. For Neut/SCWO operations, 14 of the 63 detected chemicals (22%) did not have established toxicity benchmark levels. For Neut/GPCR/TW-SCWO operations, 99 of the 188 detected chemicals (53%) did not have established toxicity benchmark levels. For Elchem Ox operations, 50 of the 103 detected chemicals (49%) did not have established toxicity benchmark levels. For most of the substances for which toxicity could not be quantitatively evaluated, emission levels would be very low (e.g., less than 10 g/d). These low emissions would be associated with very low overall ambient

TABLE C.2 Summary of Noncarcinogenic and Carcinogenic Risk Estimates for the Four Technologies at the Four Storage Sites[a]

	Neut/Bio[b]				Neut/SCWO			
Human Health Impacts[c]	ANAD	PBA	PCD	BGAD	ANAD	PBA	PCD	BGAD
Hazard Index (HI of <1 means adverse health impacts are unlikely)								
MEI[d] in off-post general public, nerve agent	NA[d]	NA	NA	NA	2×10^{-3}	7×10^{-3}	NA	4×10^{-4}
MEI in off-post general public, mustard agent	3×10^{-3}	NA	1×10^{-3}	9×10^{-5}	2×10^{-3}	NA	7×10^{-4}	2×10^{-5}
MEI in on-post population, nerve agent	NA	NA	NA	NA	2×10^{-4}	6×10^{-4}	NA	8×10^{-5}
MEI in on-post population, mustard agent	3×10^{-4}	NA	3×10^{-4}	2×10^{-5}	2×10^{-4}	NA	1×10^{-4}	6×10^{-6}
Increased lifetime carcinogenic risk (risk of 10^{-6} is generally considered negligible)								
MEI in off-post general public, nerve agent	NA	NA	NA	NA	3×10^{-8}	2×10^{-8}	NA	9×10^{-10}
MEI in off-post general public, mustard agent	8×10^{-9}	NA	5×10^{-9}	1×10^{-10}	7×10^{-9}	NA	3×10^{-9}	3×10^{-11}
MEI in on-post population, nerve agent	NA	NA	NA	NA	2×10^{-9}	2×10^{-9}	NA	2×10^{-10}
MEI in on-post population, mustard agent	2×10^{-9}	NA	3×10^{-9}	3×10^{-11}	5×10^{-10}	NA	6×10^{-10}	1×10^{-11}
Increased lifetime carcinogenic risk to population due to worst-case mustard emissions[e]								
Off-post	2×10^{-7}	NA	2×10^{-7}	2×10^{-9}	2×10^{-7}	NA	2×10^{-7}	2×10^{-9}
On-post	1×10^{-8}	NA	7×10^{-9}	4×10^{-10}	1×10^{-8}	NA	1×10^{-8}	4×10^{-10}

TABLE C.2 (Cont.)

	Neut/GPCR/TW-SCWO				Elchem Ox			
Human Health Impacts[c]	ANAD	PBA	PCD	BGAD	ANAD	PBA	PCD	BGAD
Hazard Index (HI of <1 means adverse health impacts are unlikely)								
MEI[c] in off-post general public, nerve agent	3×10^{-3}	5×10^{-3}	NA	2×10^{-3}	5×10^{-3}	7×10^{-4}	NA	3×10^{-4}
MEI in off-post general public, mustard agent	5×10^{-4}	NA	NA	4×10^{-5}	2×10^{-3}	NA	NA	2×10^{-5}
MEI in on-post population, nerve agent	2×10^{-3}	6×10^{-4}	NA	1×10^{-3}	4×10^{-4}	5×10^{-5}	NA	9×10^{-5}
MEI in on-post population, mustard agent	3×10^{-4}	NA	NA	1×10^{-5}	2×10^{-4}	NA	NA	7×10^{-6}
Increased lifetime carcinogenic risk (risk of 10^{-6} is generally considered negligible)								
MEI in off-post general public, nerve agent	2×10^{-9}	4×10^{-9}	NA	1×10^{-9}	5×10^{-8}	2×10^{-9}	NA	1×10^{-9}
MEI in off-post general public, mustard agent	7×10^{-10}	NA	NA	6×10^{-11}	6×10^{-9}	NA	NA	4×10^{-11}
MEI in on-post population, nerve agent	3×10^{-9}	2×10^{-10}	NA	3×10^{-10}	5×10^{-9}	2×10^{-10}	NA	3×10^{-10}
MEI in on-post population, mustard agent	7×10^{-10}	NA	NA	2×10^{-11}	5×10^{-10}	NA	NA	1×10^{-11}
Increased lifetime carcinogenic risk to population due to worst-case mustard emissions[e]								
Off-post	2×10^{-7}	NA	NA	2×10^{-9}	2×10^{-7}	NA	NA	2×10^{-9}
On-post	1×10^{-8}	NA	NA	4×10^{-10}	1×10^{-8}	NA	NA	4×10^{-10}

[a] Based on emission estimates from demonstration testing (Kimmell et al. 2001) and model estimates of maximum on-post and off-post concentrations and adjusted to account for fluctuating operations. ISCST3 model was used. Estimates for general public assumed 24-h/d exposures for the duration of operations. Estimates for the on-post population assumed 8-h/d exposures and 250-d/yr for the duration of operations. Potential noncarcinogenic impacts from some detected chemicals could not be evaluated quantitatively because toxicity data were not available. For Neut/Bio, Neut/SCWO, Neut/GPCR/TW-SCWO, and Elchem Ox, 17 of 107, 14 of 63, 99 of 188, and 50 of 103 chemicals, respectively, could not be quantitatively evaluated for either noncarcinogenic or carcinogenic effects.

[b] For Neut/Bio, the value shown assumes no further treatment of emissions from the biotreatment vent after they have been processed in the immobilized cell bioreactor (ICB) unit. This risk is only slightly higher (generally less than a factor of 10) than the risk when treatment of biovent emissions is assumed.

[c] From all technologies, carcinogenic risks are less than 10^{-6} and hazard indexes are less than 0.01, all in the negligible range. Although calculated cancer risks range from approximately 10^{-10} to 10^{-7}, and calculated hazard indexes range from 10^{-4} to 10^{-2}, there is no significant difference in risk among the technologies. In other words, for all the technologies, increased cancer and noncancer risks from inhalation of emissions are in the range considered to be negligible.

[d] MEI = maximum exposed individual; NA = not applicable.

[e] Although the facilities would be designed to operate without mustard releases, these values were estimated as a worst case by assuming continuous emission at the detection limit (Kimmell et al. 2001). The estimated concentrations are all 1% or less of the allowable concentrations for general population exposures.

TABLE C.3 List of Substances with No Toxicity Values and Associated Maximum Concentrations[a]

Chemical	Highest Concentration (μg/m^3) Mustard Processing	GB Processing	VX Processing	Technology[b] for Maximum Concentration	Technology Systems[b] in Which Detected
(R)-(-)-2,2-Dimethyl-1,3-dioxolane-4-methanol	2.9×10^{-14}	-	-	3	3
1,2,4-Trimethylbenzene	-	7.7×10^{-15}	2.7×10^{-12}	3	3
1,5-Pentanediol, dinitrate	-	3.2×10^{-12}	2.1×10^{-12}	4	4
1-Butanol, 3-methyl-, nitrate	-	1.4×10^{-11}	9.1×10^{-12}	4	4
1-Ethyl-2,2,6-trimethylcyclohexane	-	-	2.0E-12	3	3
1-Hexanol, 2-ethyl-	4.6×10^{-4}	2.8×10^{-4}	1.3×10^{-10}	3	3
1H-Indene	1.1×10^{-4}	7.0×10^{-5}	9.8×10^{-10}	3	3
1H-Indene, 2,3-dihydro-	-	4.6×10^{-14}	-	3	3
1-Propene, 3,3,3-trichloro-	4.9×10^{-15}	-	-	3	3
2-(2-Butoxyethoxy)ethanol	-	-	2.3×10^{-12}	3	3
2,4-Dimethylphenol	4.5×10^{-5}	2.8×10^{-5}	3.6×10^{-10}	3	3
2-Heptanone	-	3.3×10^{-13}	2.1×10^{-13}	4	4
2-Hexanone	4.8×10^{-14}	3.3×10^{-12}	2.3×10^{-12}	4	4
2-Methylnaphthalene	8.1×10^{-7}	8.1×10^{-7}	8.1×10^{-7}	3	1, 2, 3, 4
2-Nitrophenol	-	5.1×10^{-15}	-	3	3
2-Octanone	1.1×10^{-14}	6.0×10^{-13}	4.2×10^{-13}	4	4
2-Pentanol, nitrate	-	2.0×10^{-11}	1.3×10^{-11}	4	4
4-Methyl-2-pentanone	3.5×10^{-14}	3.0×10^{-13}	3.4×10^{-13}	4	4
4-Octene, (E)-	1.6×10^{-14}	1.3×10^{-13}	1.5×10^{-13}	4	4
9H-Fluoren-9-one	-	2.7×10^{-12}	-	3	3
Acenaphthylene	9.5×10^{-7}	9.5×10^{-7}	9.5×10^{-7}	3	1, 2, 3, 4
Acetamide, N,N-dimethyl-	-	1.1×10^{-12}	6.9×10^{-13}	4	4
Acetic acid	-	-	7.5×10^{-13}	3	3, 4
Aldehydes	1.2×10^{-2}	1.2×10^{-2}	1.2×10^{-2}	3	1, 2, 3, 4
Aluminum	3.0×10^{-4}	1.8×10^{-4}	1.1×10^{-9}	3	3
Benzaldehyde, 4-ethyl-	3.6×10^{-5}	2.2×10^{-5}	2.8×10^{-7}	3	3
Benzaldehyde, ethyl-	2.2×10^{-5}	1.4×10^{-5}	3.9×10^{-6}	3	3
Benzaldehyde, ethyl-	2.1×10^{-5}	1.3×10^{-5}	3.7×10^{-6}	3	3
Benzene, 1,2,3-trimethyl-	-	-	5.2×10^{-13}	3	3
Benzene, 1,2,4,5-tetramethyl-	-	-	2.5×10^{-12}	3	3
Benzene, 1-methyl-2-propyl-	-	-	2.4×10^{-12}	3	3
Benzene, 1-methyl-3-propyl-	-	-	5.9×10^{-13}	3	3
Benzo(g,h,i)perylene	1.3×10^{-7}	1.3×10^{-7}	1.3×10^{-7}	3	1, 2, 3, 4
Benzyl alcohol	2.1×10^{-5}	1.7×10^{-5}	1.2×10^{-5}	3	3
Butanal	4.7×10^{-14}	7.8×10^{-15}	3.9×10^{-14}	3	3
Butane	7.1×10^{-2}	7.1×10^{-2}	7.1×10^{-2}	3	1, 2, 3, 4
C3-Alkyl benzenes	2.4×10^{-12}	4.8×10^{-13}	-	3	3
Calcium	5.9×10^{-4}	4.1×10^{-4}	3.0×10^{-5}	3	3
Cobalt	6.6×10^{-6}	6.2×10^{-6}	3.7×10^{-4}	3	1, 2, 3, 4
Copper	8.0×10^{-5}	9.6×10^{-5}	6.0×10^{-5}	3	1, 2, 3, 4
Cyclododecane	-	3.0×10^{-5}	3.7×10^{-5}	3	3
Cyclohexane, 1,2,3-trimethyl-	5.5×10^{-14}	4.6×10^{-13}	5.2×10^{-13}	4	4

TABLE C.3 (Cont.)

Chemical	Highest Concentration (μg/m^3) Mustard Processing	GB Processing	VX Processing	Technology[b] for Maximum Concentration	Technology Systems[b] in Which Detected
Cyclohexane, 2-butyl-1,1,3-trimethyl-	-	-	4.7×10^{-13}	3	3
Cyclohexane, butyl-	2.1×10^{-13}	5.7×10^{-15}	3.7×10^{-12}	3	3
Cyclohexane, hexyl-	-	-	5.3×10^{-13}	3	3
Cyclohexane, propyl-	2.4×10^{-13}	-	-	3	3
Cyclohexanol	-	-	1.2×10^{-12}	3	3
Cyclohexasiloxane, dodecamethyl-	9.4×10^{-15}	-	-	3	3
Cyclotetrasiloxane, octamethyl-	4.9×10^{-5}	3.0×10^{-5}	1.0×10^{-5}	3	3, 4
Decane	1.0×10^{-12}	6.2×10^{-14}	1.5×10^{-11}	3	3, 4
Decane, 2,6,7-trimethyl-	-	5.1×10^{-15}	-	3	3
Decane, 2-methyl-	-	-	3.4×10^{-12}	3	3
Decane, 3-methyl-	2.5×10^{-13}	-	2.6×10^{-12}	3	3
Decane, 4-methyl-	3.4×10^{-15}	6.7×10^{-15}	1.9×10^{-12}	3	3
Decane, 5-methyl-	-	2.4×10^{-14}	-	3	3
Decanenitrile	1.3×10^{-14}	5.6×10^{-13}	4.1×10^{-13}	4	4
Dibenzofuran	-	1.1×10^{-5}	4.2×10^{-12}	3	1, 3
Diethylene glycol	-	-	7.0×10^{-12}	3	3
Dimethylphthalate	3.0×10^{-5}	1.8×10^{-5}	3.3×10^{-7}	3	1
Diphenylmethane	-	5.0×10^{-15}	-	3	3
Dodecane	2.0×10^{-5}	1.2×10^{-5}	2.7×10^{-5}	3	3, 4
Dodecane, 2,6,10-trimethyl-	-	7.1×10^{-15}	-	3	3
Dodecane, 4-methyl-	-	2.1×10^{-14}	-	3	3
Dodecane, 6-methyl-	3.8×10^{-15}	1.3×10^{-14}	1.8×10^{-12}	3	3
Ethane	1.0×10^{-1}	1.0×10^{-1}	1.0×10^{-1}	3	1, 2, 3, 4
Ethanol, 2-(2-butoxyethoxy)-, acetate	1.6×10^{-14}	2.4×10^{-14}	-	3	3
Ethanone, 1-(3-methylphenyl)-	-	7.6×10^{-15}	-	3	3
Ethanone, 1-phenyl-	-	5.5×10^{-14}	-	3	3
Ether	-	2.1×10^{-3}	2.7×10^{-5}	3	3
Heptadecane	-	1.7×10^{-14}	-	3	3
Heptanal	1.2×10^{-13}	2.8×10^{-13}	-	3	3, 4
Heptane, 3-ethyl-2-methyl-	-	1.7×10^{-14}	1.1×10^{-12}	3	3
Heptanenitrile	-	4.3×10^{-13}	2.7×10^{-13}	4	4
Hexadecane	1.3×10^{-8}	7.6×10^{-13}	5.2×10^{-13}	4	4
Hexadecane, 2,6,10,14-tetramethyl-	-	3.2×10^{-14}	-	3	3
Hexanal	3.0×10^{-14}	1.0×10^{-13}	1.4×10^{-13}	3	3
Hexanenitrile	-	3.9×10^{-13}	2.4×10^{-13}	4	4
Iron	4.4×10^{-4}	2.7×10^{-4}	1.4×10^{-3}	3	3
Isopropyl nitrate	3.8×10^{-7}	9.2×10^{-11}	5.9×10^{-11}	4	4
Magnesium	8.3×10^{-5}	6.2×10^{-5}	2.4×10^{-5}	3	3
Malonic acid	7.2×10^{-12}	2.1×10^{-11}	-	3	3
MPA	-	-	1.1×10^{-17}	4	4

TABLE C.3 (Cont.)

Chemical	Highest Concentration (μg/m^3) Mustard Processing	GB Processing	VX Processing	Technology[b] for Maximum Concentration	Technology Systems[b] in Which Detected
m-Tolualdehyde	-	7.0×10^{-14}	6.7×10^{-14}	3	3
Naphthalene, 1,2,3,4-tetrahydro-	-	-	1.3×10^{-12}	3	3
Naphthalene, 1,2,3,4-tetrahydro-6-methyl-	-	-	6.9×10^{-13}	3	3
Naphthalene, 1,7-dimethyl-	-	-	7.4×10^{-13}	3	3
Naphthalene, 1-methyl	-	1.9×10^{-14}	-	3	3
Nitric acid esters	-	3.4×10^{-12}	2.2×10^{-12}	4	4
Nitric acid, butyl ester	-	1.6×10^{-11}	1.0×10^{-11}	4	4
Nitric acid, decyl ester	1.8×10^{-14}	1.4×10^{-12}	9.9×10^{-13}	4	4
Nitric acid, ethyl ester	-	9.0×10^{-12}	5.7×10^{-12}	4	4
Nitric acid, hexyl ester	-	8.9×10^{-12}	5.6×10^{-12}	4	4
Nitric acid, nonyl ester	5.8×10^{-14}	3.3×10^{-12}	2.3×10^{-12}	4	4
Nitric acid, pentyl ester	-	9.3×10^{-12}	5.9×10^{-12}	4	4
Nitric acid, propyl ester	-	9.6×10^{-12}	6.1×10^{-12}	4	4
Nonanal	1.5×10^{-13}	1.2×10^{-12}	1.4×10^{-12}	4	4
Nonane, 2,6-dimethyl-	-	1.9×10^{-14}	6.3×10^{-12}	3	3
Nonane, 3,7-dimethyl-	-	-	9.3×10^{-13}	3	3
Nonane, 3-methyl-	-	-	4.8×10^{-13}	3	3
Nonanenitrile	1.6×10^{-14}	9.1×10^{-13}	6.5×10^{-13}	4	4
n-Propylbenzene	1.5×10^{-13}	-	-	3	3
Octanal	1.0×10^{-13}	1.4×10^{-12}	1.3×10^{-12}	4	4
Octane, 2,6-dimethyl-	3.8×10^{-13}	-	-	3	3
Octane, 3,6-dimethyl-	-	-	2.2×10^{-12}	3	3
Octane, 3-methyl-	1.4×10^{-13}	-	-	3	3
Octanenitrile	-	9.6×10^{-13}	6.1×10^{-13}	4	4
p-Creosol (4-Methylphenol)	5.5×10^{-13}	5.5×10^{-14}	5.5×10^{-14}	2	2
Pentadecane	3.8×10^{-15}	1.0×10^{-14}	1.6×10^{-12}	3	3, 4
Pentanal	9.3×10^{-14}	1.3×10^{-13}	-	3	3
Pentane(n)	8.7×10^{-2}	8.7×10^{-2}	8.7×10^{-2}	3	1, 2, 3, 4
Phenanthrene	5.7×10^{-6}	5.7×10^{-6}	5.7×10^{-6}	3	1, 2, 3, 4
Phosphorus	1.6×10^{-4}	1.2×10^{-4}	$1.5E \times 10^{-3}$	3	1, 2, 3
Polycyclic organic matter (fluorene)	4.8×10^{-14}	NA[c]	NA	1	1
Potassium	1.4×10^{-12}	-	2.4×10^{-10}	3	3
Propanal (propionaldehyde)	-	9.4×10^{-14}	1.2×10^{-13}	3	1, 3
Propane	5.4×10^{-2}	5.4×10^{-2}	5.4×10^{-2}	3	1, 2, 3, 4
Propylene	4.5×10^{-4}	4.5×10^{-4}	4.5×10^{-4}	3	1, 2, 3, 4
Sodium	8.0×10^{-3}	5.3×10^{-3}	8.1×10^{-6}	3	3
Sulfur, mol. (S8)	1.2×10^{-13}	-	-	3	3
Tetradecane	2.2×10^{-13}	7.0×10^{-14}	7.2×10^{-12}	3	3, 4
Tin	5.2×10^{-5}	3.1×10^{-5}	1.9×10^{-6}	3	3
Tridecane	2.7×10^{-13}	1.1×10^{-13}	3.3×10^{-12}	3	3, 4
Tridecane, 2-methyl-	-	-	2.0×10^{-12}	3	3
Tridecane, 4-methyl-	-	-	9.3×10^{-13}	3	3
Tridecane, 6-propyl-	-	-	7.1×10^{-13}	3	3

TABLE C.3 (Cont.)

Chemical	Highest Concentration (µg/m³)			Technology[b] for Maximum Concentration	Technology Systems[b] in Which Detected
	Mustard Processing	GB Processing	VX Processing		
Undecane	6.8×10^{-13}	1.0×10^{-13}	9.6×10^{-12}	3	3, 4
Undecane, 2,10-dimethyl-	-	3.2×10^{-14}	4.2×10^{-13}	3	3
Undecane, 2,6-dimethyl-	-	3.9×10^{-14}	-	3	3
Undecane, 2-methyl-	-	2.5×10^{-14}	-	3	3
Undecane, 3,6-dimethyl-	-	-	1.5×10^{-12}	3	3
Undecane, 4-methyl-	-	-	9.8×10^{-13}	3	3
Total = 130					

[a] ANAD was the installation with maximum modeled concentrations; used on-post values. A hyphen means the substance was not detected.

[b] Indicates the technology system for which this substance was detected during demonstration testing: 1 = Neut/Bio; 2 = Neut/SCWO; 3 = Neut/GPCR/TW-SCWO; 4 = Elchem Ox.

[c] NA = not applicable.

on-post and off-post concentrations (Table C.3). Although not quantitatively assessed, toxic effects would be highly unlikely in association with these very low ambient concentrations. For several substances emitted from boilers and diesel generators (aldehydes, propane, butane, pentane, and ethane), emission levels were somewhat higher (up to about 1 kg/d). Although potential health effects from inhalation of these substances could not be quantitatively evaluated because of the lack of toxicity benchmark levels, such data would not distinguish among risks associated with the alternate technologies because each of the technologies evaluated uses boilers and diesel generators.

C.4 REFERENCES FOR APPENDIX C

Agency for Toxic Substances and Disease Registry, 1992, *Toxicological Profile for Mustard "Gas*," TP-91/22, prepared by Clement International Corp., for U.S. Department of Health and Human Services, Public Health Service, Washington, D.C., Sept.

ATSDR: see Agency for Toxic Substances and Disease Registry.

CDC: see Centers for Disease Control.

Centers for Disease Control, 1988, "Final Recommendations for Protecting the Health and Safety against Potential Adverse Effects of Long-Term Exposure to Low Doses of Agents: GA, GB, VX, Mustard Agent (H, HD, T) and Lewisite (L)," Department of Health and Human Services, Centers for Disease Control, *Federal Register* 53(50):8504–07, March 15.

EPA: See U.S. Environmental Protection Agency.

Hartmann, H.M., and L. Nieves, 2001, *Estimated Maximum Annual Average On-Post and Off-Post Concentrations, Intakes, and Risks for Detected Compounds Associated with Pilot Testing of the ACWA Technology Systems*, memo from Hartmann and Nieves (Argonne National Laboratory, Argonne, Ill.) to file.

Kimmell, T.A., et al., 2001, *Technology Resource Document for the Assembled Chemical Weapons Assessment Environmental Impact Statement*, ANL/EAD/TM-101, Vols. 1–5 and errata, Argonne National Laboratory, Argonne, Ill.

Mitretek, 2001a, *Estimates of Environmental Releases Associated with the Destruction of Assembled Chemical Weapons during Pilot Plant Testing of the Parsons Honeywell Neutralization/Biotreatment Process*, Mitretek Systems, Inc., McLean, Va., May.

Mitretek, 2001b, *Estimates of Environmental Releases Associated with the Destruction of Assembled Chemical Weapons during Pilot Plant Testing of the General Atomics Neutralization/Supercritical Water Oxidation Process*, Mitretek Systems, Inc., McLean, Va., May.

Mitretek, 2001c, *Estimates of Environmental Releases Associated with the Destruction of Assembled Chemical Weapons during Pilot Plant Testing of the Foster Wheeler-Ecologic-Kvaerner Neutralization/Supercritical Water Oxidation with Gas Phase Chemical Reduction Process*, Mitretek Systems, Inc., McLean, Va., May.

Mitretek, 2001d, *Estimates of Environmental Releases Associated with the Destruction of Assembled Chemical Weapons during Pilot Plant Testing of the AEA Technology Silver II Electrochemical Oxidation Process*, Mitretek Systems, Inc., McLean, Va., May.

National Research Council, 1997, *Risk Assessment and Management at Deseret Chemical Depot and the Tooele Chemical Agent Disposal Facility*, prepared by National Research Council, Washington, D.C., published by National Academy Press, Washington, D.C.

PMACWA, 1999, *Assembled Chemical Weapons Program: Supplemental Report to Congress*, U.S. Department of Defense, Program Manager Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md., Sept 30.

Smith, R.L., et al., 1999, *Ranking and Selection of Hazardous Air Pollutants for Listing under Section 112(k) of the Clean Air Act Amendments of 1990*, Technical Support Document, July 28, Table 1, "Dose-Response Assessment Information, with Sources, Used for Ranking," U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, http://www.epa.gov/ttn/uatw/urban/urbanpg.html, accessed on Apr. 12, 2001.

U.S. Environmental Protection Agency, 1990, "National Oil and Hazardous Substances Pollution Contingency Plan; Final Rule (40 CFR Part 300)," *Federal Register* 55(46):8666–8865, March 8.

U.S. Environmental Protection Agency, 1991, *Upper-Bound Quantitative Cancer Risk Estimate for Populations Adjacent to Sulfur Mustard Incineration Facilities,* EPA/600/8-91/053, Office of Research and Development, Washington, D.C., July.

U.S. Environmental Protection Agency, 1994, *Exposure Assessment Guidance for RCRA Hazardous Waste Combustion Facilities (Draft),* EPA 530/R-94/021, Office of Solid Waste and Emergency Response, Washington, D.C., Apr.

U.S. Environmental Protection Agency, 1995, *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models*, EPA-454/B-95-003a and updated model (00101), Office of Air Quality Planning and Standards, Research Triangle Park, N.C., Sept. 6.

U.S. Environmental Protection Agency, 1997, *Health Effects Assessment Summary Tables, FY-1997 Update*, EPA/540/R-97/036, Office of Solid Waste and Emergency Response, Washington D.C., July.

U.S. Environmental Protection Agency, 2000, *Integrated Risk Information System (IRIS),* Office of Remedial and Emergency Response, http://www.epa.gov/ngispgm3/iris/index.html, accessed Oct.

U.S. Environmental Protection Agency, 2001, *The U.S. EPA TEF Values,* Office of Research and Development, http://www.epa.gov/ncea/dchem.htm, accessed Nov. 2.

APPENDIX D:

LETTERS OF CONSULTATION AND REVISED BIOLOGICAL ASSESSMENT FOR ANNISTON ARMY DEPOT

ARGONNE NATIONAL LABORATORY
9700 SOUTH CASS AVENUE, BUILDING 900, ARGONNE, ILLINOIS 60439 TELEPHONE: 630/252-8849

May 4, 2000

Mr. Larry Goldman, Field Supervisor
U.S. Fish and Wildlife Service
Daphne Field Office
1208-B Main Street
P.O. Drawer 1190
Daphne, AL 36526

Dear Mr. Goldman:

The Department of Army, Assembled Chemical Weapons Assessment Program and the Chemical Demilitarization Program are preparing an environmental impact statement concerning its plans to destroy chemical agent and munitions stored at Anniston Army Depot (AAD) located in south western corner of Calhoun County, Alabama. This EIS will evaluate two different technologies and the no action for destruction of chemical agent and munitions stored at AAD. I've included a map showing the location of the AAD and copies of the Federal Register notices for your use.

We would appreciate receiving information on any federally-protected species that may inhabit or visit the AAD and could possibly be affected by construction of demonstration facilities or an incinerator. As part of the analysis of ecological impacts we will assess potential impacts to federally endangered, threatened, and candidate species. A list of these species and their residency status at AAD or in the vicinity would be useful for the analysis.

Thank you in advance for your assistance.

Sincerely,

Ed Pentecost

Edwin D. Pentecost, PhD
Environmental Assessment Division

Encl.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
P. O. Drawer 1190
Daphne, Alabama 36526

IN REPLY REFER TO:
00-1408a

May 25, 2000

Dr. Edwin D. Pentecost
Argonne National Laboratory
9700 South Cass Avenue, Building 900
Argonne, IL 60439

Dear Dr. Pentecost:

This is in response to your letter, dated May 4, 2000, requesting endangered species information for inclusion in an Environmental Impact Statement pursuant to the Army's plans to destroy chemical agent and munitions at Anniston Army Depot, Calhoun County, Alabama.

The Service has determined that the following endangered or threatened species need to be considered in an Environmental Impact Statement for Anniston Army Depot:

Tennessee yellow-eyed grass	*Xyris tennessensis*
Red-cockaded woodpecker	*Picoides borealis*
Gray bat	*Myotis grisescens*
Mohr's Barbara's buttons	*Marshallia mohrii*

If aquatic habitats will be affected either on the Depot or in adjacent areas then the list should be expanded to include the following:

Pygmy sculpin	Cottus pygmaeus
Blue shiner	Cyprinella caerulea
Fine-lined pocketbook mussel	Lampsilis altilis
Tulotoma snail	Tulotoma magnifica
Painted rocksnail	Leptoxis taeniata
Southern pigtoe mussel	Pleurobema georgianum

If you have questions or need additional information, please call Mr. Bruce Porter at (334) 441-5181, ext 37.

Sincerely,

Larry E. Goldman
Field Supervisor

PHONE: 334-441-5181 www.fws.gov FAX: 334-441-6222
SHIPPING ADDRESS: 1208-B Main Street, Daphne, AL 36526

DEPARTMENT OF THE ARMY
PROGRAM MANAGER FOR ASSEMBLED CHEMICAL WEAPON ASSESSMENT
ABERDEEN PROVING GROUND, MD 21010-5423

REPLY TO
ATTENTION OF

AMSSB-PM-ACWA 4 October 2001

MEMORANDUM FOR Mr. Larry E. Goldman, US Department of the Interior, Fish and Wildlife Service, P.O. Drawer 1190, Daphne, AL 36526

SUBJECT: Completed Biological Assessment

1. We have completed a Biological Assessment for the proposed Assembled Chemical Weapons pilot test project at the Anniston Army Depot (ANAD) in Calhoun County, Alabama, pursuant to the Endangered Species Act requirements. The biological assessment was prepared based on your response to our letter requesting information on federally listed endangered species that occur on ANAD (see your response to Dr. Edwin D. Pentecost, Argonne National Laboratory, dated 25 May 2000). I am enclosing a copy of the biological assessment for your review and concurrence.

2. If you have questions on the biological assessment do not hesitate to contact me or Dr. Pentecost at (630) 252-8849.

Jon Ware

JON WARE
Environmental Team Leader

Encl

CF:
E. Pentecost, ANL
W. Burns, ANAD

BIOLOGICAL ASSESSMENT FOR THE ASSEMBLED CHEMICAL WEAPONS ASSESSMENT PROGRAM AT ANNISTON ARMY DEPOT, ANNISTON, ALABAMA

Prepared for

PM Assembled Chemical Weapons Assessment
Aberdeen Proving Ground, MD 21010-5424

December 2001

Biological Assessment for the Assembled Chemical Weapons Assessment Program at Anniston Army Depot, Anniston, Alabama

Background

The U.S. Department of Defense (DOD) was directed by Congress as part of the Omnibus Consolidated Appropriations Act of 1997 (Public Law 104-208) to "demonstrate not less than two alternatives to the baseline incineration process for demilitarization of assembled chemical munitions." The DOD also was directed by Congress in this legislation to establish an Assembled Chemical Weapons Assessment (ACWA) Program. The Program Manager for ACWA announced the DOD's intent to prepare an environmental impact statement (EIS) on plans to design, construct, and operate one or more pilot test facilities for assembled chemical weapon destruction technologies at one or more chemical weapons stockpile sites (Fed. Register, Vol. 65, No. 73, pp. 20139–20140, August 14, 2000). Potential locations for pilot testing include Blue Grass Army Depot in Kentucky, Pine Bluff Arsenal in Arkansas, Pueblo Chemical Depot in Colorado, and the Anniston Army Depot (ANAD) in Alabama.

In fulfilling its responsibilities under the National Environmental Policy Act of 1969 and the Endangered Species Act of 1974, the DOD has prepared this biological assessment of potential impacts to federally listed species from constructing and operating ACWA pilot test facilities at the ANAD. The ANAD is an active DOD installation in Calhoun County, Alabama, occupying 15,279 acres (6,185 ha) located about 56 miles (90 km) east of Birmingham, Alabama. The installation facilities consist of earth-covered igloos, warehouses, aboveground magazines, maintenance buildings, and facilities used for administration, operations, medical care, and housing.

Project Description

Pilot testing of the ACWA technologies is intended to provide DOD with valuable information regarding the suitability of alternative technologies for the destruction of nerve agent and mustard agent, currently contained in munitions stored at ANAD and the other installations. The ACWA technologies consist of the use of electrochemical oxidation or chemical neutralization followed by either supercritical water oxidation or a process using microorganisms known as biological treatment. The ACWA facilities are assumed to operate for about 36 months as a bounding case for the EIS analysis.

The ACWA pilot test facilities would occupy an area of about 25 acres (10 ha). Three alternative locations for the test facilities are being evaluated in the environmental impact statement (Figure 1). Site A covers about 32.6 acres (13.2 ha), Site B occupies 149 acres (60.3 ha), and Site C is approximately 36.4 acres (14.7 ha) in size. Construction of the pilot facility may require substantial site preparation in highly sloped areas of the sites.

In addition to the structures associated with the ACWA pilot test facilities, construction of the site infrastructure would require disturbance within existing rights-of-way for gas, water, sewer, and electrical power lines and the creation of several new corridors for these utilities. Although the locations of all areas disturbed during construction cannot be identified at this time, for the

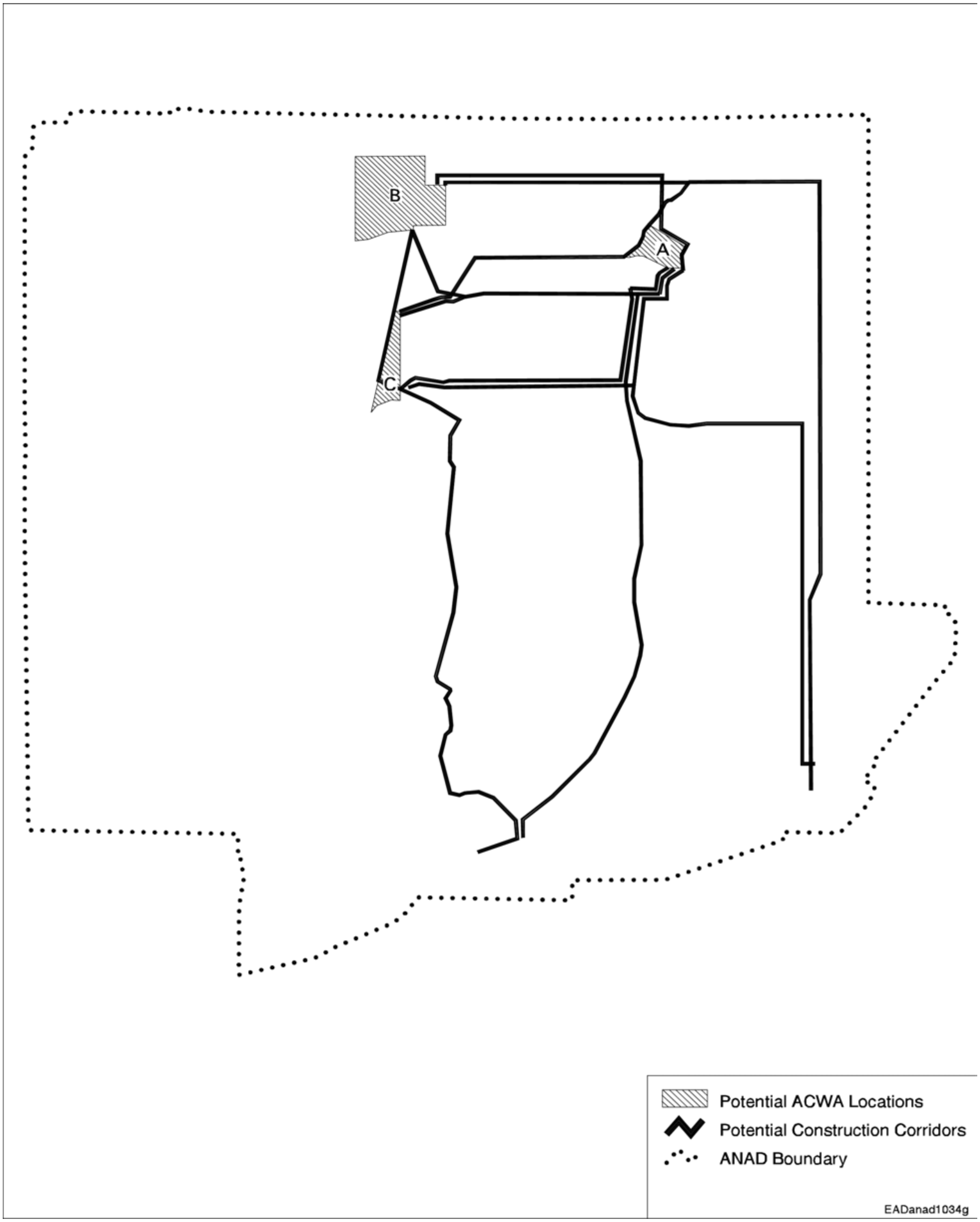

FIGURE 1 Potential Areas of Disturbance for Construction of ACWA Pilot Facilities at Anniston Army Depot

purpose of this biological assessment, probable locations were assumed, to allow for an evaluation of the impacts of construction activities on known locations of listed species.

No liquid wastes produced by the treatment processes would be released to the environment. During pilot testing of the technologies, minor amounts of trace metals (up to 8.3×10^{-4} lb/day [0.38 g/day]) and organic compounds (up to 0.58 lb/day [260 g/day]) would be emitted to the atmosphere.

Affected Environment

Located near the southern edge of the Appalachian mountain range, the ANAD is surrounded by a mosaic of forest communities and agricultural lands, in a temperate climate. The predominant forest type in the vicinity of ANAD is mixed broadleaf deciduous/pine forest. Common associates include oak, hickory, longleaf pine, and loblolly pine. Most of the land on ANAD has been cleared and now supports second growth forest managed for timber production and other uses. There is little undisturbed area remaining on the installation except for an approximate 1,000 to 1,200 acres (405 to 486 ha) of old-growth oak-hickory forest in the restricted area that occupies the northwest corner of ANAD (Godwin et al. 1994).

The eastern half of Site A is forested with an immature broadleaf deciduous forest community composed primarily of red oak, white oak, and hickory (USGS 1998). The western half of the site is wooded but is not under forest management. The adjacent area to the northeast is an immature pine-hardwood forest community composed primarily of loblolly pine and broadleaf deciduous species. Site A is situated at the confluence of a perennial stream flowing from the southwest and an intermittent stream flowing from the south. Both of these streams are located within excavated channels. The perennial stream exits the ANAD near its northeast corner. Approximately 12 acres (4.9 ha) of the stream's 100-year floodplain occur within Site A.

Site B is representative of an upland hardwood forest and is managed for wildlife habitat and timber production. The western half of Site B lies within a broadleaf deciduous forest community composed primarily of red oak, white oak, and hickory (USGS 1998). Forest management in this area includes selective cutting. The eastern half of the site is wooded but is not under forest management. Tree species of the closed forest canopy include chestnut oak (*Quercus prinus*), swamp chestnut oak (*Quercus michauxii*), and southern red oak (*Quercus falcata*). Pines are present in the far western portion of the site, which is lower in elevation. Flowering dogwood (*Cornus florida*) and immature oaks make up the shrub layer, with numerous oak seedlings present. No intermittent streams occur on Site B. The northern portion of the site lies within the watershed of an intermittent stream that flows north, while the southern portion of Site B lies within the watershed of an intermittent stream that flows to the northwest.

Site C slopes away fairly rapidly from Ammo Workshop Road. At the southern end of the site, the elevation is considerably lower. The entire site is included within an immature loblolly pine forest community (USGS 1998). Longleaf pine (*Pinus palustris*) and shortleaf pine (*Pinus echinata)* occur on this site together with hardwoods, such as black jack oak (*Quercus marilandica*), mockernut hickory (*Carya tomentosa*), butternut hickory (*Carya cordiformis*), and sweet gum (*Liquidambar styraciflua*). The vegetation density at Site C is greater than that of the other two sites, and much of the site is overgrown with kudzu (*Pueraria montana*). Site C is located within the watershed of the perennial stream that intersects Site A.

Protected Species at Anniston Army Depot

An installationwide survey was conducted in 1994 by the Alabama Natural Heritage Program for endangered, threatened, and candidate flora and fauna (Godwin et al. 1994). The only federally listed species that was found on the ANAD installation was *Xyris tennesseensis* (Tennessee yellow-eyed grass), listed as endangered. One population of *X. tennesseensis* was located within a seep, along a spring run, in the vicinity of the toxic burning ground in the west-central portion of the installation (Figure 2). A second population of *X. tennesseensis* has since been discovered along the banks of a perennial stream in the northeast corner of ANAD, near the boundary between ANAD and the Pelham Range (Burns 2000). Two populations of *X. tennesseensis* also occur on the Pelham Range, an installation adjacent to ANAD, to the north (U.S. Army 1998).

Although *Picoides borealis* (the red-cockaded woodpecker), listed as endangered, is a resident species in northern Alabama, this species does not occur on the ANAD site. The floral and faunal survey, conducted in 1994 by the Alabama Natural Heritage Program, and a subsequent breeding bird survey completed in 1997 (Bailey et al. 1997) have not been able to locate this species on the installation. *Picoides borealis* has historically resided on the Pelham Range of Fort McClellan, adjacent to ANAD, but a 1998 survey concluded that this species no longer occurs there (Reisz Engineers 1998). However, *Picoides borealis* does occur at two locations within the Talladega National Forest, one approximately 25 mi (40 km) east of ANAD and the other about 30 mi (50 km) to the south. This species requires open mature pine woodland and savannah habitat, and nests in groups with a home range of 100 to 400 acres (40.5 to 161.9 ha) (FWS 2000). This open habitat is typically maintained by periodic fire. Roosting and nesting cavities are excavated in live pine trees with heartwood at least 5.5 to 6 in. (14.0 to 15.2 cm) in diameter (FWS 2000). Longleaf, loblolly, and shortleaf pines are the most common trees used, with longleaf pine being preferred. Cavity trees average between 80 and 150 years in age, with 60 to 80 years generally being the minimum (FWS 2000). Trees that are selected are usually infected with the heart rot fungus, which is found primarily in old trees. Currently, no suitable habitat exists for this species at ANAD. The stands of mature forest currently present on the installation consist of oak and hickory canopy species. If future monitoring documents the presence of *Picoides borealis*, the U.S. Fish and Wildlife Service would be contacted to determine appropriate protection measures.

As the largest member of the genus *Myotis* in the eastern United States, *Myotis grisescens* (the gray bat), listed as endangered, can be distinguished from other bats by its unicolored dorsal fur. This monotypic species is found mostly in Alabama, northern Arkansas, Kentucky, Missouri, and Tennessee. Some *M. grisescens* also appear in parts of other states, including Georgia, Indiana, Illinois, and Kansas.

M. grisescens are restricted almost entirely to caves or cavelike habitats. They are highly selective of caves that provide specific temperature and roosting conditions. In winter, *M. grisescens* roost only in deep vertical caves with a temperature range of 6 to 11°C (42 to 51°F). As a result, only a small number of caves can be used throughout the year. Blowing Wind

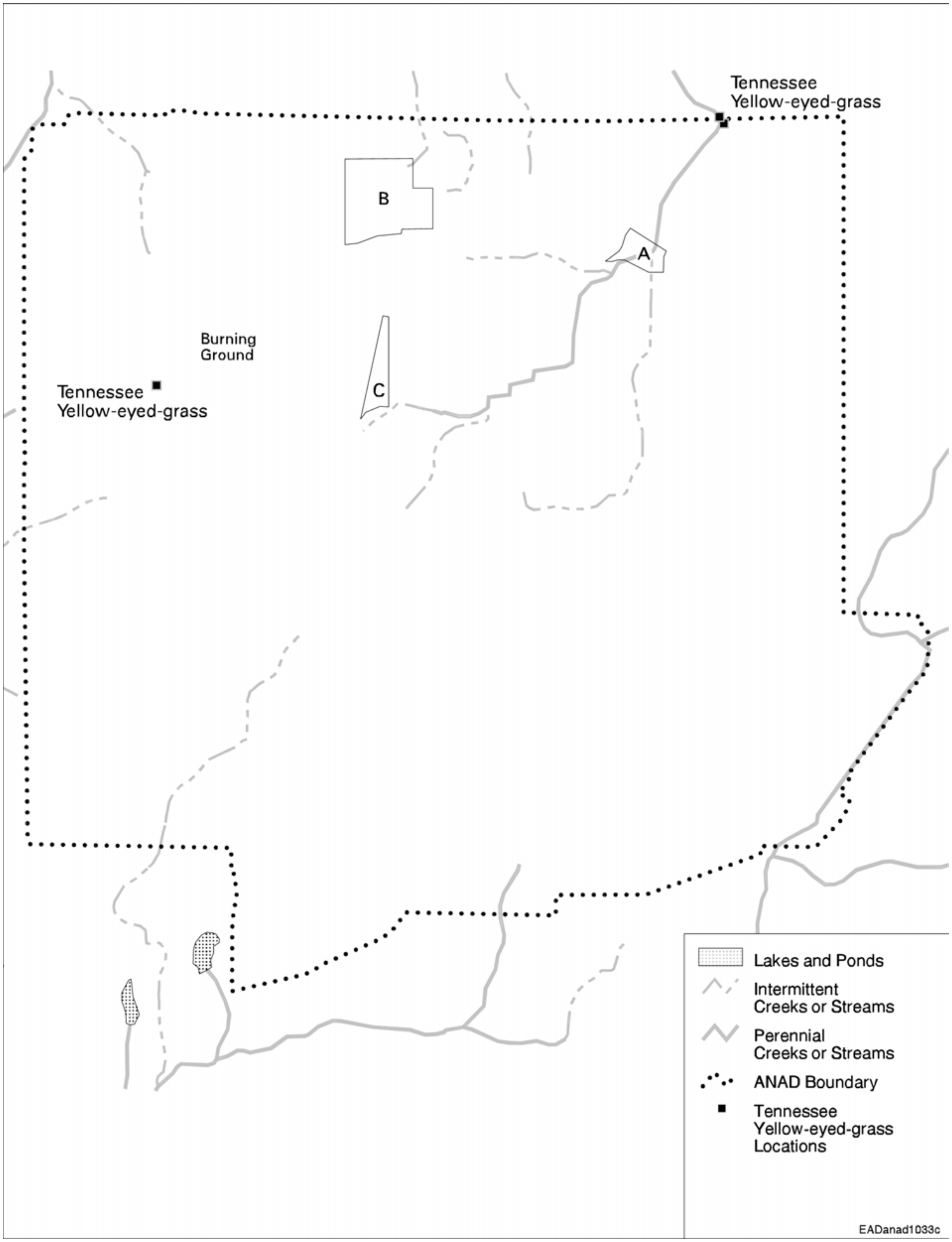

FIGURE 2 Locations of Existing Tennessee Yellow-Eyed Grass at Anniston Army Depot

Cave and Fern Cave National Wildlife Refuges, both of which are located in Decatur, Alabama, are known to be the most important summer and winter caves, respectively, for *M. grisescens.* The two caves are about 85 mi (136 km) northwest of ANAD in northern Alabama.

M. grisescens has been captured on the Pelham Range next to ANAD, although no roosts have been identified (U.S. Army 1998). The other closest known occurrence is located southwest of ANAD, approximately 43 mi (69 km) from Area A, 42 mi (67 km) from Area B, and 41 mi (66 km) from Area C.

Although *Myotis grisescens* is known to occur on the Pelham Range north of ANAD, it does not occur on ANAD. The small unnamed stream that passes through Area A is unlikely to provide foraging habitat for *M. grisescens* because of its narrow excavated channel. Facility construction would not affect caves used for hibernating, maternity, or roosting since suitable caves do not exist on ANAD or in the immediate vicinity. Foraging habitat, such as large stream corridors, lakes, or adjacent forests, also would not be affected by facility or infrastructure construction. Consequently, construction of an ACWA pilot test facility would not result in impacts on the *M. grisescens*.

Marshallia mohrii (Mohr's Barbara's buttons), listed as threatened, is a perennial herb with stems 1 to 2.5 ft (0.3 to 0.8 m) in height. The tubular-shaped flower is white, pale pink, and lavender and blooms from mid-May through June. Fruit is produced in July and August. This herb prefers moist prairielike openings in woodlands and is also found along shale-bedded streams. Associations with soils of the Conasauga-Firestone Association are known to occur. These are sandy clays with high organic content. *M. mohrii* can be found in either full sun or partial shade.

Once known to span three different physiographic regions (Cahaba Valley, Warrior Basin, and Coosa Valley) in Alabama and Georgia, *M. mohrii* is now found only in Alabama in Calhoun, Etowah, Bibb, and central Cherokee Counties. The location of *M. mohrii* closest to ANAD is in Calhoun County, approximately 4 mi (6 km) from Area A, 2 mi (3 km) from Area B, and 3 mi (5 km) from Area C.

Marshallia mohrii is not known to occur on ANAD, although it is present just to the west of ANAD and on Pelham Range to the north. Habitat associated with *M. mohrii* on the Pelham range consists of ephemeral streams with an open canopy maintained by frequent wildfires. Habitat for *M. mohrii* is not present at or near the proposed facility or infrastructure construction sites. Therefore, facility construction would not result in impacts on *M. mohrii*.

Species Description and Biology

The following description and habitat requirements of *Xyris tennesseensis* (Tennessee yellow-eyed grass) were obtained primarily from the U.S. Fish and Wildlife Service final rule for the determination of endangered species status (FWS 1991) and the recovery plan (FWS 1994), except where noted. *Xyris tennesseensis* is a perennial plant of the Xyridaceae family. It was listed by the U.S. Fish and Wildlife Service as an endangered species on July 26, 1991, and is known from only 14 extant populations. Eight of these occur in Alabama, with six others in

Georgia and Tennessee. These isolated populations typically occur on sites of less than 1 acre (0.4 ha) and range in size from a few dozen to thousands of individuals.

This species occurs in clumps from few to many bulbous-based individuals, with stems 2.3 to 3.3 ft (7 to 10 dm) in height. The leaves are basal, linear, and mostly 5.5 to 17.7 in. (14 to 45 cm) in length, the larger ones appearing slightly twisted. They are typically pink, red, or purplish in color at the base, while the blade is deep green. Leaves overlap each other one-eighth to one-third of their length. The inflorescence is a dense spike 0.4 to 0.6 in. (1.0 to 1.5 cm) long, solitary at the tip of a 1 to 2 ft- (3 to 7 dm-) long scape. The pale yellow flowers open in late morning and wither by mid-afternoon, with only one or a few flowers open at any time. Flowering takes place from August through September.

Habitat requirements for *X. tennesseensis* include open or thinly wooded areas, with soil that is moist to wet year round. This species typically occurs on seep-slopes, the banks or gravelly shallows of small streams, and in springy meadows. Water quality is critical to habitat suitability, as *X. tennesseensis* requires clean, spring-fed headwater streams or associated seeps. Unlike other species of *Xyris*, *X. tennesseensis* is found to grow in soils associated with calcareous rocks, and, as a result, soils near *X. tennesseensis* are generally neutral to alkaline. They can be found either in full sun or under partial shade. However, successful seed germination requires open, wet areas with high light levels. The principal pollinators of *X. tennesseensis* in a population north of ANAD are two species of solitary bees (Reisz Engineers 1998).

Threats to *X. tennesseensis* populations include habitat loss or degradation due to drainage or diversion of seeps or groundwater, agriculture or silvicultural uses and practices, gravel quarrying, and road construction and maintenance. Erosion due to timber operations upslope of *X. tennesseensis* populations may result in sedimentation into seeps and water quality degradation of the watershed, thus reducing habitat quality. In addition to such anthropogenic effects, natural succession in areas occupied by *X. tennesseensis* may result in overcrowding and decreased light levels due to woody plant encroachment. The invasion of kudzu into areas occupied by *X. tennesseensis* may threaten the viability of some populations (U.S. Army 1998). A recovery plan was prepared in 1994 that addresses the potential threats to *X. tennesseensis* and the actions needed for recovery (FWS 1994).

Impacts of ACWA Pilot Test Facilities on *Xyris tennesseensis* (Tennessee Yellow-eyed Grass)

Currently, two populations of *X. tennesseensis* are known to occur on ANAD (Figure 2). One is located within a seep near the burning ground in the west-central portion of the installation, approximately 1.3 mi (2.0 km) from the nearest proposed pilot test facility site. The other population is located on the banks of a perennial stream, near the northeast corner of the installation and approximately 4,600 ft (1,400 m) downstream from Site A. The closest population to Sites A, B, and C are located about 0.9 mi (1.4 km), 1.9 mi (3.6 km), and 1.4 mi (2.2 km) away, respectively.

Construction of the ACWA pilot test facilities would disturb 25 acres (10 ha) at the site selected. Neither Site A, B, nor C is situated on or near the two populations of *X. tennesseensis*. Site A is situated at the confluence of a small perennial and intermittent stream and includes approximately 12 acres (4.9 ha) of the 100-year floodplain. Consequently, construction activities at Site A may require the placement of culverts or the re-routing of stream channels.

Surface disturbance for electric, gas, sewer, and water lines is expected to occur during construction of new corridors as well as along previously disturbed rights-of-way. Construction activities for these utilities is estimated to disturb corridors of up to 30 ft (9.1 m) each in width (up to 120 ft [36.6 m] for electricity). Installation of utility lines within the new and existing utility corridors may result in disturbance to a number of streams crossing the corridors.

Sedimentation may occur within surface waters downstream of the facility construction site due to site grading and stream channel impacts. Construction in close proximity to the stream channels may also result in accidental releases of contaminants into the streams. Construction of the new utility corridors, north of Site A (adjacent to the perennial stream), and southwest of Site A (crossing the stream), may result in similar impacts. Biota within or along streams downgradient of Site A or the utility corridors could be adversely affected by uncontrolled runoff from the facility construction site or utility corridors. Consequently, the population of *X. tennesseensis* located along the perennial stream, downstream of Site A, could be indirectly affected by construction activities. However, the implementation of best management practices for erosion and sediment control would be expected to greatly reduce the potential for any adverse effects.

Although the locations of other areas disturbed during construction cannot be identified at this time, the following locations will be identified in the final engineering design: (1) the sanitary waste treatment facility, (2) electrical substation, (3) parking lots, (4) a construction sedimentation pond, and (5) routes for buried communication cables. However, for the purposes of this biological assessment, probable locations were assumed, to allow for an evaluation of impacts of construction activities on known locations of *X. tennesseensis* populations.

Conservation Measures (Protective Measures to Minimize Effects of the ACWA Project)

The FWS has developed a recovery plan in order to protect and manage the existing populations of *X. tennesseensis* and promote research on the species' ecological requirements and life history. Specific objectives and management actions at ANAD to protect *X. tennesseensis* populations should include these:

- Develop a management plan to maintain and enhance *X. tennesseensis* populations at ANAD. Development of the plan should be coordinated with the U.S. Fish and Wildlife Service. The plan would identify actions needed to maintain necessary conditions for viable *X. tennesseensis* habitat. Goals of the plan should include the attainment of self-sustaining populations. Once the plan is finalized, it should be incorporated into the current natural resource management plan.

- In consultation with the U.S. Fish and Wildlife Service, ANAD should develop *X. tennesseensis* population goals that are compatible with the military mission. The goals will rely on the 1994 survey results and the *X. tennesseensis* Recovery Plan for the US FWS Southeast Region.

- Establish study areas encompassing *X. tennesseensis* populations. The boundaries of primary and secondary habitat should be determined. Monitoring of populations should be conducted, at least annually, to determine if the populations are reproducing successfully and maintaining stable numbers or increasing. Monitoring should also identify potential threats to population viability. Establishment of the study areas will allow ANAD land management personnel to monitor the effectiveness of intermediate management actions.

- Specific intermediate management actions should be implemented at locations where *X. tennesseensis* is known to exist. Suitable light and moisture conditions should be maintained at the locations of known populations. Management actions could include elimination of invasive weeds, prevention of erosion and siltation, and prevention of damage from trampling or vehicles. Corrective action should be taken for imminent threats to populations.

If the U.S. Army decides to build an ACWA pilot test facility at ANAD, a project-specific mitigation plan would be developed for *X. tennesseensis*. The following measures would be taken to further protect *X. tennesseensis* populations and habitat once draft facility and infrastructure designs were developed and decisions were made on placement of structures and infrastructure requirements.

- Determine the precise locations of areas needed for construction of the ACWA site and support facilities, including fabrication and lay down areas.

- Conduct surveys for *X. tennesseensis* on the proposed facility sites and in areas likely to be impacted by construction of the proposed utility corridors, particularly in locations where construction may impact streams and ponds.

- Implement storm water runoff control measures and avoid construction activities or equipment within buffer areas along streams where practicable, to minimize impacts to water quality. The success of mitigation to prevent soil erosion and control storm water runoff in areas of steep terrain should be monitored regularly.

- Instruct construction managers on what types of habitat to avoid and who to notify if questions arise about possible impact to *X. tennesseensis* populations during the construction process.

Conclusion (Effect Determination)

Impacts to *X. tennesseensis* from construction associated with the ACWA pilot test facility and infrastructure cannot be accurately determined until all facility structure and infrastructure locations are identified. Figure 1 shows potential locations for access roads, the electrical power line, water lines, and gas lines that would be needed for construction at Sites A, B, or C. By superimposing known locations of *X. tennesseensis* populations over the infrastructure and site facility locations, potential areas of impact can be identified.

Although no populations of *X. tennesseensis* occur at proposed locations of the pilot test facility or infrastructure corridors, indirect impacts to *X. tennesseensis* may occur. Site A is located on a 100-year floodplain, and facility construction may require the placement of culverts or re-routing of the streams at Site A. Adverse impacts to the population downstream, along the perennial stream, may occur if re-routing of the stream is necessary. However, the implementation of best management practices to prevent soil erosion and control storm water runoff would be expected to greatly reduce or eliminate the potential for downstream effects. Potential indirect impacts to *X. tennesseensis* could be avoided by locating the ACWA facilities at Sites B or C.

Operation of the ACWA facilities is not expected to impact the *X. tennesseensis*. Trace elements released to the atmosphere by the destruction methodologies being tested would be less than 1.2×10^{-10} lb/day [5.4×10^{-8} g/day] and would be dispersed over a relatively large geographic area. Process water is either recycled or disposed of in a manner to meet existing regulations. No chemical agent (i.e., mustard or nerve agent) or degradation products would be released during normal facility operations. Sanitary effluent from the wastewater treatment facility would meet National Pollutant Discharge Elimination System standards set for the facility by the State of Alabama.

It is concluded that the construction of ACWA pilot test facilities and associated infrastructure “may affect, but is not likely to adversely affect” a population of *X. tennesseensis* if an ACWA facility were to be constructed at Site A. However, construction of ACWA facilities and associated infrastructure would have “no effect” on *X. tennesseensis* if the facility were to be built at Sites B or C. This conclusion is based on the proximity of project activities to known populations documented during surveys of the ANAD site (Godwin et al. 1994) and personal communications with on-site staff (Burns 2000).

Literature Cited

Bailey, M.A. 1997, *Survey of the Breeding Birds of Anniston Army Depot, Alabama*, final report, prepared by the Nature Conservancy/Alabama Natural Heritage Program, Montgomery, Ala., for the U.S. Fish and Wildlife Service, Southeast Region, Atlanta, Ga.

Burns, W., 2000, personal communication from Burns (Anniston Army Depot, Anniston, Ala.) to C.L. Tsao (Argonne National Laboratory, Argonne, Ill.), Aug. 10.

Godwin, J.C., J.L. Hilton, and M.A. Bailey, 1994, *Faunal and Floral Survey of Anniston Army Depot and Coosa River Annex: Federal Endangered, Threatened, and Candidate Species*, prepared by Alabama Natural Heritage Program, Alabama Department of Conservation and Natural Resources, State Lands Division, Montgomery, Ala., for Anniston Army Depot, Anniston, Ala.

Reisz Engineers, 1998, *Red-Cockaded Woodpecker Endangered Species Survey for the U.S. Army Chemical and Military Police Centers and Fort McClellan*, prepared by Reisz, Huntsville, Ala., for Fort McClellan, Ala.

Reisz Engineers, 1999, *Pollination Biology of the Endangered Plant,* Xyris tennesseensis (Xyridaceae).

U.S. Army, 1998, *Integrated Natural Resources Management Plan, 1998-2002, Fort McClellan, Alabama*, Directorate of the Environment.

U.S. Fish and Wildlife Service (FWS), 1991, "Endangered and Threatened Wildlife and Plants: Endangered Status for the Plant *Xyris tennesseensis* (Tennessee Yellow-Eyed Grass)," 56 *Federal Register* 34151, July 26.

U.S. Fish and Wildlife Service (FWS), 1994, *Recovery Plan for Tennessee Yellow-Eyed Grass* (Xyris tennessensis Kral), Jackson, Miss.

U.S. Fish and Wildlife Service (FWS), 2000, *Technical/Agency Draft Revised Recovery Plan for the Red-Cockaded Woodpecker (*Picoides borealis*)*, Atlanta, Ga.

U.S. Geological Survey (USGS), 1998, *Timber Land Tracts*, geospatial data for Anniston Army Depot.

Contacts Made

William Burns	Anniston Army Depot

Preparers

Chih L. Tsao	Argonne National Laboratory
Robert Van Lonkhuyzen	Argonne National Laboratory

APPENDIX E:

LETTERS OF CONSULTATION AND BIOLOGICAL ASSESSMENT FOR BLUE GRASS ARMY DEPOT

ARGONNE NATIONAL LABORATORY
9700 SOUTH CASS AVENUE, BUILDING 900, ARGONNE, ILLINOIS 60439 TELEPHONE: 630/252-8849

June 22, 2000

Mr. Lee Barclay, Field Supervisor
Cookeville Field Office
U. S. Fish and Wildlife Service
446 Neal Street
Cookeville, TN 38501

Dear Mr. Barclay:

The Department of Army, Assembled Chemical Weapons Assessment Program is preparing an environmental impact statement concerning its plans conduct pilot testing for the destruction of chemical agent and munitions stored at the Blue Grass Army Depot, located in Madison County, Kentucky about 3 mi southeast of the city of Richmond. The EIS will evaluate construction and operation of two different disposal technologies for destruction of chemical agent and munitions currently in storage at the depot. I've included a copy of the Federal Register Notice of Intent for the EIS.

We would appreciate receiving information on any federally-protected species that may be present at the Blue Grass site and in the site vicinity (within about a 30 mi radius of the site). Construction of the plant facilities, access rads, and other infrastructure upgrades would likely disturb about 40-50 acres. As part of the analysis of ecological impacts we will assess potential impacts to federally endangered, threatened, and candidate species. A list of these species and their residency status in the Blue Grass vicinity would be useful for the analysis.

Thank you in advance for your assistance.

Sincerely,

Edwin D. Pentecost

Edwin D. Pentecost, PhD
Environmental Assessment Division

Encl.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
446 Neal Street
Cookeville, TN 38501

July 25, 2000

Mr. Edwin D. Pentecost, Ph.D.
Argonne National Laboratory
9700 South Cass Avenue, Building 900
Argonne, Illinois 60439

Dear Dr. Pentecost:

Thank you for your letter and enclosure of June 22, 2000, regarding the preparation of an Environmental Impact Statement (EIS) for pilot testing of the destruction of chemical agents and munitions stored at the Blue Grass Army Depot in Madison County, Kentucky. U.S. Fish and Wildlife Service (Service) personnel have reviewed the information submitted and offer the following comments for consideration.

According to our records, the following federally listed endangered species occur on the Blue Grass Army Depot:

Running buffalo clover (*Trifolium stoloniferum*)
Indiana bat (*Myotis sodalis*)

According to our records, the following federally listed endangered species occur within a 30-mile radius of the Blue Grass Army Depot:

Running buffalo clover (*Trifolium stoloniferum*)
Indiana bat (*Myotis sodalis*)
Gray bat (*Myotis grisescens*)
Virginia big-eared bat (*Corynorhinus townsendii virginianus*)
Cumberland bean (*Villosa trabalis*)
Cumberland elktoe (*Alasmidonta atropurpurea*)
Little-wing pearly mussel (*Pegias fabula*)

Qualified biologists should assess potential impacts and determine if the proposed project may affect the species. We recommend that you submit a copy of your assessments and findings to this office for review and concurrence. A finding of "may affect" could require the initiation of formal consultation procedures.

These constitute the comments of the U.S. Department of the Interior in accordance with provisions of the Endangered Species Act (87 Stat. 884, as amended: 16 U.S.C. 1531 et seq.). We appreciate the opportunity to comment. Should you have any questions or need further assistance, please contact Steve Alexander of my staff at 931/528-6481, ext. 210, or via e-mail at *steven_alexander@fws.gov*.

Sincerely,

Lee A. Barclay

Lee A. Barclay, Ph.D.
Field Supervisor

DEPARTMENT OF THE ARMY
PROGRAM MANAGER FOR ASSEMBLED CHEMICAL WEAPON ASSESSMENT
ABERDEEN PROVING GROUND, MD 21010-5423

REPLY TO
ATTENTION OF

December 15, 2000

Assembled Chemical Weapons Assessment

Dr. Lee A. Barclay
U.S. Department of Interior
Fish and Wildlife Service
446 Neal Street
Cookeville, TN 38501

Dear Dr. Barclay:

We have completed a Biological Assessment for the proposed Assembled Chemical Weapons pilot test project at Blue Grass Army Depot (BGAD) in Madison County, Kentucky pursuant to the Endangered Species Act requirements. The biological assessment was prepared based on your response to our letter requesting information on federally listed endangered species that occur on BGAD (see your response to Dr. Edwin D. Pentecost, Argonne National Laboratory dated July 25, 2000). Dr. Pentecost contacted Mr. Steven Alexander with questions on endangered species distribution in preparing the assessment. I am enclosing a copy of the biological assessment for your review and concurrence.

If you have questions on the biological assessment, don't hesitate to contact Dr. Pentecost (630) 252-8849 or me at (410) 436-2210.

Sincerely,

Jon Ware

Jon Ware

Enclosure

Copies Furnished:
E. Pentecost, ANL
J. Elliott, BGAD

United States Department of the Interior

FISH AND WILDLIFE SERVICE
446 Neal Street
Cookeville, TN 38501

January 19, 2001

Mr. Jon Ware
Program Manager for Assembled Chemical
Weapon Assessment
Aberdeen Proving Ground, Maryland 21010-5423

Re: FWS #01-878

Dear Mr. Ware:

Thank you for your letter and enclosure of December 15, 2000, transmitting a biological assessment for the running buffalo clover relative to the proposed Assembled Chemical Weapons Pilot Test Project at the Blue Grass Army Depot in Madison County, Kentucky. Fish and Wildlife personnel have reviewed the document and we offer the following comments.

The biological assessment concludes that the proposed action is likely to adversely affect running buffalo clover. This determination requires initiation of formal consultation. However, the document states that construction impacts to running buffalo clover associated with the proposed action can not be accurately determined until decisions are made regarding facility structure and infrastructure locations. The document also indicates that protective measures would be implemented to avoid adverse effects to the species during construction of the facility, access roads, and utility lines.

If you wish to proceed with the proposed action based on the finding made in the biological assessment, we recommend that you submit a letter to this office requesting initiation of formal consultation. Your request should include the following:

1. A description of the action to be considered.

2. A description of the specific area that may be affected by the action.

3. A description of any listed species or critical habitat that may be affected by the action.

4. A description of the manner in which the action may affect any listed species or critical habitat and an analysis of any cumulative effects.

5. Relevant reports, including any environmental impact statement or environmental assessment prepared.

6. Any other relevant available information on the action, the affected species, or critical habitat.

If you wish to re-evaluate the proposed action and its potential effects to the running buffalo clover pending final decisions on specific locations of the facility and associated roads and utility lines, please submit a supplement to the biological assessment with a determination of effect when those decisions have been made. We will review the supplement and provide a response at that time. This may be done concurrently with development of the environmental impact statement that is being prepared for this action.

Thank you for the opportunity to comment on this action. If you have any questions, please contact Jim Widlak of my staff at 931/528-6481, ext. 202.

Sincerely,

Lee A. Barclay

Lee A. Barclay, Ph.D.
Field Supervisor

BIOLOGICAL ASSESSMENT FOR THE ASSEMBLED CHEMICAL WEAPONS ASSESSMENT PROGRAM AT BLUE GRASS ARMY DEPOT, RICHMOND, KENTUCKY

Submitted to

Dr. Lee A. Barclay
U.S. Department of Interior
Fish and Wildlife Service

by

John Ware
PM Assembled Chemical Weapons Assessment
Aberdeen Proving Ground, MD 21010-5424

December 2000

Biological Assessment for the Assembled Chemical Weapons Assessment Program at Blue Grass Army Depot, Richmond, Kentucky

Background

The Department of Defense (DOD) was directed by Congress as part of the Omnibus Consolidated Appropriations Act of 1997 (Public Law 104-208) to "demonstrate not less than two alternatives to the baseline incineration process for demilitarization of assembled chemical munitions". The DOD also was directed by Congress in this legislation to establish an Assembled Chemical Weapons Assessment (ACWA) Program. The Program Manager for ACWA announced the DOD's intent to prepare an Environmental Impact Statement (EIS) on plans to design, construct, and operate one or more pilot test facilities for assembled chemical weapon destruction technologies at one or more storage sites (Fed. Register, Vol. 65, No. 73, pp. 20139-20140, August 14, 2000). Potential locations for pilot testing include Anniston Army Depot in Alabama, Pine Bluff Arsenal in Arkansas, Pueblo Chemical Depot in Colorado and the Blue Grass Army Depot (BGAD) in Kentucky.

In fulfilling its responsibilities under the National Environmental Policy Act of 1969 and the Endangered Species Act of 1974, the DOD has prepared this biological assessment of potential impacts to federally-listed species from constructing and operating ACWA pilot test facilities at the BGAD. The BGAD is an active DOD installation in Madison County, Kentucky occupying 14,596 ac (5909 ha) located about 3.5 miles (5.6 km) south of Richmond. The installation facilities consist of 902 earth-covered igloos, 20 warehouses, 12 above ground magazines, 11 maintenance buildings, and 207 facilities used for administration, operations, medical care, and housing. BGAD allows deer hunting on designated areas of the installation during on specified dates during the deer hunting season. Livestock grazing is also permitted on designated tracts of land at BGAD throughout the year.

Project Description

The ACWA pilot test facilities would occupy an area of about 22 ac (8.9 ha) located adjacent to the Chemical Agent Storage Area in the north-central portion of BGAD (see Figure 1). Two alternative locations for the test facilities are being evaluated in the EIS; one is located along the southeast perimeter of the storage area (Area A) and a second is located along the western perimeter of the storage area (Area B). Each area encompasses about 110 ac (44.5 ha). The ACWA technologies being evaluated are intended to provide DOD with valuable information in deciding on the technology to be selected for disposal of nerve agent and mustard gas currently contained in munitions stored in igloos at the BGAD. The two treatment technologies that would be tested are neutralization followed by super critical water oxidation and neutralization followed by biological treatment. In order to dispose of all nerve and mustard gas at BGAD the ACWA facilities are assumed to operate for about 36 months as a bounding case for the EIS analysis. The following paragraphs provide a brief overview of the treatment technologies.

Neutralization-Super Critical Water Oxidation
After disassembling the munitions to access the agent and energetics (explosives and propellants) this technology would neutralice the chemical agents and energetics with water and caustic chemicals. The products of the neutralization would then be destroyed using the Supercritical Water Oxidation (SCWO) process. SCWO mineralizes the resulting chemicals at temperatures and pressures above the critical point of water (705.2 F. and 3,204.6 psia). Effluents could be held and tested before release through pollution processes. Process water would be reused and solid residues would be disposed of in a hazardous waste landfill.

Neutralization-Biotreatment
After disassembling the munitions to access the agent and energetics this technology would neutralize the chemical agents with water and caustic chemical. The products of neutralization would then be destroyed in a biological treatment process operated at temperature and pressures near ambient conditions. Organic vapors and odors would be passed through an air pollution control process. Recovered metal parts and dunnage would be treated at high temperatures and effluents would be held and tested before release through the pollution control processes. Process water would be reused and solid residues would be disposed on in a landfill.

No liquid wastes produced by the two treatment processes will be released to the environment. Any process-generated liquids will be disposed of properly in containers suitable for disposal in an offsite licensed disposal facility. During pilot testing of the two technologies minor amounts of trace metals (i. e., $< 10^{-8}$ lbs./yr.) and organic compounds will be emitted to the atmosphere. Monitoring of emissions would likely be required under the RCRA permit that would be required for operation of the ACWA facilities. Operation of the facilities will require laundry facilities for workers and construction of a sanitary waste treatment facility.

In addition to land required for the ACWA pilot test facilities about 48 ac (19.4 ha) could be disturbed during construction of the site infrastructure. These areas of disturbance include a new north-south access road connecting the BGAD boundary with the ACWA facilities, road widening, parking lots, vehicle and parts storage buildings, a sedimentation pond to control construction runoff, two electrical substations, rights-of-ways for gas, water, electrical power lines, a sanitary sewer line, and buried communication lines.

Affected Environment

The BGAD is located in the Outer Bluegrass Subsection of the Low Plateaus Province in east central Kentucky. As a result of grazing much of the installation is fescue-dominated grassland with isolated stands of black cherry (*Prunus serotina*), black locust (*Robinia pseudoacacia*) and brambles (*Rubus, spp.*). Other portions of the installation where grazing no longer occurs have been planted in oaks and other hardwood tree species to create larger, contiguous blocks of forest habitat (BGAD 2000a). Forests on well-drained upland areas of BGAD include bluegrass mesophytic cane forest, bluegrass savanna-woodland, calcareous subxeric forest and calcareous mesophytic forest (BGAD 2000a). Canopy dominants vary based on soil moisture, aspect, and past disturbance. Common canopy trees include black walnut (*Juglans nigra*), Ohio buckeye (*Aesculus glabra*), bur oak (*Quercus macrocarpa*), chinkapin oak (*Q. muhlenbergii*), shumard oak (*Q. shumardii*), white oak (*Q. alba*) pignut hickory (*Carya glabra*), shagbark hickory (*C.

ovata), honey locust (*Gleditsia triacanthos*), sugar maple (*Acer saccharum*), and white ash (*Fraxinus americana*). Understory species have been severely impacted by cattle grazing.

Areas A and B support different plant communities. Area A is an ungrazed grassland plant community with a few scattered American sycamore (*Platanus occidentalis*) trees in the eastern portion. Immediately northeast of Area A is a bluegrass mesophytic cane forest. Area B is comprised of a stand of mixed hardwood trees on a relatively level area immediately west of the Chemical Agent Storage Area. An intermittent stream traverses the western portion of the area. Area B is within a livestock-grazing tract that encompasses most of the western portion of BGAD.

Endangered Species at Blue Grass Army Depot

The only federally-listed endangered species documented from surveys at BGAD is the running buffalo clover (*Trifolium stoloniferum*). Mist net surveys for bats inhabiting or visiting BGAD have failed to detect the endangered Indiana bat (*Myotis sodalis*). Six mist net surveys conducted along Muddy Creek located south and east of the project area during the summer of 1993 recorded four bat species (Bloom, et al., 1995). Although the Indiana bat is thought to occur at BGAD and in the general vicinity (letter dated July 25, 2000 from Lee Barclay, U.S. Fish and Wildlife Service to Edwin Pentecost, Argonne National Laboratory) surveys have yet to document its presence on the installation. Based on discussions with natural resources staff at BGAD during an ACWA site visit in June 2000, there are no documented records of the Indiana bat on the installation. Since 1993 ongoing surveys by the Kentucky Nature Preserves Commission, Kentucky Nature Conservancy, and Eastern Kentucky University researchers have not detected the Indiana bat. Therefore, this biological assessment addresses only running buffalo clover.

The RBC was listed as endangered, effective July 6, 1987 by the U.S. Fish and Wildlife Service (Fed. Register, Vol. 52, No. 108, pg. 21478, June 5, 1987). Historically RBC was documented as occurring in Kansas, Missouri, Arkansas, Illinois, Indiana, Ohio, Kentucky, and West Virginia. At the time of listing the only confirmed populations were from two locations in West Virginia. After field observations at documented locations in these states, Brooks (1983) concluded that *T. stoloniferum* was possibly extinct. Bloom, et al., (1995) reported that the Kentucky Nature Preserves Commission had documentation in 1994 of *T. stoloniferum* occurring in nine Kentucky counties all within the Bluegrass Region. Twenty-five populations were known at Kentucky locations in addition to populations on the BGAD. Bloom, et al., (1995) also reported that experts from Ohio, Indiana and West Virginia confirmed the existence of multiple populations in those states since 1987. The increase in known populations since July 1987 may be a function of more extensive surveys by qualified botanists rather than an increase in the population within the RBC's geographic range. Recent observations at BGAD have also discovered new populations since the surveys in 1993 and 1994 (BGAD 2000b).

Current Status of Running Buffalo Clover at Blue Grass Army Depot

Bloom, et al., (1995) reported that surveys conducted in 1993 and 1994 at BGAD yielded 145 patches of RBC. A patch was defined as "one or more clustered running buffalo clover plants at least 7.5 m from any other Running Buffalo Clover plants". Patch sizes ranged from one plant in an area of approximately one square foot (0.09 sq m) to hundreds of plants covering over 1200 square feet (>108 sq m). Most patches contained less than 20 plants and covered less than 100 square feet (<9 sq m). The known locations of RBC at BGAD are shown in Figure 1. In May 1999 a collaborative effort by BGAD, Eastern Kentucky University, the Kentucky Office of The Nature Conservancy, and the Kentucky Nature Preserves Commission was made to evaluate a random sample from the 145 patches located in 1994. The study was intended to document site condition and compare data with previously collected information (BGAD 2000b). Study results indicated a decline or loss of 8 of the 30 patches examined that were surveyed and described in 1994, and a change in RBC patch condition based on dense cover from competing vegetation. Healthier populations were found along deer trails and areas of stream scouring. Flowering in some patches, however, was more prolific in 1999 than in 1994. Detailed plans for protection and continued monitoring of RBC on BGAD are described in the Endangered Species Management Plan and Environmental Assessment (BGAD 2000b). Protection measures and planned management goals are discussed later in the biological assessment.

Species Description and Biology

The following description of RBC is taken mostly from Bloom, et al., (1995) and BGAD (2000b): Running buffalo clover (*Trifolium stoloniferum*) is a glabrous, stolon forming perennial species of the Pea family (Fabaceae). It possesses trifoliate leaves that grow from a central rooted crown (referred to as the mother plant) and at nodes along the stolons. The leaves are often typically short making the plant difficult to detect. Plants vary in height from 3-20 inches (7.6 – 50.8 cm) above the soil surface. Some leafy nodes become rooted during the growing season both early in the season and in late summer when the stoloniferous nodes and mother plant senesce. The mother plant typically produces 1-2 flower heads in May and June at BGAD. Fruit forms in July. Flowers are typically white with purple streaking and about 1 inch wide. Each flower stem has a pair of opposite leaves below the flower head. Stipules are green and leafy. RBC differs from white clover (*T. repens*) by having leafier stipules and the pair of leaves on the flower stalk. It also differs from two other clover species, red clover (*T. pratense*) by the flower color and lack of pubescence, and from alsike clover (*T. hybridum*) by its stoloniferous habit.

RBC grows on mesic, well-drained soils with a somewhat open canopy cover having light intensity of about 40-60% full sunlight (Bloom, et al., 1995). It is a perennial species that occurs in savannas, open woodlands, along floodplains, and mesic terraces (BGAD 2000b). Plants seem to thrive in areas where moderate disturbance has reduced competition from other herbaceous and shrub vegetation. Sources of disturbance include livestock grazing, light trampling of floodplain areas, stream scouring, and mowing. Also, the exotic species, scorpion grass (*Microstegium vimineum*) occurs in dense stands in the herbaceous layer of open canopy floodplain areas where many RBC stands have been documented (Bloom, et al., 1995). Scorpion grass was reported at all but 17 of the 145 patches where RBC was found. In many areas where RBC was found during the 1993 and 1994 surveys, scorpion grass represented 75-100% of the herbaceous ground cover. Such dense stands are likely to be unfavorable for the continued survival of RBC, competing for light and nutrients in specific patches. Bloom, et al., (1995) reports that some success has occurred on BGAD where experimental applications of the monocot-specific herbicide POAST™ was used on dense scorpion grass patches prior to seed production in September. RBC plants survived the application of herbicide while scorpion grass was completely eliminated. Bloom, et al., (1995) suggest that a multi-year application of herbicides may be necessary to eliminate scorpion grass from RBC patches to assure its continued survival at BGAD. Such applications may be required since scorpion grass seeds can remain viable in the soil for several years.

Impacts of ACWA Pilot Test Facilities on Running Buffalo Clover

Construction of the ACWA Pilot Test Facilities will disturb about 22 ac (8.9 ha) at the site selected. Neither Area A nor B is in locations where RBC has been detected during field surveys (see Figure 1). Although surveys have not detected RBC patches at Areas A or B, adjacent areas support open canopy floodplain forest that is considered suitable habitat. Potential RBC habitat along intermittent streams and floodplain forest at BGAD in the vicinity of the candidate ACWA sites is shown in Figure 2. Potential impacts to RBC could occur from construction of a new access road to Area B, a 69 kV electric transmission line, and from new gas, water, and sanitary sewer pipelines needed to support the ACWA site. These rights-of-ways will be subject to surface disturbance during infrastructure construction that may traverse extant patches of RBC along the Muddy Creek and tributaries located south and east of Areas A and B.

Surface disturbance for gas and water lines is expected to occur along previously disturbed road rights-of-ways. Gas and water pipelines are estimated to disturb a right-of-way up to 60 ft (18.3 m) in width. The 69 kV power line will require a 40-foot (12.2 m) wide right-of-way to meet National Electrical Safety Code requirements (Institute of Electrical and Electronics Engineers, Inc., 1987). Approximately 20 and 29 wooden poles with an average 320-ft (97.6 m) spacing would be needed to supply power to Areas A and B respectively. The power line would extend from an existing power line traversing the northern portion the BGAD, south to onsite highway Route 2 and then turn west to the ACWA site. A maximum area of approximately 900 ft^2 (83.6 m^2) would be disturbed at each wooden pole and conductor stringing location during construction. The locations of other areas disturbed during construction cannot be identified at this time. Locations of the following areas will be identified in the final engineering design: the sanitary waste treatment facility, electrical substation, parking lots, a construction sedimentation pond, and routes for buried communication cables. For purposes of this biological assessment however, probable locations were assumed to allow an evaluation of construction activities on known location of RBC populations.

Conservation Measures (Protective Measures to Minimize Effects of ACWA Project)

The BGAD has several goals and plans in place to protect and manage both existing patches of RBC and potential habitat. Potential habitat consists of about 1,000 ac (404.9 ha) along floodplains adjacent to perennial streams. In addition, BGAD intends to follow measures and goals being developed in the Draft Recovery Plan for RBC currently being prepared by the U.S. Fish and Wildlife Service. Specific goals, objectives and actions implemented at BGAD (BGAD 2000b) to protect RBC patches include:

- Develop the BGAD Endangered Species Management Plan (ESMP) with input and interaction from the U.S. Fish and Wildlife Service, Kentucky Nature Preserve Commission, and the Kentucky Office of The Nature Conservancy. Once the ESMP is finalized it will be

incorporated into the BGAD's Integrated Natural Resources Management Plan. A Draft Final ESMP was prepared in June 2000 (BGAD 2000b)
- Conduct an installation-wide survey of RBC beginning in Spring 2000. The objective of the survey is to establish a baseline for evaluating future RBC populations, goals, and management needs for monitoring management success and tracking of future population trends
- Assess the current status of RBC populations on BGAD using the Spring 2000 survey data. New patches will be marked with a sign designating presence of a threatened or endangered species at a specific location
- Develop and initiate intermediate actions to maintain and enhance RBC populations and suitable habitat at BGAD. These actions will be developed with input from the U.S. Fish and Wildlife Service
- Establish study areas encompassing RBC patches. Specific intermediate management actions will be implemented at certain locations. Establishment of the study areas will enable BGAD land management personnel to monitor effectiveness of intermediate management actions
- Conduct annual RBC population counts during the first five years the ESMP is in force using the same data collection and analysis techniques used during the Spring 2000 survey. Results will allow land managers to alter or cancel management activities based on population trends
- In consultation with the U.S. Fish and Wildlife Service, BGAD will develop RBC population goals that are compatible with the military mission. The goals will rely on the Spring 2000 survey results and the Draft RBC Recovery Plan.

If the U.S. Army decides to build an ACWA pilot test facility at BGAD a project specific mitigation plan will be developed for RBC. The following measures will be taken to further protect RBC patches and habitat once draft facility and infrastructure designs are developed and tentative decisions are made on placement of structures and infrastructure requirements.

- Attempt to locate facilities away from existing and potential RBC habitat
- Evaluate how utility corridors and roadways can be moved to avoid or span known RBC patches and potential habitat
- Determine the location and precise locations for fabrication and laydown areas needed for construction of the 22 ac (8.9 ha) ACWA site and support facilities
- Conduct clearance surveys for RBC in areas likely to be impacted by construction
- Instruct construction managers on what types of habitat to avoid and whom to notify if questions arise about possible impact to RBC patches during the construction process
- Have a qualified botanist on site during construction to assure RBC patches are avoided to the extent possible

Conclusions (Effects Determination)

Construction impacts on RBC associated with the ACWA pilot test facility and infrastructure cannot be accurately determined until decisions are made on facility structure and infrastructure locations. Potential habitat and known locations are shown in Figures 1 and 2. The distribution of RBC on the northern portion of BGAD is also shown on a topographic map of the project area (see Figure 3). Figure 4 shows potential locations for access roads, the 69 kV electrical power line, water lines, gas lines, and fiber optic cable communication lines that would be needed for construction at either Area A or B. By superimposing locations of RBC patches identified in surveys conducted in 1993 - 1994 over the infrastructure and site facility locations, potential areas of impact can be identified. Some flexibility to avoid potential offsite impacts to RBC is possible in locating the ACWA facilities in Areas A and B since about 22 ac (8.9 ha) of the 100 ac (40.5 ha) in each area will be required. A project decision on locations of new access roads or existing BGAG roads (depicted as Option 1 or 2 in Figure 4) could potentially impact previously identified patches of RBC southwest of Area B. Eight separate patches were recorded in close proximity [(i.e., locations less than 100 ft (30.5 m)] to existing roadways within this area. Construction of the communication cable along the road right-of-way under Option 1 could have both negative and positive impacts to existing RBC populations. New habitat could be created by removal of the herbaceous or shrub ground cover along the right-of-way by stringing the fiber optic cable, which could enhance invasion of disturbed areas by RBC following cable installation. To the extent that known populations could not be avoided, direct loss of individual plants or patches would occur. Some loss of RBC plants or potential habitat could result from sediment buildup along rights-of-ways during construction activities, if runoff from disturbed sites occurs.

Construction of the 69 kV power line to Area A would traverse floodplain habitat near known RBC locations along tributaries of the Muddy Creek to the northeast (see Figure 4). Impacts can be minimized or avoided if tower spacing is adjusted to avoid known RBC patches. Clearance surveys prior to decision making on tower and conductor stringing locations would further reduce potential construction impacts.

Construction at the ACWA site would disturb about 22 ac (8.9 ha). A 1.4 ac (0.6 ha) sedimentation pond would be installed to control runoff from construction areas, and avoid sediment buildup in intermittent streams.

Operation of the ACWA facilities is not expected to impact the RBC. Trace elements released to the atmosphere by the destruction methodologies being tested for chemical agent destruction would be $<10^{-8}$ lbs./yr. and be dispersed over a relatively large geographic area. Process water is either recycled or disposed of in a manner to meet existing regulations. No chemical agent (i.e., mustard gas or nerve gas) or degradation products would be released during normal facility operations. Sanitary effluent from the wastewater treatment facility would meet National Pollutant Discharge Elimination System standards set for the facility by the State of Kentucky.

It is concluded that the construction of ACWA facilities and associated infrastructure “may affect and is likely to adversely affect” some individual patches of RBC. This conclusion is based on the proximity of project activities to known patches documented during the 1993 and 1994 surveys. Once BGAD personnel receive the results of spring surveys conducted in 2000, more current information will be available on patch distributions. This new information will be made available to the U.S. Fish and Wildlife Service once reviewed by the BGAD environmental staff.

Literature Cited

BGAD. 2000a. Integrated Natural Resources Management Plan and Environmental Assessment, Blue Grass Army Depot, Richmond, Kentucky. Prepared by Gulf Engineers and Consultants, Prepared for U.S. Army Corps of Engineers, Louisville District, Louisville, KY. 128 pp.

BGAD 2000b. Endangered Species Management Plan and Environmental Assessment, Blue Grass Army Depot, Richmond, Kentucky. Prepared by Gulf Engineers and Consultants, Prepared for U.S. Army Corps of Engineers, Louisville District, Louisville, KY. 25 pp. + appendices.

Bloom, T., Cicerello, R. R., and B. Palmer-Ball, Jr. 1995. Rare Species and Aquatic Faunal Survey of Bluegrass Army Depot, Kentucky, Prepared by Kentucky State Nature Preserves Commission, Prepared for Bluegrass Army Depot, Richmond, Kentucky.

Brooks, R. E. 1983. *Trifolium stoloniferum*, Running Buffalo Clover: Description, Distribution and Current Status. Rhodora 85: 343-354.

Institute of Electrical and Electronics Engineers, Inc. 1987. Tables from the National Electrical Safety Code, An American National Standard. The Institute of Electrical and Electronics Engineers, Inc., New York, NY, 64 pp.

Contacts Made

Lee Barclay	U.S. Fish and Wildlife Service
Steven Carpenter	U.S. Fish and Wildlife Service
Mary Murray	Blue Grass Army Depot
Joseph Elliott	Blue Grass Army Depot

Preparer

Edwin D. Pentecost	Argonne National Laboratory

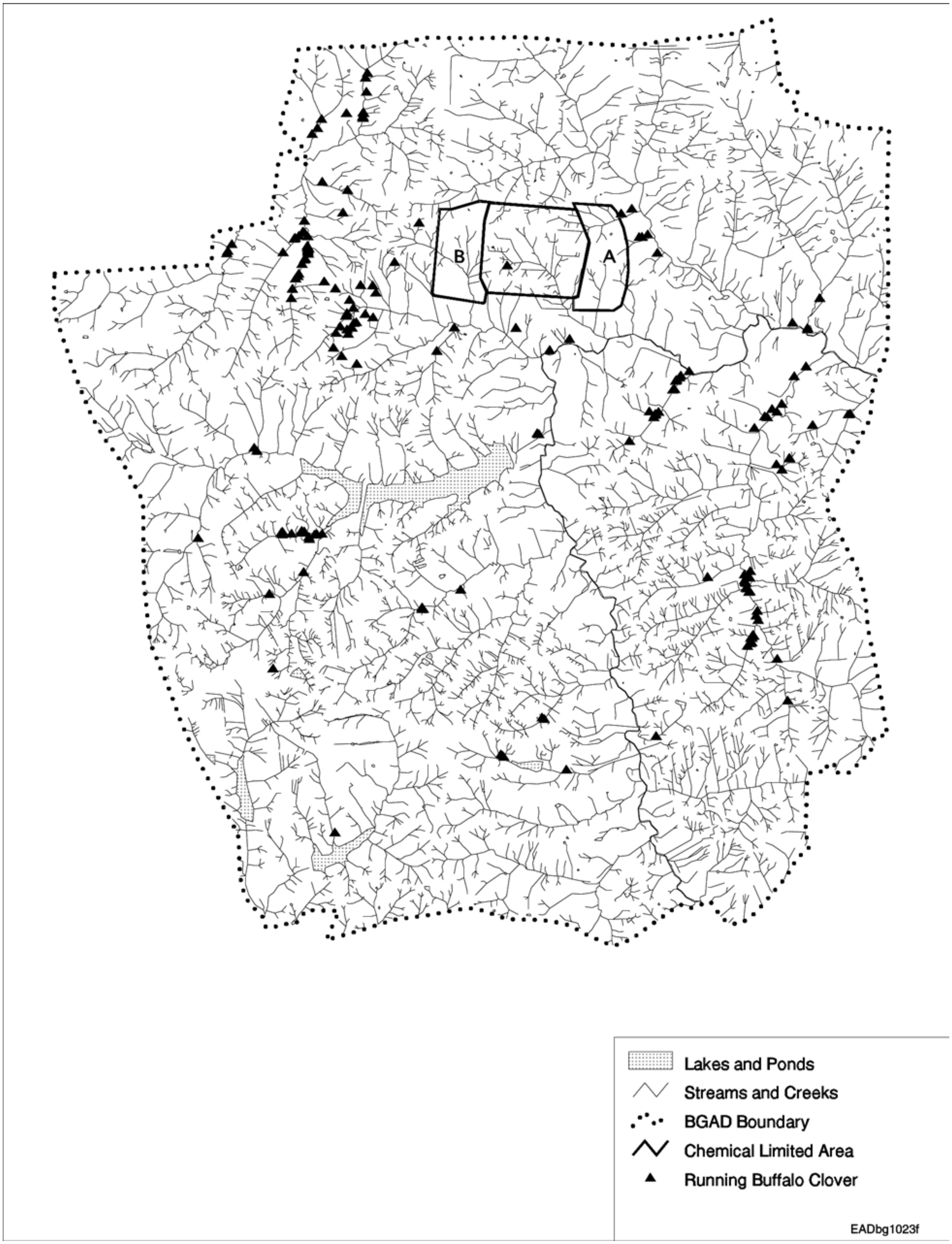

FIGURE 1 Blue Grass Army Depot Showing Chemical Storage Area and Possible Locations (A&B) for ACWA Pilot Test Facilities

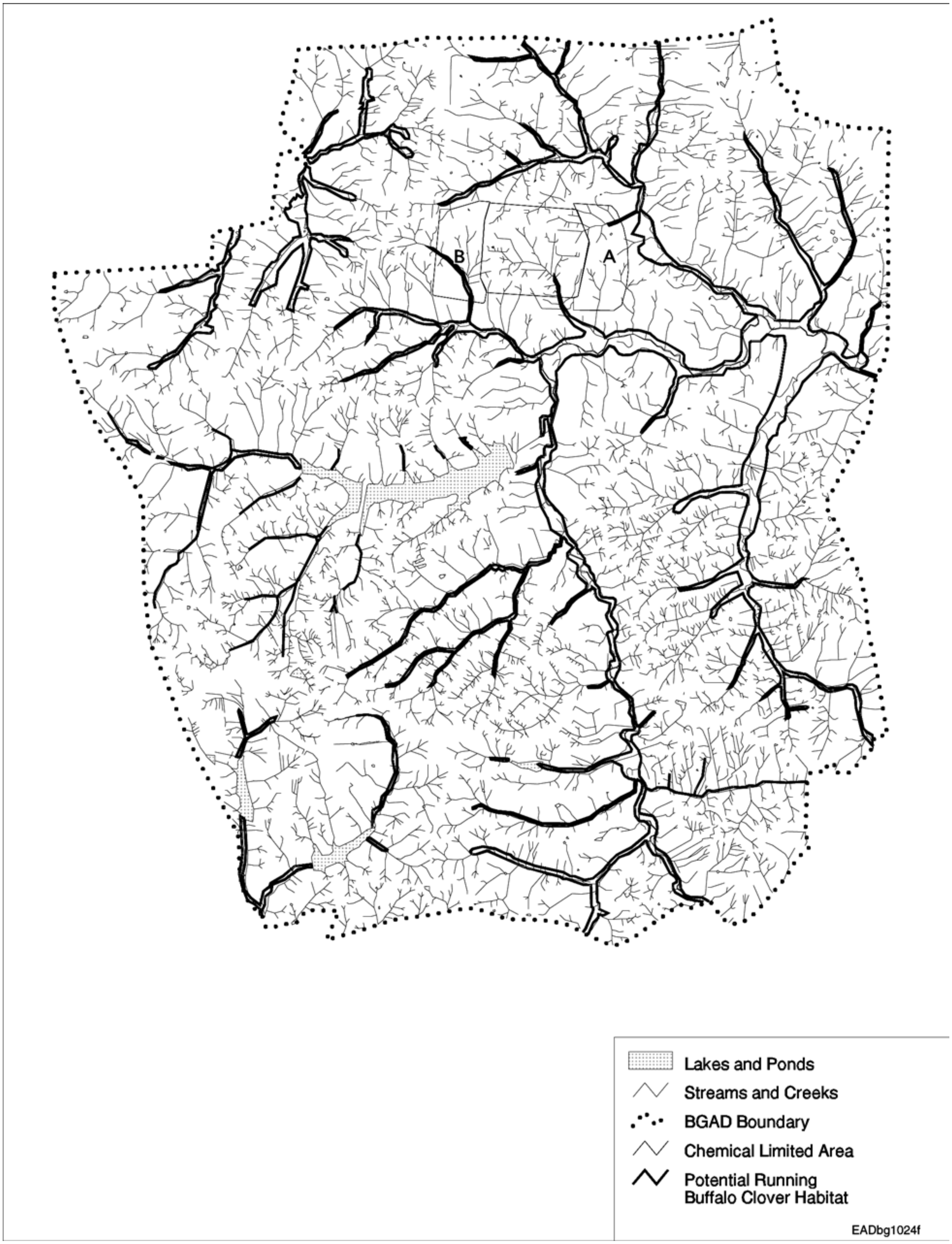

FIGURE 2 Potential Habitat for Running Buffalo Clover (Trifolium Stoloniferum) at Blue Grass Army Depot

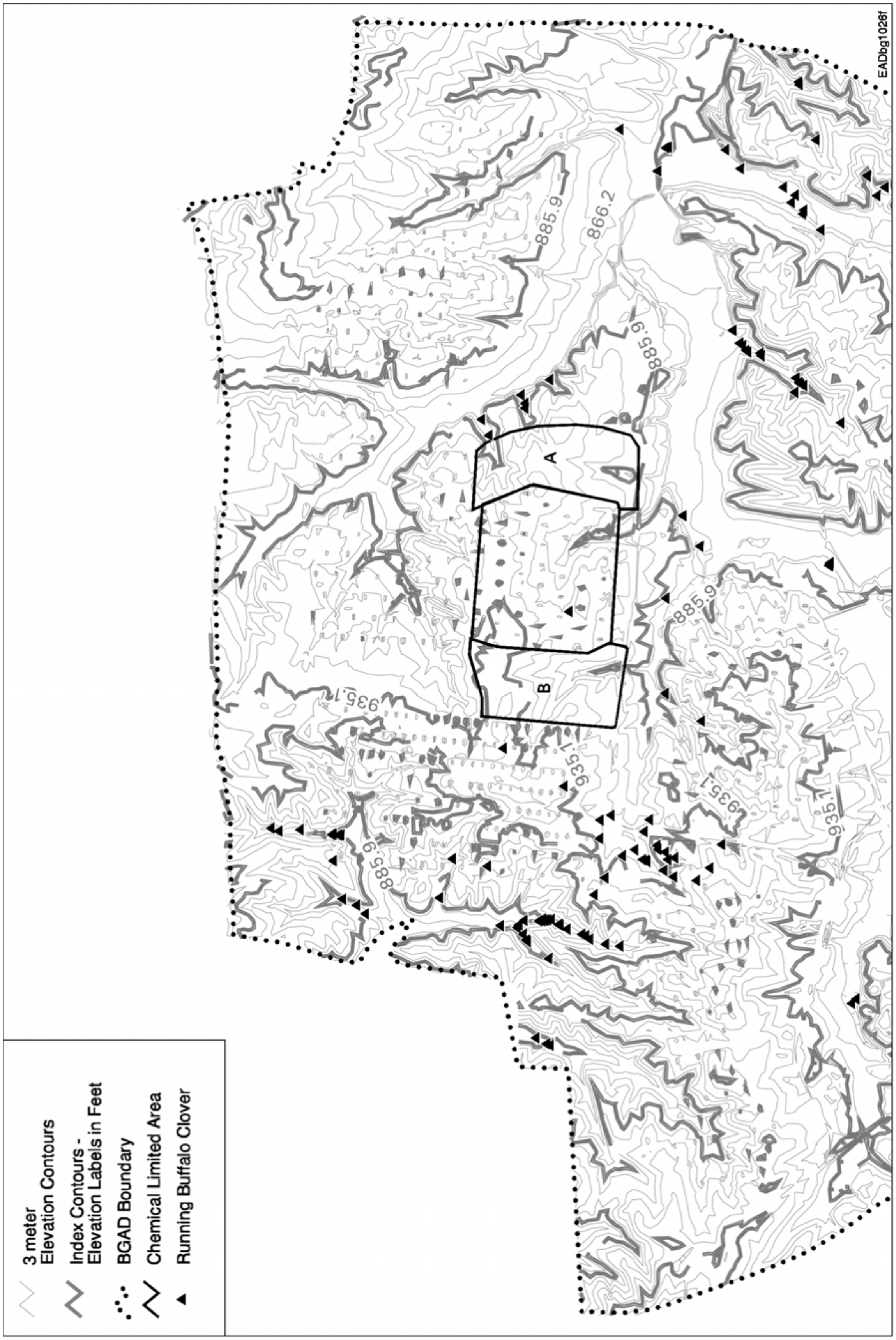

FIGURE 3 Elevational Contours at Blue Grass Army Depot in the Vicinity of Alternative ACWA Sites (Areas A & B)

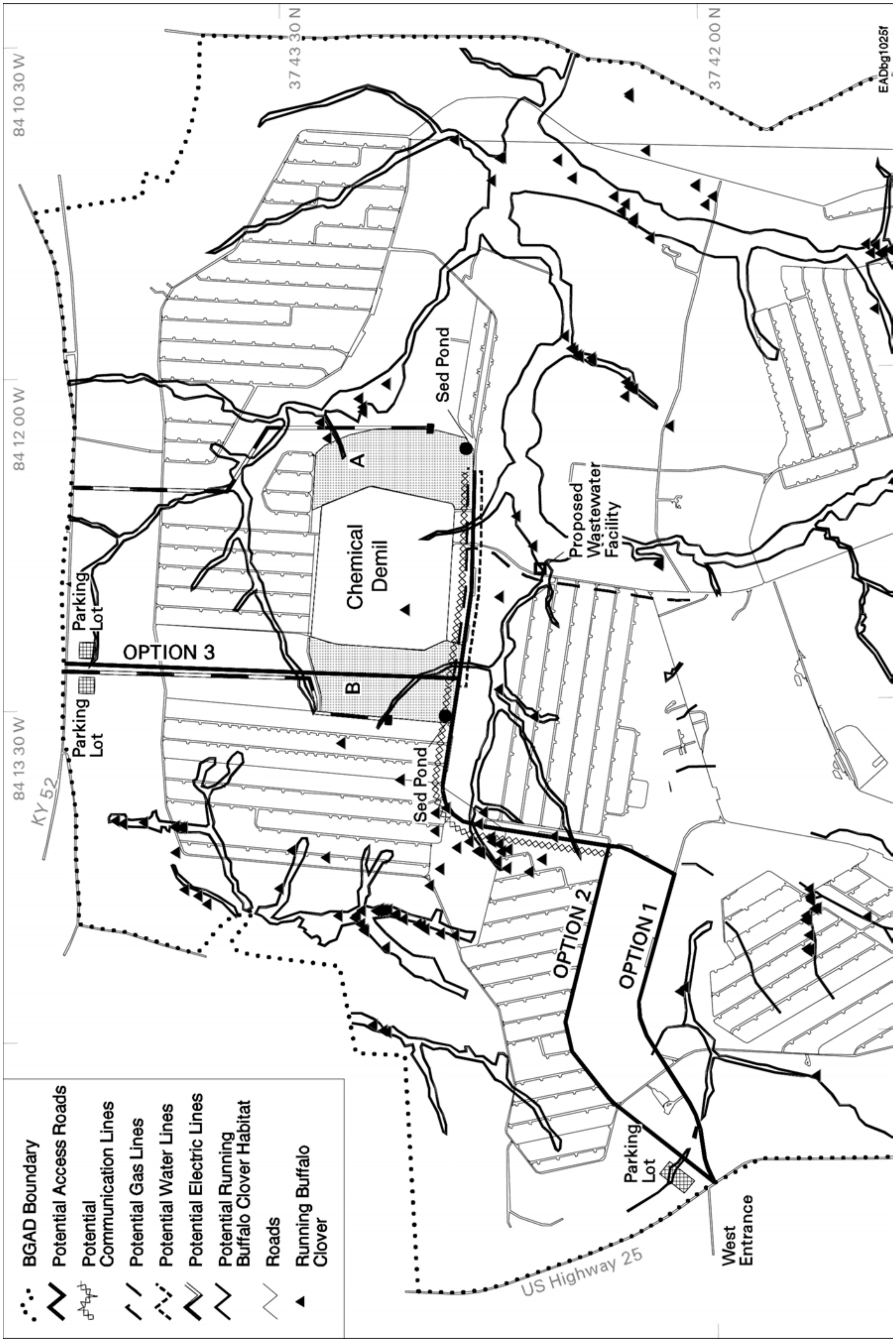

FIGURE 4 Potential Areas of Disturbance for Construction of ACWA Pilot Test Facilities at Blue Grass Army Depot

APPENDIX F:

CULTURAL RESOURCES: HISTORIC CONTEXTS AND CONSULTATION LETTERS

APPENDIX F:

CULTURAL RESOURCES: HISTORIC CONTEXTS AND CONSULTATION LETTERS

F.1 ANNISTON ARMY DEPOT PREHISTORIC AND HISTORIC CONTEXT

F.1.1 Prehistory

The prehistoric and historic context for known and potential cultural resources at Anniston Army Depot (ANAD) has been discussed by Dye (1984), U.S. Army Corps of Engineers (COE 1997), and Jordan and Whitley (1999) and is only briefly summarized here. Although the Coosa Valley has a long history of occupation, the uplands that form ANAD were peripheral to the main areas of occupation. Except for areas excluded for safety reasons, all of the undisturbed areas of ANAD have been subject to some level of archaeological investigation. Those surveys indicate that prehistoric populations hunted and gathered in the area, but very likely left behind only temporary campsites rather than more permanent settlements.

The earliest potential occupation of the area occurred during the Paleo-Indian Period (12,000 – 8,000 B.C.), when small kin-based hunting bands may have passed through the area, leaving the ephemeral remains of temporary campsites. During the succeeding Archaic Period (7,000 – 1,000 B.C.), a wider range of resources were exploited and settlement patterns varied seasonally. Base camps were located in floodplains. Upland areas such as those at ANAD were used only for seasonal short-lived hunting camps. Fifteen Archaic sites have been identified at Pelham Range, just north of ANAD, but none has been found on ANAD itself (COE 1997). The succeeding Woodland Period (1,000 B.C. – A.D. 900) is characterized by increased reliance on agriculture, sedentism, more elaborate sites and material culture, and regional integration. No Woodland sites are known from ANAD (COE 1997). The final florescence of southeastern Native American cultures occurred during the Mississippian Period (A.D. 900 – 1500). Chiefdoms emerged in this period, a development characterized by increased trade, reliance on agriculture, and more elaborate settlements, including ceremonial centers.

F.1.2 Ethnohistory

European contact with the Native Americans of the Coosa Valley began in 1540, when Hernando de Soto encountered Mississippian settlements there. Over the next two centuries, increased European contact drastically altered the structure of the Native American population. Native Americans became increasingly dependent on European metal tools and firearms and were caught up in the competition between European powers. British traders arrived in the 1600s, and the French, who previously were established at Mobile, constructed a fort at the confluence of the Coosa and Tallapoosa Rivers in 1717. As contact with Europeans grew, the introduction of disease and warfare drastically reduced Native American populations. Descendants of the Mississippian chiefdoms, including the Coosa, banded together and migrated south, forming the Creek Confederacy. The Upper Creek inhabited the ANAD region, establishing towns along the Coosa River. Euro-American settlement in the area west of the Coosa began in earnest after 1814, when the Red Sticks, a confederation of Creeks that (under the influence of Tecumseh) sided with the British in the War of 1812, were removed from that area. Conflicts between the Creeks and the settlers increased. In 1825, the Upper Creeks ceded their lands east of the Mississippi. In 1832, Benton County (now Calhoun County) was formed from Creek lands to encourage Euro-American settlement. Euro-American farmers traveled to the territory along Creek trading paths. They built their farmsteads on high ground near streams or springs where there was room for cattle and hogs to range. In 1836, the remaining Creeks were removed from the area and marched to Oklahoma, with the loss of thousands of lives (Jordan and Whitley 1999). Interest among their descendants in their southeastern homelands is increasing.

F.1.3 History

Benton County contained iron ore, timber, and water power — the three components necessary for the production of iron in 19th-century America — and was well situated to supply the more established areas with iron tools. The county became a center of iron production in the South and was important to Confederate industrial production during the Civil War. Although the early mills were destroyed during the war, new mills were established later. The local availability of cotton also lead to the establishment of textile mills. The planned community of Anniston was established in 1872 to serve as a company town for the Woodstock Iron Co. Anniston grew as an industrial center. Building on this base, Anniston grew into a center for the manufacture of cast iron pipes and fittings (Jordan and Whitley 1999), with local farmers profiting from the new market for their goods. The lands occupied by ANAD were only on the fringes of this development. After the Civil War, Bynum Station was founded along the Georgia Pacific Railroad at ANAD’s southern boundary. A 1910 plat of the area shows that the Woodstock Iron and Steel Company owned much of the land constituting Bynum Station, but iron mining was limited to two locations on the eastern edge of ANAD. Calhoun County soil survey maps (1961) show two other mining sites within ANAD’s boundaries.

Military use of the area began in 1898 with the establishment of Camp Shipp at Blue Mountain. Camp Shipp lasted for only a year, but, in 1917, Camp McClellan was established at Anniston to train U.S. troops for World War I. Camp McClellan became Fort McClellan in 1929, and permanent construction began in 1933. During World War II, 500,000 troops were trained at Fort McClellan. However, Fort McClellan proved unsuitable as an arms depot. In 1940, as part of the U.S. arms buildup prior to World War II, 13,000 acres, including Bynum Station, was acquired for the Anniston Ordnance Depot (AOD). The construction of AOD began in 1941, and the facility opened in 1942. The construction of the many rows of munitions storage igloos required substantial earth moving over much of the site. Topsoil was scraped up and then piled over the concrete igloo structures. At the height of World War II, 6,700 people were employed at

AOD. After the war, a program of demilitarization and renovation adapted the site to its new functions of tank and artillery overhaul and munitions maintenance. In 1968, with the deactivation of the office of Chief of Ordnance, the site was renamed the Anniston Army Depot. It includes 15,000 acres, and its mission is to receive, store, and issue munitions, and to maintain combat vehicles and artillery (Hightower 1984).

F.1.4 Summary of Archaeological Surveys and Resources

Because the ANAD area presented few opportunities for permanent settlement and because of significant ground disturbance, the potential for the occurrence of archaeological resources at ANAD is limited. Industrialization of the Anniston area began in the mid-19th century. Four mines and numerous gravel pits or quarries now within ANAD's boundaries are indicated on soil survey maps (Harlin and Perry 1961). In the 1940s, when ANAD was established, large sections of the site were disturbed during the construction of the storage igloos and industrial areas. The main potential for preserved archaeological resources lies in certain favorable locations within the buffer zones surrounding and separating the storage blocs. An initial cultural resources reconnaissance of ANAD concluded that because of the restricted public access to ANAD, there was a good possibility that intact cultural resources could be located in these areas (Dye 1984). Surveys of the less disturbed areas were begun in 1984.

The U.S. Army Corps of Engineers, Mobile District, conducted six archaeological surveys at ANAD between 1984 and 1997. These included surveys of proposed construction sites, timber sale lots, and areas considered to have a high potential for yielding archaeological remains (COE 1997). Surveys of the proposed construction sites for the M55 Rocket Demilitarization Plant and the Demilitarization Project were conducted in 1984 and 1991. No cultural resources were recorded in these surveys (COE 1984, 1991). In 1992, 2,262 acres of timber sale plots was surveyed. This survey focused on areas around sinks and springs, because of their high to moderate potential for yielding cultural resources. Again, no cultural resources were recorded. Eight additional high-potential areas were surveyed in 1993. Three prehistoric sites, three historic cemeteries, and one historic settlement site were recorded in that survey. A final survey of 50 acres just outside the southeastern gate of ANAD was conducted in 1996. That survey recovered isolated prehistoric finds from the plowzone, but identified no intact sites. Areas restricted for safety or security reasons were not surveyed. Restricted areas include the Chemical Limited Area, areas within 1,200 ft of the Burning Ground, and areas within 2,400 ft of the Demolition Pit (COE 1997). Of the resources encountered in these surveys, one prehistoric site, the three historic cemeteries, and the settlement site (the Wilkinson Complex) were deemed to have potential for inclusion on the *National Register of Historic Places* (NRHP). Phase II excavations were conducted at a cave site (Field Site 1), in 1998; it was determined to be not eligible for listing on the NRHP (Jordan and Whitley 1999).

In 1997, the Alabama State Historic Preservation Officer (SHPO) concurred that the necessary surveys of "all areas within ANAD considered suitable for archeological survey" had been completed (COE 1997). However, since these surveys were conducted at different levels of intensity, with the broader surveys only checking areas with the highest potential for yielding sites, the Alabama SHPO may require a more intensive survey of any selected construction site before concurring on a no adverse effect determination for a project.

F.1.5 Summary of Evaluations of Historic Structures

ANAD was constructed beginning in 1941 as part of Phase A of World War II depot construction. This activity was during the Protective Mobilization Phase of the war and thus played an important role in the logistical support of the Army during the critical early months of the war (Whelan et al. 1997). Because of their potential significance in the U.S. arms buildup in preparation for World War II, ANAD structures constructed before 1946 were evaluated in 1984. No structures were recorded as meeting Army criteria for important historical structures or eligibility criteria for the NRHP at that time (Hightower 1984). Documentation showing SHPO concurrence with that determination had not yet been found at the time this environmental impact statement (EIS) was being prepared. Furthermore, it does not appear that an evaluation of ANAD Cold War properties has been undertaken.

F.1.6 Summary of National Register of Historic Places Properties near ANAD

Nearly 100 properties within 30 mi (50 km) of ANAD are listed on the NRHP (list available in Wescott 2001). Five counties in Alabama fall within the 30-mi (50-km) radius of ANAD — Calhoun, Clay, Cleburne, Etowah, and Talladega. Many of these properties are located in the city of Anniston. The NRHP-listed properties include industrial (mills, plants), commercial (banks, stores, theaters, downtown historic districts), residential (houses and districts), and institutional (schools, libraries, churches, courthouses, post offices) buildings and other structures (bridges, railroad depots).

F.2 PINE BLUFF ARSENAL PREHISTORIC AND HISTORIC CONTEXT

F.2.1 Prehistory

Archaeological investigations in the region of the Pine Bluff Arsenal (PBA) have identified prehistoric sites ranging from the Paleo-Indian Period (13,000 B.C. – 10,000 B.C.) to the Mississippian Period (A.D. 1000 – A.D. 1500). Summaries of archaeological research conducted in southeastern Arkansas can be found in reports by Jeter and co-workers (Jeter 1982; Jeter et al. 1982, 1989). The local distribution of prehistoric sites is concentrated along major rivers and tributary streams and their associated terraces. The areas of highest probability for containing prehistoric material (on the basis of information from past archaeological surveys) are along the Arkansas River terraces, within the lower portions of the active tributary floodplains, and within the relic tributary floodplains (Bennett et al. 1993). Areas associated with historic activities (farming and historic settlement) and tributary valley slopes have a low probability for occurrence of intact prehistoric material. Earth-moving activities associated with development and operations at PBA have been most heavily concentrated along the Arkansas River terraces, thus decreasing the likelihood of discovering intact buried archaeological deposits in those areas.

F.2.2 Ethnohistory

Ethnohistorically, horticulturalist groups, including the Quapaw and the Tunica, used the confluence of the Arkansas and Mississippi River valleys. (See Morse and Morse 1983 for a discussion of pre-Euro-American culture histories.) These groups were greatly affected by disease and displacement resulting from contact with Europeans in the 18th century (Leitch 1979). The Quapaw were the predominate group occupying the region of PBA in the early 19th century. An 1818 treaty created a reservation, including what is now the site of PBA, for the Quapaw; however, this area was ceded to the United States in 1824 (Bennett et al. 1993). The native groups from this region were relocated to Oklahoma and Kansas by the mid-19th century.

F.2.3 History

The general history of southeastern Arkansas is focused on the Mississippi and Arkansas Rivers. The first European excursions into the region were by the Spanish and French. European activity increased with the establishment of the Arkansas Post in 1686. Initially, the region was used primarily by hunters and traders operating along the Arkansas River. The first report of farming in the Arkansas River area is in the 1790s (Bennett et al. 1993). The United States acquired this region in 1803 as part of the Louisiana Purchase. By 1825, the area surrounding what is now PBA was the location of several plantations. The larger plantations located in the Arkansas River bottom lands were worked predominately by slave labor, while smaller family farms were located along the tributaries. The region remained a rural farming area, with the Arkansas River serving as the primary means of transportation, until after the Civil War. Agricultural practices were altered after the Civil War from the use of slave labor to the tenant farming system. However, the main economy remained agriculture. The McCoy, MacFadden, and McGreggor plantations were established along the eastern edge of the future PBA boundaries during this period. The introduction of railroads in the 1870s allowed people to move away from the river without loosing access to markets. One of the first rail lines was placed near the western boundary of the current PBA and connected Pine Bluff to Little Rock. Small farming and railroad communities were established along the rail lines. This general pattern continued in the PBA area until the 1940s.

The local distribution of historic archaeological sites is concentrated along transportation features, including railways, rivers, and roads. The two areas of highest probability for occurrence of historic sites are along the Arkansas River terrace and along the route of the railway line that ran along the western boundary of PBA. Some farms are historically reported in areas that now are in the interior of PBA; however, these areas were heavily modified by PBA activities (Bennett et al. 1993). Likewise, the Arkansas River terraces and the area along the historic railway were also heavily modified by PBA activities, greatly reducing the probability of finding intact historic archaeological deposits.

Construction of PBA began in 1941. The facility was designed to manufacture magnesium- and aluminum-based incendiary munitions but soon expanded to include the production of war gases, smoke munitions, and napalm bombs. Between 1946 and 1950, PBA was placed on standby. During this period the war gas facilities were dismantled. The arsenal began manufacturing incendiary and smoke munitions at the start of the Korean Conflict. The facility has continued to serve this function to present. In 1972, 500 acres of PBA was converted to a National Center for Toxicological Research. The general military history of PBA is summarized by Hess (1984).

F.2.4 Summary of Archaeological Surveys and Resources

Between 1967 and 1990, about 10,270 acres of PBA was surveyed for archaeological resources. In 1982, Bennett and Stewart-Abernathy surveyed 200 acres; in 1985, the Army Engineer District surveyed 27 acres. Dunn surveyed about 43 acres in 1988, and Archaeological Assessments Inc. surveyed the remaining undisturbed 10,000 acres of the arsenal in 1990 (Bennett et al. 1993). No archaeological sites were identified during the 1982–1988 surveys; 46 archaeological sites were identified in 1990. Seven of those sites were recommended for additional investigations to determine their eligibility to the NRHP. In 2000, those seven sites were investigated by the Arkansas Archaeological Survey (House and Farmer 2000). On the basis of the findings from those excavations, three of the seven sites (3JE285, 3JE307, 3JE312A-C) were determined eligible for listing on the NRHP.

The majority of the prehistoric sites identified during the 1990 survey consisted of highly dispersed lithic scatters along the Arkansas River Terrace. Those scatters lacked diagnostic material. Two prehistoric sites located on the relic floodplains of the Eastwood Bayou (3JE285) and Phillips Creek (3JE290) did contain diagnostic materials and appear to date from A.D. 500 to A.D. 1500 (Bennett et al. 1993). Site 3JE285 was recommended eligible for listing on the NRHP, while 3JE290 was recommended not eligible (House and Farmer 2000).

Evidence of archaeological sites dating to the historic period (1840-1940) was identified during the 1990 archaeological survey. Sites attributed to the 1840-1880 period were located but were found to be heavily disturbed by subsequent activities. Sites dating to the 1880-1940 period appeared to retain greater integrity. Five of the seven sites reserved for further testing date to the later historic period. Two of the five historic archaeological sites (3JE307 and 3JE312A-C) were recommended eligible for listing on the NRHP (House and Farmer 2000). Site 3JE307 is a 1920s era farmstead that was operated by an African American woman. Site 3JE312A-C represents the remains of the 1930s era town of Warbritton.

F.2.5 Summary of Evaluations of Historic Structures

The MacDonald and Mack Partnership conducted a survey and evaluation of historic properties in 1984. The survey examined the 830 extant buildings at PBA in that year. None of the buildings examined met the Army criteria for important historical structures or the eligibility criteria for listing on the NRHP at that time. Documentation showing SHPO concurrence with this determination had not yet been found when this EIS was being prepared. The Cold War properties at PBA have not yet been evaluated for historic significance.

During the 1990 archaeological investigations, three structures pre-dating PBA were identified (Bennett et al. 1993). The first was the commandant's residence, which was a 1930s structure that was modified for reuse by the Arsenal. The structure was determined ineligible for listing on the NRHP because of the alterations it had undergone. Sites 3JE294 and 3JE295 are two pre-1940 structures that were moved from their original locations and had been rehabilitated for use by PBA. No determination of eligibility has been conducted for these two structures, but in general, structures moved from their original location are not typically considered eligible for listing on the NRHP.

F.2.6 Summary of National Register of Historic Places Properties Near PBA

Nearly 280 properties listed on the NRHP are located within 30 mi (50 km) of PBA (list available in Wescott 2001). Six counties in Arkansas fall within the 30-mi (50-km) radius of PBA — Jefferson, Cleveland, Grant, Lincoln, Pulaski, and Saline. The majority of these properties are located in the cities of Little Rock and Pine Bluff. The NRHP-listed properties include commercial (hotels, banks, stores, theaters, downtown historic districts), residential (apartments, houses, and districts), and institutional, including military (schools, churches, courthouses, post offices, armories) buildings and other structures (monuments, memorials, viaducts and overpasses, riverboat). In addition, cemeteries, plantations, battlefields, and archaeological sites (mounds) listed on the NRHP occur within 30 mi (50 km) of PBA.

F.3 PUEBLO CHEMICAL DEPOT PREHISTORIC AND HISTORIC CONTEXT

F.3.1 Prehistory

In archaeological investigations in the Arkansas River Valley, researchers have encountered prehistoric sites (mostly lithic scatters and camp sites) dating from the Paleo-Indian Period (8000 to 5500 B.C.) through the Plains Village Tradition (or Middle Ceramic Period, A.D. 1000 to 1550). The local distribution of prehistoric sites includes locations along major river terraces and tributary streams. The areas of Pueblo Chemical Depot (PCD) that have a high potential for containing prehistoric cultural resources include "ridges covered with eolian sand

and overlooking drainages, lower ridges paralleling intermittent drainages, and blowouts" (Montgomery 1984). Flatter areas within the facility are thought to have less potential for containing sites, as indicated by local prehistoric settlement patterns (derived from the known archaeological record) and partly because of the area's past use and disturbance by military activity. In general, fewer sites have been found in the open plain areas away from water sources. The administrative area and large bunker area were subjected to major ground disturbance (up to 3 to 6 ft [0.9 to 1.8 m] deep) during construction. The likelihood of finding intact archaeological deposits eligible for listing on the NRHP within these disturbed areas of PCD is very small (Montgomery 1984).

F.3.2 Ethnohistory

Ethnohistorically, horticulturalists and Plains Indian groups, such as the Plains Apache, inhabited the southeast Colorado Plains. The Plains Apache moved south and were replaced by the Utes and Comanches in the 1700s. The Comanches continued southward to occupy the plains south of the Arkansas River. The Cheyenne and Arapahoe, originally from north and east of the Colorado Plains, inhabited the plains north of the Arkansas River by the 1800s. Native American groups from this area were largely relocated to Oklahoma by 1869 (Montgomery 1984).

F.3.3 History

Summaries of the general history of southeastern Colorado and the PCD property before military acquisition are provided in the archaeological reports previously prepared for PCD (Montgomery 1984; Larson and Penny 1995; Foothill Engineering Consultants, Inc. [FEC] 1998). The primary historic themes for the region include discovery and exploration, early colonization and exploitation, and settlement expansion and economic diversification (Montgomery 1984). The Arkansas River played a critical role in the development of the area. Although Spanish explorers may have come close to the area as early as the late 1600s, it was during the early 1800s that fur trappers and traders started establishing a presence in the form of trails along the Arkansas River and its tributaries. The establishment of trading posts (Fort Cass and Bents Old Fort) along the river in the 1830s opened the area to permanent European settlement. The closest historical trail to the depot is the Chico Creek cutoff, established in the late 1850s. The trail starts at the Arkansas River and continues north along PCD's western boundary.

Military installations, such as Fort Reynolds and Camp Fillmore, were established nearby during the 1860s as the number of settlements began to increase following the Gold Rush of 1859 and the establishment of the Colorado Territory in 1861. A stage-line route from the Booneville stage station to the military bases was established south of PCD; a northern continuation of this line may have been established along Haynes Creek on the eastern periphery of PCD, but this has not been confirmed (Montgomery 1984). Trends of open-range cattle ranching, homesteading, large-scale irrigation projects, and dry-land farming occurred at various times in the region. During the 1920s, many small cattle ranches were consolidated into larger companies. The land that later became PCD was owned by the Thatcher Land and Cattle Company (formerly the Bloom Cattle Company) (FEC 1998). Agriculture and livestock raising are currently the predominant land uses in southeastern Colorado.

Military occupation of what was then called the Pueblo Ordnance Depot (POD) began in 1943.[1] POD was one of 16 new ordnance depots constructed in 1942 for a World War II mobilization expansion program. The depot's primary function was storage and shipment of ammunition, but it was also used as a medical supply depot.

In the early 1950s, during the Cold War, POD was a distribution center for military supplies for 78 installations in a nine-state region from the Dakotas to Arizona. During that time, POD expanded much of its storage capacity and facilities to accommodate a growing workforce. Also during this time, POD began storing chemical munitions, such as distilled mustard, that were being produced at Rocky Mountain Arsenal near Denver, and the Redstone Arsenal in Huntsville, Alabama. The chemical munitions originally were stored in the igloos in C-Block, but they were later moved to G-Block in the northeastern portion of POD. Nuclear weapons, such as atomic cannon ammunition, were stored in J-Block from 1954 until 1965.

Another expansion occurred in the late 1950s with the addition of a new function for the depot: missile storage and maintenance. In 1961, POD was the "nation's prime depot for maintenance, rebuilding, and storage of the Army's three major missiles [the Redstone, Pershing, and Sergeant] and their systems" (Simmons and Simmons 1998). Hawk and LaCrosse missiles were also serviced at POD.

POD was renamed Pueblo Army Depot (PAD) in 1962. Depot closures in South Dakota and Nebraska in the mid-1960s led to yet another expansion of PAD, making it one of the largest U.S. Army Materiel Command depots in the nation. Activities carried out there continued to diversify; the facility was used to maintain and rebuild vehicles and equipment and to store, maintain, and distribute materials for fixed and floating bridges; it also served as a repository for U.S. Army historical properties.

A phase-down of PAD was announced in 1974 in response to the end of the Vietnam War. Many activities were transferred to other facilities. PAD continued to be a storage supply depot for ammunition and supplies and a maintenance facility for the Pershing missile system. In 1976, PAD became a satellite facility to Tooele Army Depot and was renamed Pueblo Depot Activity (PDA).

[1] The military history presented here is summarized from Front Range Research Associates, Inc. (Simmons and Simmons 1998).

The main mission of the depot today is the storage of a portion of the nation's chemical weapons stockpile. In 1996, PDA was again renamed to reflect its primary mission; it is currently called Pueblo Chemical Depot (PCD).

F.3.4 Summary of Archaeological Surveys and Resources

Between 1994 and 1996, approximately 11,334 acres of PCD was surveyed for archaeological sites. In 1994, Larson-Tibesar Associates, Inc., surveyed 3,690 acres in the eastern third of PCD, and in the following two years, FEC surveyed 7,644 acres to complete the current inventory of archaeological resources at the PCD. Forty-five sites and 128 isolated finds were recorded. Three sites, 5PE1719, 5PE1930, and 5PE2093 were recommended as eligible for listing on the NRHP; further testing was recommended for 32 of the sites (Larson and Penny 1995; FEC 1998).

More than 80% of the sites recorded at PCD (37 of 45) are located along Chico, Boone, and Haynes Creeks, within or near the edges of the creek valleys (Larson and Penny 1995; FEC 1998). There is a potential for additional prehistoric sites to be present at PCD in the undisturbed portions of the facility.

Archaeological surveys have revealed few sites at PCD pertaining to the historic period, and none of the recorded sites have been directly attributed to the ethnohistoric period. The three historic sites that have been recorded at PCD can be dated to between 1880 and 1942 (when the property was acquired by the government). Twelve of the isolated finds are historic, consisting of glass or ceramic sherds. Additional testing of one of the sites (5PE1735) was recommended. This site, with visible foundations, appears to have been an early 20th century ranch. The other historic archaeological resources were considered not eligible for the NRHP (Larson and Penny 1995; FEC 1998).

F.3.5 Summary of Evaluations of Historic Structures

A survey and evaluation of historic structures at the PCD was initially completed by McDonald and Mack Partnership in 1984. The result of that initial assessment was that none of the 27 buildings evaluated was eligible for listing on the NRHP. The Colorado SHPO found that assessment inadequate and recommended that all structures on PCD be reevaluated. In 1996, Front Range Research Associates, Inc. (FRRA) finalized a historic structures survey of PCD (Simmons and Simmons 1998). The contractor concluded that four districts and one building were potentially eligible for listing on the NRHP. The districts included one World War II district consisting of underground ammunition storage magazines, above-ground ammunition magazines, warehouses, and administration and support buildings; and three Cold War era districts: Hi PODner (or ParDner) Park, the Pershing missile demilitarization area, and the nuclear weapons storage area (within J Block). Building 1, the post headquarters, was the only building recommended individually eligible for the NRHP. A Programmatic Agreement (PA) was signed in 1997 between the Army, the Colorado SHPO, and the Advisory Council on Historic Preservation stipulating that the recommendations of the FRRA report were acceptable and that the above-mentioned building and districts are eligible (U.S. Army et al. 1997). The PA also states that the unsurveyed structures in the G Block, which house part of the nation's chemical weapon stockpile, are also eligible for the NRHP. The PA further states that documentation of the facilities at PCD has been completed and "no further documentation is required to mitigate the effects of leasing, licensing, and/or disposal of facilities at the Depot" (U.S. Army et al. 1997).

F.3.6 Summary of National Register of Historic Places Properties near PCD

Nearly 60 properties within 30 mi (50 km) of PCD are listed on the NRHP (list available in Wescott 2001). Three counties in Colorado fall within the 30-mi (50-km) radius of PCD — Pueblo, Crowley, and El Paso. Most of the listed properties are located within the city of Pueblo. The NRHP-listed properties include commercial (hotels, stores, downtown historic districts), residential (houses and districts), industrial (mills, warehouses), and institutional (schools, churches, courthouses, orphanages) buildings and other transportation structures (railroad depots, bridges). Archaeological sites (petroglyphs), the Pueblo City Park Zoo, and the City Park Carousel, also listed on the NRHP, are within 30 mi (50 km) of PCD.

F.4 BLUE GRASS ARMY DEPOT PREHISTORIC AND HISTORIC CONTEXT

F.4.1 Prehistory

Archaeological investigations have identified prehistoric sites ranging from the Paleo-Indian Period (10,500 B.C. – 8,000 B.C.) to the Fort Ancient Period (A.D. 1000 – A.D. 1750) in the Blue Grass Army Depot (BGAD) region. Summaries of the prehistoric context of the BGAD region have been provided by Geo-Marine, Inc. (1996), Hockensmith et al. (1988), Muller (1986), and Pollack (1987, 1990). Results of previous archaeological surveys indicate that the local distribution of prehistoric sites in the BGAD region depends on proximity to water features, level terrain, and areas of high elevation that offer expansive views. Such areas, as well as level regions associated with stream confluences, are considered to be high probability locations for prehistoric archaeological sites (Geo-Marine, Inc. 1996). Areas considered to be of low probability for prehistoric archaeological sites lack access to water sources and are generally uneven or contain steep slopes. Areas that have been disturbed by BGAD activities are also considered to be of low potential. Nearly 5,000 acres of BGAD has been significantly altered by depot activities (Geo-Marine, Inc. 1996). There is little or no probability of finding intact archaeological resources in these regions.

F.4.2 Ethnohistory

Ethnohistorically, the Shawnee, Cherokee, and Iroquois were the primary Native American groups associated with the region in which BGAD is now located; the Delaware, Miami, Mingo, Tutelo, and Wyandot tribes also were present in the region before the early 1800s, but in fewer numbers. The largest known Shawnee cultural center in the region was located 30 mi (50 km) north of the current location of BGAD. The Shawnee used the Kentucky River area mainly for hunting. The Cherokee, whose traditional territory is to the east and south of BGAD, also utilized this region mainly for hunting. The aggression of the Iroquois placed constant pressure on the area population. The Iroquois began raiding Shawnee towns for prisoners in the mid-1600s. These raids caused the Shawnee to abandon many of their villages. As a result of the raids, the Iroquois were seen by Euro-Americans as the group who controlled the region. The Euro-Americans took control of the region in 1795 as a result of a treaty with the Iroquois. Shortly after this treaty was signed, the Shawnee, Cherokee, and Iroquois populations relocated west of the Mississippi (Geo-Marine, Inc. 1996).

F.4.3 History

A more detailed history of the BGAD region is provided in the BGAD Cultural Resources Management Plan (Geo-Marine, Inc. 1996). Europeans first entered the BGAD area in the mid-18th century. French and English traders were known to be in the region by the 1750s. With the cessation of the French and Indian War in 1763, the British claimed the lands west of the Appalachians, and intensive land speculation began. Soon, many forts were established to protect the growing number of Europeans in the region. Banta's Fort and Fort Estill were established by the Low Dutch Company within the present boundaries of BGAD in 1781. Estill Station was also built within the current BGAD boundaries in 1782. Madison County was established in 1786. Kentucky achieved statehood in 1798. The region was settled as an agricultural area. A few large estates using slave labor dominated the region. The outbreak of the Civil War in 1861 found Kentucky with divided loyalties. The state remained neutral throughout the conflict. Union forces occupied the northern portion of the state, while the Confederates held the south. A clash between the two armies occurred on the present boundaries of BGAD in late 1861. After the battle, the Confederate forces were removed from the region. After the Civil War, the region converted to a sharecropper/tenant farming system of agriculture. The introduction of railroads in 1869 opened the region to new markets, thus strengthening the economy and stimulating population growth. New communities were established along the railroad. The region's population was economically challenged in the 1930s by drought and the increased mechanization of farming. The area benefited from several of the New Deal programs. The economy did not recover until the construction of BGAD began in the 1940s. The construction project provided employment for the local population.

The local distribution of historic archaeological sites is less well documented than that for prehistoric sites. Information provided by historic maps of the region suggests that the location of the earliest historic occupations (c. 1780s) would coincide with the high probability areas associated with prehistoric archaeological sites (Geo-Marine, Inc. 1996). In the later historic periods (1800–1900s), it is likely that historic archaeological site locations would focus less on water sources and more on roads, railroads, and proximity to industrial features (markets, saw mills, grist mills, warehouses, etc.) (Geo-Marine, Inc. 1996). Two factors affect the determination of local distributions of historic archaeological sites at BGAD. First, BGAD activities would have utilized existing transportation features, thus increasing the likelihood that disturbances affected historic archaeological sites. Second, only 1% of BGAD has been surveyed for archaeological sites, thus providing a relatively small sample on which to base historic archaeological site location distribution.

BGAD was originally built as Blue Grass Ordinance Depot in 1942 as part of the military buildup during World War II. The facility originally was a supply depot for ordinance and nonexplosive combat equipment. The function of the depot expanded to include storage of chemical warfare equipment in 1943. Between World War II and the Gulf War, the depot was expanded again to provide facilities for the renovation and demolition of ammunition and for the maintenance of guided missiles. The depot merged with the Lexington Signal Depot in 1964. The Lexington facility ended its supply and maintenance mission in 1992 and closed completely in 1994. The remaining Blue Grass facility was reorganized and named Blue Grass Army Depot in 1992.

F.4.4 Summary of Archaeological Surveys and Resources

Between 1983 and 1993, about 150 acres, or about 1% of BGAD's 14,600 acres (5,900 ha), was surveyed for archaeological resources. The surveys were conducted between 1983 and 1996 by Ball, Boedy, the COE, (Louisville District), and Waite and Ensor (Geo-Marine, Inc. 1996). No sites were recorded by Ball. The Boedy and COE surveys each identified one archaeological site. A 1993 survey by Waite and Ensor identified 37 archaeological sites. Of the total of 39 archaeological sites identified at BGAD, 25 are prehistoric, 10 are historic, and 6 are multicomponent (prehistoric/historic) sites. In addition, 17 historic and 11 prehistoric isolated finds have been identified. None of the sites identified at BGAD is currently listed on the NRHP. However, 16 prehistoric, 8 historic, and 5 multicomponent sites are listed as potentially eligible but requiring additional investigation (Geo-Marine, Inc. 1996). A total of 10 archaeological sites are considered ineligible for the NRHP, including 8 prehistoric sites, 1 historic site, and 1 multicomponent site.

The surveys conducted at BGAD have been primarily project-driven and thus focused on discreet areas. The majority of the facility remains to be surveyed. Prehistoric sites remaining on the facility could potentially relate to resource procurement, short- and long-term encampments, base camps, mounds, and additional isolated finds. Also, upland forested bluff crests and lower floodplains may possibly include villages (Geo-Marine, Inc. 1996).

Several archivally reported historic sites at BGAD have not been identified in the field. Three resources dating to the early 1780s, Banta Fort, Fort Estill, and Estill Station, have yet to be field verified. The Civil War Battle of Richmond is reported to have taken place on BGAD property; however, the exact location of the battle has not been established, and a survey for archaeological evidence from the engagement is yet to be undertaken. At least nine historic sites also have been reported at BGAD but have not been officially recorded. In addition, 900 graves from various cemeteries within BGAD were moved off the depot in 1942 when construction of the base began (Geo-Marine, Inc. 1996). It is possible that some graves still remain intact on the facility. The majority of the historic archaeological sites potentially located at BGAD relate to agricultural production and processing and the raising and processing of livestock.

F.4.5 Summary of Evaluations of Historic Structures

BGAD has yet to conduct an architectural inventory of its 1,153 extant structures. Preliminary research into the built environment has identified 964 structures that pre-date 1946. Of this number, 904 are considered potentially eligible for listing on the NRHP. Additional research on the pre-1946 buildings is necessary for final determinations. The BGAD Cultural Resources Management Plan (Geo-Marine, Inc. 1996) indicates that many of the buildings in this potentially eligible class include numerous igloo storage buildings and safe houses and that full documentation of a single example of each would be sufficient for compliance. Most of the remaining 189 structures date to the Cold War era; no formal evaluations or recommendations have been developed for these buildings. However, initial examination suggests that 60 of the Cold War era buildings are likely to be ineligible for listing on the NRHP (Geo-Marine, Inc. 1996). The generation of an historic context and evaluations of standing structures are currently needed for BGAD.

F.4.6 Summary of National Register of Historic Places Properties near BGAD

More than 570 properties within 30 mi (50 km) of BGAD are listed on the NRHP (list available in Wescott 2001). All or portions of twenty counties in Kentucky fall within the 30-mi (50-km) radius — Madison, Bourbon, Boyle, Clark, Estill, Fayette, Garrard, Jackson, Jessamine, Laurel, Lee, Lincoln, Menifee, Mercer, Montgomery, Owsley, Powell, Rockcastle, Wolfe, and Woodford. The majority of the listed properties are in the cities of Richmond, Danville, Winchester, Lexington, Lancaster, Nicholasville, and Mount Sterling. The NRHP-listed properties include commercial (hotels, banks, stores, taverns, theaters, downtown historic districts), industrial (mills, gins, furnaces), residential (houses, farms, and districts), and institutional properties including military buildings (schools, churches, courthouses, post offices, armories) and other structures (monuments, memorials, railroad). Cemeteries, battlefields, and several archaeological sites (including mounds, petroglyphs, earthworks, village sites, etc.) within 30 mi (50 km) of BGAD are listed on the NRHP.

F.5 REFERENCES FOR APPENDIX F

Bennett, W.J., and J. Stewart-Abernathy, 1982, *Cultural Resources Survey of Two Proposed Facility Locations, Pine Bluff Arsenal, Jefferson County, Arkansas*, Archeological Assessments Report No. 16, prepared by Archeological Assessments, Inc., Nashville, Ark., for U.S. Army Corps of Engineers, Fort Worth District, Texas.

Bennett, W.J., et al., 1993, *The Humanly-Altered Landscape: The Archaeological Record at the Pine Bluff Arsenal, Jefferson County, Arkansas*, Archeological Assessments Report No. 142, prepared by Archeological Assessments, Inc., Nashville, Ark., for U.S. Army Corps of Engineers, Little Rock District, Ark.

COE: see U.S. Army Corps of Engineers.

Dye, D.H., 1984, *An Archeological Overview and Management Plan for the Anniston Army Depot, Calhoun County, Alabama*, DARCOM Report No. 26, prepared by Dye, Memphis State University, Memphis, Tenn., for Woodward-Clyde Consultants, Walnut Creek, Calif., for the National Park Service, Atlanta, Ga., for U.S. Army Materiel Development and Readiness Command, Sept. 24.

FEC: see Foothill Engineering Consultants, Inc.

Foothill Engineering Consultants, Inc., 1998, *Cultural Resources Survey of the Pueblo Chemical Depot, Pueblo County, Colorado*, Vols. I–III, prepared by T. Hoeffer et al., FEC, Golden, Colo., submitted to Rust Environmental and Infrastructure, Englewood, for Colo., for U.S. Army Corps of Engineers, Omaha District, Omaha, Neb., May 26.

Geo-Marine, Inc., 1996, *Blue Grass Army Depot Cultural Resources Management Plan*, prepared for Blue Grass Army Depot, Madison County, Ky., Nov.

Harlin, W.V., and E.A. Perry, 1961, *Soil Survey, Calhoun County Alabama*, Series 1958, No. 9, U.S. Department of Agriculture, Soil Conservation Service, and Alabama Department of Agriculture and Industries, Alabama Agricultural Experiment Station, Sept.

Hess, J.A., 1984, *Written Historical and Descriptive Data, Pine Bluff Arsenal*, HAER No. AR-2, prepared for the U.S. Department of the Interior, Historic American Engineering Record, National Park Service, Washington, D.C.

Hightower, B.E., 1984, *Written Historical and Descriptive Data, Historic American Engineering Record, Anniston Army Depot*, HAER No. AL-10, prepared by Building Technology Incorporated for the Historic American Building Survey/Historic American Engineering Record, National Park Service, Washington, D.C.

Hockensmith, C.D., et al., 1988, *Paleoindian and Archaic Research in Kentucky*, Kentucky Heritage Council, Frankfort, Ky.

House, J.H., and M.V. Farmer, 2000, *Phase II Testing of Seven Archaeological Sites on the Pine Bluff Arsenal, Jefferson County, Arkansas*, prepared by Arkansas Archaeological Survey, Fayetteville, Ark., for U.S. Army, Pine Bluff Arsenal, Dec.

Jeter, M.D., 1982, "The Archeology of Southeast Arkansas: An Overview for the 1980s," pp. 76–131 in *Arkansas Archeology in Review*, N.L. Trubowitz and M.D. Jeter (editors), Arkansas Archeological Survey, Research Report No. 15, Fayetteville, Ark.

Jeter, M.D., et al., 1982, "Southeast Arkansas," pp. SE1–SE97 in *A State Plan for the Conservation of Archeological Resources in Arkansas*, H.A. Davis (editor), Arkansas Archeological Survey Research Series Report No. 21, Fayetteville, Ark.

Jeter, M.D., et al., 1989, *Archeology and Bioarcheology of the Lower Mississippi Valley and Trans-Mississippi South in Arkansas and Louisiana*, report prepared by the Arkansas Archeological Survey, Fayetteville, Ark., for the Southwestern Division, U.S. Army Corps of Engineers.

Jordan, W.R., and T.G. Whitley, 1999, *Phase II Excavations of Field Site 1, Anniston Army Depot, Calhoun County, Alabama*, COESAM/PDER-98/013, prepared by Brockington and Associates, Inc., for U.S. Army Corps of Engineers, Mobile District, for Anniston Army Depot, Anniston, Ala.

Larson, T.K., and D.M. Penny (editors), 1995, *Results of a Class III Pedestrian Survey on Portions of the Pueblo Depot Activity Area, Pueblo County, Colorado*, Vols. I and II, prepared by Gulf Engineers & Consultants, Inc., Baton Rouge, La., and Larson-Tibesar Associates, Inc., Laramie, Wyo., for U.S. Army Corps of Engineers, Omaha District, Omaha, Neb, Jan.

Leitch, B.A., 1979, *A Concise Dictionary of Indian Tribes of North American*, Reference Publications, Inc., Algonac, Mich.

MacDonald and Mack Partnership, 1984, *Historic Properties Report, Pueblo Depot Activity, Pueblo, Colorado*, Minneapolis, Minn., Aug.

Montgomery, J., 1984, *An Archaeological Overview and Management Plan for the Pueblo Depot Activity, Pueblo County, Colorado*, prepared by Nickens and Associates, Montrose, Colo.

Morse, D.F., and P.A. Morse, 1983, *Archaeology of the Central Mississippi Valley*, Academic Press, New York, N.Y.

Muller, J.D., 1986, *Archaeology of the Lower Ohio River Valley,* Academic Press, New York, N.Y.

Pollack, D. (editor), 1987, *Current Archaeological Research in Kentucky,* Kentucky Heritage Council, Frankfort, Ky.

Pollack, D. (editor), 1990, *The Archaeology of Kentucky: Past Accomplishments and Future Directions,* Vol. 1, Report No. 1, State Historic Preservation Comprehensive Plan, Kentucky Heritage Council, Frankfort, Ky.

Simmons, T.H., and R.L. Simmons, 1998, *Historic Structures Survey, Pueblo Chemical Depot, Pueblo County, Colorado,* prepared by Front Range Research Associates, Inc., Denver, Colo., for Foothill Engineering Consultants, Inc., Golden, Colo., Apr. 8.

U.S. Army et al., 1997, *Programmatic Agreement among United States Army, Colorado State Historic Preservation Officer, and Advisory Council on Historic Preservation for the Utilization and Eventual Disposal of Above Ground Facilities at Pueblo Chemical Depot, Colorado*.

U.S. Army Corps of Engineers, 1984, *A Cultural Resource Survey of the M-55 Rocket Demilitarization Plant of the Anniston Army Depot, Calhoun County, Alabama*, Mobile District, Ala., Jan 17.

U.S. Army Corps of Engineers, 1991, *Cultural Resource Survey of the Demilitarization Project, Anniston Army Depot, Calhoun County, Alabama,* Mobile District, Ala., Feb.

U.S. Army Corps of Engineers, 1997, *Integrated Cultural Resources Management Plan, Anniston Army Depot, Calhoun County, Alabama,* prepared by the Environmental Resources Planning Section, COE, Mobile District, Ala., for the Directorate of Risk Management, Anniston Army Depot, Ala., May.

Wescott, K.L., 2001, memo with tables listing all historic properties on the National Register of Historic Places within 30 mi (50 km) of ANAD, PBA, PCD, and BGAD, from Wescott (Argonne National Laboratory, Argonne, Ill.) to file, Apr. 10.

Whelan, D.C., et al., 1997, *Historic Context for Department of Defense World War II Permanent Construction,* prepared by R. Christopher Goodwin Associates, Inc., Frederick, Md., for U.S. Army Corps of Engineers, Baltimore District, Md., June.

CONSULTATION LETTERS
AND RESPONSES FOR ANAD

DEPARTMENT OF THE ARMY
ANNISTON ARMY DEPOT
7 FRANKFORD AVENUE
ANNISTON, ALABAMA 36201-4199

REPLY TO
ATTENTION OF:

June 6, 2001

Directorate of Risk Management

Dr. Lee Warner, SHPO
Alabama Historical Commission
468 South Perry Street
Montgomery, AL 36130-3477

Dear Dr. Warner:

The U.S. Department of the Army is evaluating the potential impacts associated with the design, construction, and operation of a pilot facility for the destruction of chemical weapons at the Anniston Army Depot (ANAD) in Calhoun County, Alabama. As part of the decision-making process for this action, the Department of Defense (DOD) is preparing a National Environmental Policy Act (NEPA) document.

The DOD Assembled Chemical Weapons Assessment (ACWA) is preparing an environmental impact statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies for the destruction of the U.S. chemical weapon stockpile. The technologies currently under consideration in the EIS are (1) neutralization followed by supercritical water oxidation (SCWO); (2) neutralization followed by biodegradation; (3) neutralization followed by SCWO and gas-phase chemical reduction; and (4) electrochemical oxidation. The ACWA will address pilot testing these technologies at one or more U.S. chemical stockpile locations – ANAD (AL), Blue Grass Army Depot (KY), Pine Bluff Arsenal (AR), and Pueblo Chemical Depot (CO).

The enclosed map shows the location of the alternative facility footprint locations under consideration for ANAD. On April 14, 2000, ACWA issued a Notice of Intent to prepare an EIS for its action (*Federal Register* Vol. 65, No. 73, page 20139). A public scoping meeting for the ACWA EIS was held on May 16, 2000 in Anniston, Alabama.

Argonne National Laboratory (ANL) is assisting ACWA in preparing the ACWA EIS and will be evaluating potential impacts to cultural resources as part of their analysis. An archaeologist from ANL has researched available documents on archaeological surveys, historic building inventories, and Native American consultations for ANAD.

This letter initiates consultations with your office regarding the proposed project. The probability of adverse effects on cultural resources as a result of the construction and operation of an ACWA facility appears small. The potential for archaeological sites is low in most areas of ANAD and in 1997, your office concurred that the necessary surveys of "all areas within ANAD considered suitable for archaeological survey" have been completed (USACE 1997). Each of the three proposed areas for ACWA (A, B, and C) is a considerable distance from the known archaeological sites, and each area has been at least partly subject to archeological survey. Part of Proposed Area B has undergone intensive survey for other proposed construction projects (USACE 1984, 1991). Part of Proposed Area A and all of Proposed Area C have been considered as part of less intensive surveys that focused on areas with archaeological potential (USACE 1997). Only the parts of Proposed Areas A and B that lie within the Chemical Limited Area, where the chemical munitions are stored, have not been surveyed, and the ground in these areas is at least partially disturbed. The locations of the potential utility and access road corridors follow existing rights-of-way; therefore, little impact to archaeological resources is expected in these cases. While further intensive survey may be required before your office concurs on a no adverse effect determination for this project, the chances of encountering additional significant archaeological resources in areas of proposed construction appear small. No ground disturbing activities take place during operation of an ACWA facility; therefore no impacts to cultural resources are expected after construction is completed.

Only Proposed Area A contains an extant structure, Building 88, a former maintenance facility for chemical weapons that was constructed in 1944. The building is currently abandoned and in disrepair. The building is unlikely to be considered historically significant as it played no critical role in the early months of World War II; however, it was not included in an earlier study of World War II structures at ANAD (Hightower 1984). Please let us know if an evaluation of its historical significance will be required prior to its demolition.

The Army is also initiating consultations with points of contact (Tribal Historic Preservation Officers or designated representatives) from the following Native American Tribes, Bands, and Nations about the proposed project:

Alabama-Quassarte Tribal Town of the Creek Indian Nation of Oklahoma (Chief)
Cherokee Nation of Oklahoma (Principal Chief)
Eastern Band of the Cherokee Indians (Principal Chief)
Kialegee Tribal Town of the Creek Nation of Oklahoma (Town King)
Muskogee Creek Nation of Oklahoma (Principal Chief)
Poarch Band of Creek Indians (Chairman)
Thlopthlocco Tribal Town of the Creek Nation of Oklahoma (Town King)
United Keetoowah Band of Cherokee (Spokesperson)

Please submit comments within the next 30 days. Your time and consideration are greatly appreciated.

If you have any questions please call Mr. Billy Burns at extension 256-235-4217.

Sincerely,

for David M. Parks
Chief, Environmental Control
and Engineering Division

Enclosure

DEPARTMENT OF THE ARMY
ANNISTON ARMY DEPOT
7 FRANKFORD AVENUE
ANNISTON, ALABAMA 36201-4199

REPLY TO
ATTENTION OF:

June 13, 2001

Office of The Depot Commander

Mr. Bill S. Fife, Principal Chief
Muskogee Creek Nation of Oklahoma
P.O. Box 580
Okmulgee, Oklahoma 74447

Dear Mr. Fife:

The U.S. Department of the Army plans to begin destroying chemical munitions at Anniston Army Depot (ANAD), using incineration technology, in the spring of 2002. The Department of Defense (DOD) is also evaluating alternative methods for disposal of chemical munitions. The DOD Assembled Chemical Weapons Assessment (ACWA) will address pilot testing and evaluation of these alternatives to incineration at one or more U.S. chemical stockpile locations - ANAD (AL), Blue Grass Army Depot (KY), Pine Bluff Arsenal (AR), and Pueblo Chemical Depot (CO).

The U.S. Department of the Army is evaluating the potential impacts associated with the design, construction, and operation of an alternative technology pilot facility for the destruction of chemical weapons. As part of the decision-making process for this action, DOD is preparing a National Environmental Policy Act (NEPA) document.

The DOD ACWA is preparing an environmental impact statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies for the destruction of the U.S. chemical weapon stockpile. The technologies currently under consideration in the EIS are (1) neutralization followed by supercritical water oxidation (SCWO); (2) neutralization followed by biodegradation; (3) neutralization followed by SCWO and gas-phase chemical reduction; and (4) electrochemical oxidation.

The attached map shows the alternative facility footprint locations under consideration for ANAD. On April 14, 2000, ACWA issued a Notice of Intent to prepare an EIS for its action (*Federal Register* Vol. 65, No. 73, page 20139). A public scoping meeting for the ACWA EIS was held on May 16, 2000 in Anniston, Alabama.

Argonne National Laboratory (ANL) is assisting ACWA in preparing the EIS. They will be evaluating potential impacts to cultural resources as part of their analysis. An archaeologist from ANL has researched available documents on archaeological surveys, historic building inventories, and Native American consultations for ANAD.

The probability of adverse effects on cultural resources as a result of the construction and operation of an ACWA facility appears small. The potential for archaeological sites is low in most areas of ANAD, and the necessary surveys of "all areas within ANAD considered suitable for archaeological survey" have been completed (USACE 1997). Each of the three proposed areas for ACWA (A, B, and C) is a considerable distance from the known archaeological sites, and each area has been at least partly subject to archeological survey. Part of Proposed Area B has undergone intensive survey for other proposed construction projects (USACE 1984, 1991). Part of Proposed Area A and all of Proposed Area C have been considered as part of less intensive surveys that focused on areas with archaeological potential (USACE 1997). Only the parts of Proposed Areas A and B that lie within the Chemical Limited Area, where the chemical munitions are stored, have not been surveyed, and the ground in these areas is at least partially disturbed. The locations of the potential utility and access road corridors follow existing rights-of-way; therefore, little impact to archaeological resources is expected in these cases. The chances of encountering additional significant archaeological resources in areas of proposed construction appear small. No ground disturbing activities take place during operation of an ACWA facility; therefore no impacts to cultural resources are expected after construction is completed.

Only Proposed Area A contains an extant structure, Building 88, a former maintenance facility for chemical weapons that was constructed in 1944. The building is currently abandoned and in disrepair and is unlikely to be considered historically significant as it played no critical role in the early months of World War II.

The Army is initiating consultations about the proposed project with points of contact (Tribal Historic Preservation Officers or designated representatives) from the Native American Tribes, Bands, Nations, and the Alabama Historical Commission.

We would appreciate receiving information on concerns or issues you may have regarding the proposed project. We are especially interested in your assistance in identifying properties of known religious or cultural significance that may be affected by the construction and operation of the proposed facility. Sensitive information will remain confidential as stipulated in 36 CFR Part 800.11. Please submit comments within 30 days. Your time and consideration are greatly appreciated.

In the meantime, if you have any questions or require further clarification regarding the project please call Mr. Billy Burns at phone 256-235-4217.

Sincerely,

Aaron B. Hayes

AARON B. HAYES
COLONEL, OD
COMMANDING

Attachment

DEPARTMENT OF THE ARMY
ANNISTON ARMY DEPOT
7 FRANKFORD AVENUE
ANNISTON, ALABAMA 36201-4199

REPLY TO
ATTENTION OF:

June 13, 2001

Office of The Depot Commander

Mr. Eddie Tullis, Chairman
Poarch Band of Creek Indians
HCR 69A, Box 85B
Atmore, AL 63502

Dear Mr. Tullis:

The U.S. Department of the Army plans to begin destroying chemical munitions at Anniston Army Depot (ANAD), using incineration technology, in the spring of 2002. The Department of Defense (DOD) is also evaluating alternative methods for disposal of chemical munitions. The DOD Assembled Chemical Weapons Assessment (ACWA) will address pilot testing and evaluation of these alternatives to incineration at one or more U.S. chemical stockpile locations - ANAD (AL), Blue Grass Army Depot (KY), Pine Bluff Arsenal (AR), and Pueblo Chemical Depot (CO).

The U.S. Department of the Army is evaluating the potential impacts associated with the design, construction, and operation of an alternative technology pilot facility for the destruction of chemical weapons. As part of the decision-making process for this action, DOD is preparing a National Environmental Policy Act (NEPA) document.

The DOD ACWA is preparing an environmental impact statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies for the destruction of the U.S. chemical weapon stockpile. The technologies currently under consideration in the EIS are (1) neutralization followed by supercritical water oxidation (SCWO); (2) neutralization followed by biodegradation; (3) neutralization followed by SCWO and gas-phase chemical reduction; and (4) electrochemical oxidation.

The attached map shows the alternative facility footprint locations under consideration for ANAD. On April 14, 2000, ACWA issued a Notice of Intent to prepare an EIS for its action (*Federal Register* Vol. 65, No. 73, page 20139). A public scoping meeting for the ACWA EIS was held on May 16, 2000 in Anniston, Alabama.

Argonne National Laboratory (ANL) is assisting ACWA in preparing the EIS. They will be evaluating potential impacts to cultural resources as part of their analysis. An archaeologist from ANL has researched available documents on archaeological surveys, historic building inventories, and Native American consultations for ANAD.

The probability of adverse effects on cultural resources as a result of the construction and operation of an ACWA facility appears small. The potential for archaeological sites is low in most areas of ANAD, and the necessary surveys of "all areas within ANAD considered suitable for archaeological survey" have been completed (USACE 1997). Each of the three proposed areas for ACWA (A, B, and C) is a considerable distance from the known archaeological sites, and each area has been at least partly subject to archeological survey. Part of Proposed Area B has undergone intensive survey for other proposed construction projects (USACE 1984, 1991). Part of Proposed Area A and all of Proposed Area C have been considered as part of less intensive surveys that focused on areas with archaeological potential (USACE 1997). Only the parts of Proposed Areas A and B that lie within the Chemical Limited Area, where the chemical munitions are stored, have not been surveyed, and the ground in these areas is at least partially disturbed. The locations of the potential utility and access road corridors follow existing rights-of-way; therefore, little impact to archaeological resources is expected in these cases. The chances of encountering additional significant archaeological resources in areas of proposed construction appear small. No ground disturbing activities take place during operation of an ACWA facility; therefore no impacts to cultural resources are expected after construction is completed.

Only Proposed Area A contains an extant structure, Building 88, a former maintenance facility for chemical weapons that was constructed in 1944. The building is currently abandoned and in disrepair and is unlikely to be considered historically significant as it played no critical role in the early months of World War II.

The Army is initiating consultations about the proposed project with points of contact (Tribal Historic Preservation Officers or designated representatives) from the Native American Tribes, Bands, Nations, and the Alabama Historical Commission.

We would appreciate receiving information on concerns or issues you may have regarding the proposed project. We are especially interested in your assistance in identifying properties of known religious or cultural significance that may be affected by the construction and operation of the proposed facility. Sensitive information will remain confidential as stipulated in 36 CFR Part 800.11. Please submit comments within 30 days. Your time and consideration are greatly appreciated.

In the meantime, if you have any questions or require further clarification regarding the project please call Mr. Billy Burns at phone 256-235-4217.

Sincerely,

Aaron B. Hayes

AARON B. HAYES
COLONEL, OD
COMMANDING

Attachment

DEPARTMENT OF THE ARMY
ANNISTON ARMY DEPOT
7 FRANKFORD AVENUE
ANNISTON, ALABAMA 36201-4199

REPLY TO
ATTENTION OF:

June 13, 2001

Office of The Depot Commander

Mr. Jonathan Taylor, Principal Chief
Eastern Band of the Cherokee Indians
P.O. Box 455
Cherokee, North Carolina 28719

Dear Mr. Taylor:

The U.S. Department of the Army plans to begin destroying chemical munitions at Anniston Army Depot (ANAD), using incineration technology, in the spring of 2002. The Department of Defense (DOD) is also evaluating alternative methods for disposal of chemical munitions. The DOD Assembled Chemical Weapons Assessment (ACWA) will address pilot testing and evaluation of these alternatives to incineration at one or more U.S. chemical stockpile locations - ANAD (AL), Blue Grass Army Depot (KY), Pine Bluff Arsenal (AR), and Pueblo Chemical Depot (CO).

The U.S. Department of the Army is evaluating the potential impacts associated with the design, construction, and operation of an alternative technology pilot facility for the destruction of chemical weapons. As part of the decision-making process for this action, DOD is preparing a National Environmental Policy Act (NEPA) document.

The DOD ACWA is preparing an environmental impact statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies for the destruction of the U.S. chemical weapon stockpile. The technologies currently under consideration in the EIS are (1) neutralization followed by supercritical water oxidation (SCWO); (2) neutralization followed by biodegradation; (3) neutralization followed by SCWO and gas-phase chemical reduction; and (4) electrochemical oxidation.

The attached map shows the alternative facility footprint locations under consideration for ANAD. On April 14, 2000, ACWA issued a Notice of Intent to prepare an EIS for its action (*Federal Register* Vol. 65, No. 73, page 20139). A public scoping meeting for the ACWA EIS was held on May 16, 2000 in Anniston, Alabama.

Argonne National Laboratory (ANL) is assisting ACWA in preparing the EIS. They will be evaluating potential impacts to cultural resources as part of their analysis. An archaeologist from ANL has researched available documents on archaeological surveys, historic building inventories, and Native American consultations for ANAD.

The probability of adverse effects on cultural resources as a result of the construction and operation of an ACWA facility appears small. The potential for archaeological sites is low in most areas of ANAD, and the necessary surveys of "all areas within ANAD considered suitable for archaeological survey" have been completed (USACE 1997). Each of the three proposed areas for ACWA (A, B, and C) is a considerable distance from the known archaeological sites, and each area has been at least partly subject to archeological survey. Part of Proposed Area B has undergone intensive survey for other proposed construction projects (USACE 1984, 1991). Part of Proposed Area A and all of Proposed Area C have been considered as part of less intensive surveys that focused on areas with archaeological potential (USACE 1997). Only the parts of Proposed Areas A and B that lie within the Chemical Limited Area, where the chemical munitions are stored, have not been surveyed, and the ground in these areas is at least partially disturbed. The locations of the potential utility and access road corridors follow existing rights-of-way; therefore, little impact to archaeological resources is expected in these cases. The chances of encountering additional significant archaeological resources in areas of proposed construction appear small. No ground disturbing activities take place during operation of an ACWA facility; therefore no impacts to cultural resources are expected after construction is completed.

Only Proposed Area A contains an extant structure, Building 88, a former maintenance facility for chemical weapons that was constructed in 1944. The building is currently abandoned and in disrepair and is unlikely to be considered historically significant as it played no critical role in the early months of World War II.

The Army is initiating consultations about the proposed project with points of contact (Tribal Historic Preservation Officers or designated representatives) from the Native American Tribes, Bands, Nations, and the Alabama Historical Commission.

We would appreciate receiving information on concerns or issues you may have regarding the proposed project. We are especially interested in your assistance in identifying properties of known religious or cultural significance that may be affected by the construction and operation of the proposed facility. Sensitive information will remain confidential as stipulated in 36 CFR Part 800.11. Please submit comments within 30 days. Your time and consideration are greatly appreciated.

In the meantime, if you have any questions or require further clarification regarding the project please call Mr. Billy Burns at phone 256-235-4217.

Sincerely,

Aaron B. Hayes

AARON B. HAYES
COLONEL, OD
COMMANDING

Attachment

DEPARTMENT OF THE ARMY
ANNISTON ARMY DEPOT
7 FRANKFORD AVENUE
ANNISTON, ALABAMA 36201-4199

REPLY TO
ATTENTION OF:

June 13, 2001

Office of The Depot Commander

Mr. Joe Byrd, Principal Chief
Cherokee Nation of Oklahoma
P.O. Box 948
Tahlequah, Oklahoma 74465

Dear Mr. Byrd:

The U.S. Department of the Army plans to begin destroying chemical munitions at Anniston Army Depot (ANAD), using incineration technology, in the spring of 2002. The Department of Defense (DOD) is also evaluating alternative methods for disposal of chemical munitions. The DOD Assembled Chemical Weapons Assessment (ACWA) will address pilot testing and evaluation of these alternatives to incineration at one or more U.S. chemical stockpile locations - ANAD (AL), Blue Grass Army Depot (KY), Pine Bluff Arsenal (AR), and Pueblo Chemical Depot (CO).

The U.S. Department of the Army is evaluating the potential impacts associated with the design, construction, and operation of an alternative technology pilot facility for the destruction of chemical weapons. As part of the decision-making process for this action, DOD is preparing a National Environmental Policy Act (NEPA) document.

The DOD ACWA is preparing an environmental impact statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies for the destruction of the U.S. chemical weapon stockpile. The technologies currently under consideration in the EIS are (1) neutralization followed by supercritical water oxidation (SCWO); (2) neutralization followed by biodegradation; (3) neutralization followed by SCWO and gas-phase chemical reduction; and (4) electrochemical oxidation.

The attached map shows the alternative facility footprint locations under consideration for ANAD. On April 14, 2000, ACWA issued a Notice of Intent to prepare an EIS for its action (*Federal Register* Vol. 65, No. 73, page 20139). A public scoping meeting for the ACWA EIS was held on May 16, 2000 in Anniston, Alabama.

Argonne National Laboratory (ANL) is assisting ACWA in preparing the EIS. They will be evaluating potential impacts to cultural resources as part of their analysis. An archaeologist from ANL has researched available documents on archaeological surveys, historic building inventories, and Native American consultations for ANAD.

The probability of adverse effects on cultural resources as a result of the construction and operation of an ACWA facility appears small. The potential for archaeological sites is low in most areas of ANAD, and the necessary surveys of "all areas within ANAD considered suitable for archaeological survey" have been completed (USACE 1997). Each of the three proposed areas for ACWA (A, B, and C) is a considerable distance from the known archaeological sites, and each area has been at least partly subject to archeological survey. Part of Proposed Area B has undergone intensive survey for other proposed construction projects (USACE 1984, 1991). Part of Proposed Area A and all of Proposed Area C have been considered as part of less intensive surveys that focused on areas with archaeological potential (USACE 1997). Only the parts of Proposed Areas A and B that lie within the Chemical Limited Area, where the chemical munitions are stored, have not been surveyed, and the ground in these areas is at least partially disturbed. The locations of the potential utility and access road corridors follow existing rights-of-way; therefore, little impact to archaeological resources is expected in these cases. The chances of encountering additional significant archaeological resources in areas of proposed construction appear small. No ground disturbing activities take place during operation of an ACWA facility; therefore no impacts to cultural resources are expected after construction is completed.

Only Proposed Area A contains an extant structure, Building 88, a former maintenance facility for chemical weapons that was constructed in 1944. The building is currently abandoned and in disrepair and is unlikely to be considered historically significant as it played no critical role in the early months of World War II.

The Army is initiating consultations about the proposed project with points of contact (Tribal Historic Preservation Officers or designated representatives) from the Native American Tribes, Bands, Nations, and the Alabama Historical Commission.

We would appreciate receiving information on concerns or issues you may have regarding the proposed project. We are especially interested in your assistance in identifying properties of known religious or cultural significance that may be affected by the construction and operation of the proposed facility. Sensitive information will remain confidential as stipulated in 36 CFR Part 800.11. Please submit comments within 30 days. Your time and consideration are greatly appreciated.

In the meantime, if you have any questions or require further clarification regarding the project please call Mr. Billy Burns at phone 256-235-4217.

Sincerely,

Aaron B. Hayes

AARON B. HAYES
COLONEL, OD
COMMANDING

Attachment

DEPARTMENT OF THE ARMY
ANNISTON ARMY DEPOT
7 FRANKFORD AVENUE
ANNISTON, ALABAMA 36201-4199

REPLY TO
ATTENTION OF:

June 13, 2001

Office of The Depot Commander

Mr. John Ross, Spokesperson
United Keetoowah Band of Cherokee
P.O. Box 746
Tahlequah, OK 74464

Dear Mr. Ross:

The U.S. Department of the Army plans to begin destroying chemical munitions at Anniston Army Depot (ANAD), using incineration technology, in the spring of 2002. The Department of Defense (DOD) is also evaluating alternative methods for disposal of chemical munitions. The DOD Assembled Chemical Weapons Assessment (ACWA) will address pilot testing and evaluation of these alternatives to incineration at one or more U.S. chemical stockpile locations - ANAD (AL), Blue Grass Army Depot (KY), Pine Bluff Arsenal (AR), and Pueblo Chemical Depot (CO).

The U.S. Department of the Army is evaluating the potential impacts associated with the design, construction, and operation of an alternative technology pilot facility for the destruction of chemical weapons. As part of the decision-making process for this action, DOD is preparing a National Environmental Policy Act (NEPA) document.

The DOD ACWA is preparing an environmental impact statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies for the destruction of the U.S. chemical weapon stockpile. The technologies currently under consideration in the EIS are (1) neutralization followed by supercritical water oxidation (SCWO); (2) neutralization followed by biodegradation; (3) neutralization followed by SCWO and gas-phase chemical reduction; and (4) electrochemical oxidation.

The attached map shows the alternative facility footprint locations under consideration for ANAD. On April 14, 2000, ACWA issued a Notice of Intent to prepare an EIS for its action (*Federal Register* Vol. 65, No. 73, page 20139). A public scoping meeting for the ACWA EIS was held on May 16, 2000 in Anniston, Alabama.

Argonne National Laboratory (ANL) is assisting ACWA in preparing the EIS. They will be evaluating potential impacts to cultural resources as part of their analysis. An archaeologist from ANL has researched available documents on archaeological surveys, historic building inventories, and Native American consultations for ANAD.

The probability of adverse effects on cultural resources as a result of the construction and operation of an ACWA facility appears small. The potential for archaeological sites is low in most areas of ANAD, and the necessary surveys of "all areas within ANAD considered suitable for archaeological survey" have been completed (USACE 1997). Each of the three proposed areas for ACWA (A, B, and C) is a considerable distance from the known archaeological sites, and each area has been at least partly subject to archeological survey. Part of Proposed Area B has undergone intensive survey for other proposed construction projects (USACE 1984, 1991). Part of Proposed Area A and all of Proposed Area C have been considered as part of less intensive surveys that focused on areas with archaeological potential (USACE 1997). Only the parts of Proposed Areas A and B that lie within the Chemical Limited Area, where the chemical munitions are stored, have not been surveyed, and the ground in these areas is at least partially disturbed. The locations of the potential utility and access road corridors follow existing rights-of-way; therefore, little impact to archaeological resources is expected in these cases. The chances of encountering additional significant archaeological resources in areas of proposed construction appear small. No ground disturbing activities take place during operation of an ACWA facility; therefore no impacts to cultural resources are expected after construction is completed.

Only Proposed Area A contains an extant structure, Building 88, a former maintenance facility for chemical weapons that was constructed in 1944. The building is currently abandoned and in disrepair and is unlikely to be considered historically significant as it played no critical role in the early months of World War II.

The Army is initiating consultations about the proposed project with points of contact (Tribal Historic Preservation Officers or designated representatives) from the Native American Tribes, Bands, Nations, and the Alabama Historical Commission.

We would appreciate receiving information on concerns or issues you may have regarding the proposed project. We are especially interested in your assistance in identifying properties of known religious or cultural significance that may be affected by the construction and operation of the proposed facility. Sensitive information will remain confidential as stipulated in 36 CFR Part 800.11. Please submit comments within 30 days. Your time and consideration are greatly appreciated.

In the meantime, if you have any questions or require further clarification regarding the project please call Mr. Billy Burns at phone 256-235-4217.

Sincerely,

Aaron B. Hayes

AARON B. HAYES
COLONEL, OD
COMMANDING

Attachment

DEPARTMENT OF THE ARMY
ANNISTON ARMY DEPOT
7 FRANKFORD AVENUE
ANNISTON, ALABAMA 36201-4199

REPLY TO
ATTENTION OF:

June 13, 2001

Office of The Depot Commander

Mr. Tarpie Yargee, Chief
Alabama-Quassarte Tribal Town of the Creek Nation of Oklahoma
P.O. Box 537
Henryetta, OK 74437

Dear Mr. Yargee:

The U.S. Department of the Army plans to begin destroying chemical munitions at Anniston Army Depot (ANAD), using incineration technology, in the spring of 2002. The Department of Defense (DOD) is also evaluating alternative methods for disposal of chemical munitions. The DOD Assembled Chemical Weapons Assessment (ACWA) will address pilot testing and evaluation of these alternatives to incineration at one or more U.S. chemical stockpile locations - ANAD (AL), Blue Grass Army Depot (KY), Pine Bluff Arsenal (AR), and Pueblo Chemical Depot (CO).

The U.S. Department of the Army is evaluating the potential impacts associated with the design, construction, and operation of an alternative technology pilot facility for the destruction of chemical weapons. As part of the decision-making process for this action, DOD is preparing a National Environmental Policy Act (NEPA) document.

The DOD ACWA is preparing an environmental impact statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies for the destruction of the U.S. chemical weapon stockpile. The technologies currently under consideration in the EIS are (1) neutralization followed by supercritical water oxidation (SCWO); (2) neutralization followed by biodegradation; (3) neutralization followed by SCWO and gas-phase chemical reduction; and (4) electrochemical oxidation.

The attached map shows the alternative facility footprint locations under consideration for ANAD. On April 14, 2000, ACWA issued a Notice of Intent to prepare an EIS for its action (*Federal Register* Vol. 65, No. 73, page 20139). A public scoping meeting for the ACWA EIS was held on May 16, 2000 in Anniston, Alabama.

Argonne National Laboratory (ANL) is assisting ACWA in preparing the EIS. They will be evaluating potential impacts to cultural resources as part of their analysis. An archaeologist from ANL has researched available documents on archaeological surveys, historic building inventories, and Native American consultations for ANAD.

The probability of adverse effects on cultural resources as a result of the construction and operation of an ACWA facility appears small. The potential for archaeological sites is low in most areas of ANAD, and the necessary surveys of "all areas within ANAD considered suitable for archaeological survey" have been completed (USACE 1997). Each of the three proposed areas for ACWA (A, B, and C) is a considerable distance from the known archaeological sites, and each area has been at least partly subject to archeological survey. Part of Proposed Area B has undergone intensive survey for other proposed construction projects (USACE 1984, 1991). Part of Proposed Area A and all of Proposed Area C have been considered as part of less intensive surveys that focused on areas with archaeological potential (USACE 1997). Only the parts of Proposed Areas A and B that lie within the Chemical Limited Area, where the chemical munitions are stored, have not been surveyed, and the ground in these areas is at least partially disturbed. The locations of the potential utility and access road corridors follow existing rights-of-way; therefore, little impact to archaeological resources is expected in these cases. The chances of encountering additional significant archaeological resources in areas of proposed construction appear small. No ground disturbing activities take place during operation of an ACWA facility; therefore no impacts to cultural resources are expected after construction is completed.

Only Proposed Area A contains an extant structure, Building 88, a former maintenance facility for chemical weapons that was constructed in 1944. The building is currently abandoned and in disrepair and is unlikely to be considered historically significant as it played no critical role in the early months of World War II.

The Army is initiating consultations about the proposed project with points of contact (Tribal Historic Preservation Officers or designated representatives) from the Native American Tribes, Bands, Nations, and the Alabama Historical Commission.

We would appreciate receiving information on concerns or issues you may have regarding the proposed project. We are especially interested in your assistance in identifying properties of known religious or cultural significance that may be affected by the construction and operation of the proposed facility. Sensitive information will remain confidential as stipulated in 36 CFR Part 800.11. Please submit comments within 30 days. Your time and consideration are greatly appreciated.

In the meantime, if you have any questions or require further clarification regarding the project please call Mr. Billy Burns at phone 256-235-4217.

Sincerely,

Aaron B. Hayes

AARON B. HAYES
COLONEL, O.D.
COMMANDING

Attachment

DEPARTMENT OF THE ARMY
ANNISTON ARMY DEPOT
7 FRANKFORD AVENUE
ANNISTON, ALABAMA 36201-4199

REPLY TO
ATTENTION OF:

June , 2001

Office of The Depot Commander

Mr. Tony Martin, Town King
Kialegee Tribal Town of the Creek Nation of Oklahoma
318 Washita, P.O. Box 332
Wetumka, OK 74883

Dear Mr. Martin:

The U.S. Department of the Army plans to begin destroying chemical munitions at Anniston Army Depot (ANAD), using incineration technology, in the spring of 2002. The Department of Defense (DOD) is also evaluating alternative methods for disposal of chemical munitions. The DOD Assembled Chemical Weapons Assessment (ACWA) will address pilot testing and evaluation of these alternatives to incineration at one or more U.S. chemical stockpile locations - ANAD (AL), Blue Grass Army Depot (KY), Pine Bluff Arsenal (AR), and Pueblo Chemical Depot (CO).

The U.S. Department of the Army is evaluating the potential impacts associated with the design, construction, and operation of an alternative technology pilot facility for the destruction of chemical weapons. As part of the decision-making process for this action, DOD is preparing a National Environmental Policy Act (NEPA) document.

The DOD ACWA is preparing an environmental impact statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies for the destruction of the U.S. chemical weapon stockpile. The technologies currently under consideration in the EIS are (1) neutralization followed by supercritical water oxidation (SCWO); (2) neutralization followed by biodegradation; (3) neutralization followed by SCWO and gas-phase chemical reduction; and (4) electrochemical oxidation.

The attached map shows the alternative facility footprint locations under consideration for ANAD. On April 14, 2000, ACWA issued a Notice of Intent to prepare an EIS for its action (*Federal Register* Vol. 65, No. 73, page 20139). A public scoping meeting for the ACWA EIS was held on May 16, 2000 in Anniston, Alabama.

Argonne National Laboratory (ANL) is assisting ACWA in preparing the EIS. They will be evaluating potential impacts to cultural resources as part of their analysis. An archaeologist from ANL has researched available documents on archaeological surveys, historic building inventories, and Native American consultations for ANAD

The probability of adverse effects on cultural resources as a result of the construction and operation of an ACWA facility appears small. The potential for archaeological sites is low in most areas of ANAD, and the necessary surveys of "all areas within ANAD considered suitable for archaeological survey" have been completed (USACE 1997). Each of the three proposed areas for ACWA (A, B, and C) is a considerable distance from the known archaeological sites, and each area has been at least partly subject to archeological survey. Part of Proposed Area B has undergone intensive survey for other proposed construction projects (USACE 1984, 1991). Part of Proposed Area A and all of Proposed Area C have been considered as part of less intensive surveys that focused on areas with archaeological potential (USACE 1997). Only the parts of Proposed Areas A and B that lie within the Chemical Limited Area, where the chemical munitions are stored, have not been surveyed, and the ground in these areas is at least partially disturbed. The locations of the potential utility and access road corridors follow existing rights-of-way; therefore, little impact to archaeological resources is expected in these cases. The chances of encountering additional significant archaeological resources in areas of proposed construction appear small. No ground disturbing activities take place during operation of an ACWA facility; therefore no impacts to cultural resources are expected after construction is completed.

Only Proposed Area A contains an extant structure, Building 88, a former maintenance facility for chemical weapons that was constructed in 1944. The building is currently abandoned and in disrepair and is unlikely to be considered historically significant as it played no critical role in the early months of World War II.

The Army is initiating consultations about the proposed project with points of contact (Tribal Historic Preservation Officers or designated representatives) from the Native American Tribes, Bands, Nations, and the Alabama Historical Commission.

We would appreciate receiving information on concerns or issues you may have regarding the proposed project. We are especially interested in your assistance in identifying properties of known religious or cultural significance that may be affected by the construction and operation of the proposed facility. Sensitive information will remain confidential as stipulated in 36 CFR Part 800.11. Please submit comments within 30 days. Your time and consideration are greatly appreciated.

In the meantime, if you have any questions or require further clarification regarding the project please call Mr. Billy Burns at phone 256-235-4217.

Sincerely,

Aaron B. Hayes

AARON B. HAYES
COLONEL, O.D.
COMMANDING

Attachment

DEPARTMENT OF THE ARMY
ANNISTON ARMY DEPOT
7 FRANKFORD AVENUE
ANNISTON, ALABAMA 36201-4199

REPLY TO
ATTENTION OF:

June 13, 2001

Office of The Depot Commander

Mr. Grace Bunner, Town King
Thlopthlocco Tribal Town of the Creek Nation of Oklahoma
P.O. Box 706
Okemah, Ok 74859

Dear Mr. Bunner:

The U.S. Department of the Army plans to begin destroying chemical munitions at Anniston Army Depot (ANAD), using incineration technology, in the spring of 2002. The Department of Defense (DOD) is also evaluating alternative methods for disposal of chemical munitions. The DOD Assembled Chemical Weapons Assessment (ACWA) will address pilot testing and evaluation of these alternatives to incineration at one or more U.S. chemical stockpile locations - ANAD (AL), Blue Grass Army Depot (KY), Pine Bluff Arsenal (AR), and Pueblo Chemical Depot (CO).

The U.S. Department of the Army is evaluating the potential impacts associated with the design, construction, and operation of an alternative technology pilot facility for the destruction of chemical weapons. As part of the decision-making process for this action, DOD is preparing a National Environmental Policy Act (NEPA) document.

The DOD ACWA is preparing an environmental impact statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies for the destruction of the U.S. chemical weapon stockpile. The technologies currently under consideration in the EIS are (1) neutralization followed by supercritical water oxidation (SCWO); (2) neutralization followed by biodegradation; (3) neutralization followed by SCWO and gas-phase chemical reduction; and (4) electrochemical oxidation.

The attached map shows the alternative facility footprint locations under consideration for ANAD. On April 14, 2000, ACWA issued a Notice of Intent to prepare an EIS for its action (*Federal Register* Vol. 65, No. 73, page 20139). A public scoping meeting for the ACWA EIS was held on May 16, 2000 in Anniston, Alabama.

Argonne National Laboratory (ANL) is assisting ACWA in preparing the EIS. They will be evaluating potential impacts to cultural resources as part of their analysis. An archaeologist from ANL has researched available documents on archaeological surveys, historic building inventories, and Native American consultations for ANAD.

The probability of adverse effects on cultural resources as a result of the construction and operation of an ACWA facility appears small. The potential for archaeological sites is low in most areas of ANAD, and the necessary surveys of "all areas within ANAD considered suitable for archaeological survey" have been completed (USACE 1997). Each of the three proposed areas for ACWA (A, B, and C) is a considerable distance from the known archaeological sites, and each area has been at least partly subject to archeological survey. Part of Proposed Area B has undergone intensive survey for other proposed construction projects (USACE 1984, 1991). Part of Proposed Area A and all of Proposed Area C have been considered as part of less intensive surveys that focused on areas with archaeological potential (USACE 1997). Only the parts of Proposed Areas A and B that lie within the Chemical Limited Area, where the chemical munitions are stored, have not been surveyed, and the ground in these areas is at least partially disturbed. The locations of the potential utility and access road corridors follow existing rights-of-way; therefore, little impact to archaeological resources is expected in these cases. The chances of encountering additional significant archaeological resources in areas of proposed construction appear small. No ground disturbing activities take place during operation of an ACWA facility; therefore no impacts to cultural resources are expected after construction is completed.

Only Proposed Area A contains an extant structure, Building 88, a former maintenance facility for chemical weapons that was constructed in 1944. The building is currently abandoned and in disrepair and is unlikely to be considered historically significant as it played no critical role in the early months of World War II.

The Army is initiating consultations about the proposed project with points of contact (Tribal Historic Preservation Officers or designated representatives) from the Native American Tribes, Bands, Nations, and the Alabama Historical Commission.

We would appreciate receiving information on concerns or issues you may have regarding the proposed project. We are especially interested in your assistance in identifying properties of known religious or cultural significance that may be affected by the construction and operation of the proposed facility. Sensitive information will remain confidential as stipulated in 36 CFR Part 800.11. Please submit comments within 30 days. Your time and consideration are greatly appreciated.

In the meantime, if you have any questions or require further clarification regarding the project please call Mr. Billy Burns at phone 256-235-4217.

Sincerely,

Aaron B. Hayes

AARON B. HAYES
COLONEL, OD
COMMANDING

Attachment

CHEROKEE NATION
P.O. Box 948
Tahlequah, OK 74465-0948
918-456-0671

Chad "Corntassel" Smith
ᏅᎲᏳᏗ
Principal Chief

Hastings Shade
ᏅᏔᏯᏕᏂ
Deputy Principal Chief

June 26, 2001

Mr. Aaron B. Hayes
Department of the Army
Anniston Army Depot
7 Frankfort Avenue
Anniston, AL 36201-4199

Dear Mr. Hayes:

The Cherokee Nation has received your letter dated June 13 wherein you requested assistance with your site review pursuant to Section 106 of the National Historic Preservation Act as amended regarding the incineration of chemical munitions.

The Cherokee Nation is not presently aware of or able to identify any cultural resources affiliated with the Cherokee Nation within the proposed area of development. However, we are aware that inadvertent discovery may occur as a result of development, archaeological testing, or as project construction activities progress. Such activity has the potential to destroy, damage, or diminish the integrity of any Cherokee resources. Also, any such discovery may result in looting if not adequately protected. Therefore, the Cherokee Nation requests that:

1. In the event of inadvertent discovery of human remains, burial objects, or artifacts that all site surveys or other site activities cease pending notification of the Cherokee Nation;
2. Any and all remains, burial objects or artifacts must be properly secured and protected;
3. The Cherokee Nation opposes any laboratory testing, data retrieval, non-biodegradable shrouding, photographic documentation, public display, or unauthorized removal of ancestral remains or burial objects;
4. Sites known to possess or are discovered to posses ancestral remains or burial objects, or that have historical, cultural, or religious significance to the Cherokee people should be avoided.

There are three federally acknowledged Cherokee entities: the Cherokee Nation; the United Keetoowah Band of Cherokee Indians, and the Eastern Band of Cherokee Indians. Section 106 mandates tribal commentary, review or consultation with federally recognized tribal entities. Therefore, any consultation, commentary or review addressed to state recognized groups, entities, or self-identified individuals purporting to be American Indian representatives does not constitute valid tribal consultation in accordance with the authority and intent of federal legislation.

Should you desire to communicate with the designated tribal representative, you may contact me at (918) 456-0671, extension 2466.

Sincerely,

Richard J. Allen

Dr. Richard Allen
NAGPRA Representative

CONSULTATION LETTERS
AND RESPONSES FOR PBA

DEPARTMENT OF THE ARMY
PINE BLUFF ARSENAL
PINE BLUFF, ARKANSAS 71602-9500

September 14,2001

REPLY TO
ATTENTION OF

Office of the Commander

Ms. Cathie Matthews
Arkansas State Historic Officer
1500 Tower Building, 323 Center Street
Little Rock, AR 72201

Dear Ms. Matthews:

The U.S. Department of the Army is evaluating the potential impacts associated with the design, construction, and operation of a pilot facility to demonstrate alternative technologies for the destruction of chemical weapons at the Pine Bluff Arsenal in Jefferson County, Arkansas. The two enclosed maps provide the location of the arsenal and alternative facility footprint locations under consideration. This letter initiates consultations with your office regarding the project.

As part of the decision-making process for this action, the Department of Defense is developing a National Environmental Policy Act document. The Department of Defense Assembled Chemical Weapons Assessment is preparing an Environmental Impact Statement to address the potential impacts of constructing and operating a full-scale pilot facility for the testing of two or more technologies for the destruction of the U.S. chemical stockpiles. Chemical stockpile locations include Anniston Army Depot (AL), Blue Grass Army Depot (KY), Pine Bluff Arsenal (AR) and Pueblo Chemical Depot (CO).

On April 14, 2000, the Assembled Chemical Weapons Assessment issued a Notice of Intent to prepare an Environmental Impact Statement for its action (Federal Register Vol. 65, No. 73, page 20139). A public scoping meeting for the statement was held on May 10, 2000 in Pine Bluff, Arkansas.

Argonne National Laboratory is assisting in preparing the Environmental Impact Statement and will evaluate potential impacts to cultural resources as part of their analysis. An archaeologist from Argonne National Laboratory has researched available documents from Pine Bluff Arsenal on archaeological surveys, historic building inventories, and Native American consultations.

-2-

No archaeological resources or historic structures were identified in the potential construction locations for the Assembled Chemical Weapons Assessment pilot test facility (Areas A, B, and C). The locations of the potential utility and access road corridors follow existing rights-of way; therefore, no ground disturbing activities will take place during operation of the facility. No standing structures are located in the areas of proposed construction.

We would appreciate any comments regarding cultural resources or other concerns you may have regarding the proposed project. Please submit comments to Ms. Libby Fowler, Cultural Resources Manager for Pine Bluff Arsenal, within the next 30 days.

If you need further technical clarifications regarding the pilot facility project, please call Ms. Sharon Harris, Environmental Coordinator for Pine Bluff Chemical Activity, at (870) 540-3958.

Sincerely,

Mark R. Hencheid
Colonel, US Army
Commanding

Enclosure

**CONSULTATION LETTERS
AND RESPONSES FOR PCD**

DEPARTMENT OF THE ARMY
PUEBLO CHEMICAL DEPOT
45825 HIGHWAY 96 EAST
PUEBLO, COLORADO 81006-9330

REPLY TO
ATTENTION OF

March 21, 2001

Environmental Management Division

SUBJECT: NEPA Documents

Ms. Georgianna Contiguglia, SHPO
Colorado Historical Society
Office of Archaeology and Historic Preservation
1300 Broadway
Denver, CO 80203

Dear Ms. Contiguglia:

The U.S. Department of the Army is evaluating the potential impacts associated with the design, construction, and operation of a chemical weapons disposal facility at the Pueblo Chemical Depot (PCD) in Pueblo County, Colorado. As part of the decision-making process for this action, two parallel National Environmental Policy Act (NEPA) documents are being prepared by two Army programs to address distinct but related actions.

(1) The Army Program Manager for Assembled Chemical Weapons Assessment (PMACWA) is developing a programmatic environmental impact statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies that are alternatives to incineration for the destruction of the U.S. chemical weapons stockpile. The technologies currently under consideration are (1) neutralization followed by supercritical water oxidation and (2) neutralization followed by biodegradation. Additional technologies are currently being evaluated and may also be addressed in the programmatic EIS. The PMACWA EIS will address pilot testing these technologies at one or more U.S. chemical stockpile locations – Anniston Army Depot (AL), Blue Grass Army Depot (KY), Pine Bluff Arsenal (AR), and PCD (CO).

(2) The Army Program Manager for Chemical Demilitarization (PMCD) is developing a site-specific EIS to address the impacts of constructing and operating a facility to completely dispose of the chemical munitions stockpile at PCD. The CSDP EIS will assess and compare the impacts of two incineration technologies as well as the two neutralization technologies identified by the ACWA program.

The enclosed maps show the location of PCD and the alternative facility footprint locations at PCD, identified as blocks A, B, and C respectively. Corridors 1 through 4 are the potential areas being considered for the natural gas lines and communications lines. On April 14, 2000, ACWA and PMCD issued Notices of Intent to prepare EISs for their respective actions (*Federal Register* Vol. 65, No. 73, pages 20139-20140). Combined public scoping meetings for both EISs were held on May 9, 2000, in Pueblo, Colorado.

The Army is also requesting comments from points of contact (Tribal Historic Preservation Officers or designated representatives) from the following Native American Tribes/Councils about the proposed projects:

Colorado Commission of Indian Affairs,
Jicarilla Apache Tribe,
Apache Tribe of Oklahoma,
Medicine Wheel Coalition for Sacred Sites of North America,
Arapahoe Business Council,
Northern Cheyenne Tribal Council,
Northern Cheyenne Tribe,
Cheyenne-Arapahoe Tribes of Oklahoma,
Comanche Tribal Business Committee,
Comanche Tribe of Oklahoma,
Kiowa Tribe of Oklahoma,
Oglala Sioux Tribe,
Rosebud Sioux Tribe,
Shoshone Business Council,
Southern Ute Tribal Council,
Southern Ute Language and Cultural Committee, and
Ute Mountain Ute Tribal Council

We would appreciate receiving information on concerns or issues you may have regarding either proposed project. Please submit comments to the points of contact identified below within the next 30 days. Your time and consideration are greatly appreciated.

Please contact Mr. Brad Still, PCD, at (719)549-4883, or email him at stilljb@pcd-emh1.pcd.army.mil, or Mr. Jon Ware, PMACWA, at (410)436-2210, or email him at jon.ware@SBCCOM.APGEA.ARMY.MIL, or Ms. Penny Robitalle, PMCD, at (410)436-4178, or email her at penny.robitalle@pmcd.apgea.army.mil with any questions.

Sincerely,

Kathryn R. Cain

Kathryn R. Cain
Chief, Environmental Management Division

Enclosures

3

Copy Furnished:

Mr. Jon Ware, ACWA-WA, Environmental Team Leader, ATTN: AMSSB-PM-ACWA, Building E5101, Room 101, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 2101-5424

Ms. Penny Robitalle, Program Manager for Chemical Demilitarization, Corner of Hoadley and Parrish Roads, Aberdeen Proving Ground, MD 21010-4005

Document Tracking Center, Pueblo Chemical Depot, 45825 Highway 96 East, Pueblo, CO 81006-9330

DEPARTMENT OF THE ARMY
PUEBLO CHEMICAL DEPOT
45825 HIGHWAY 96 EAST
PUEBLO, COLORADO 81006-9330

REPLY TO ATTENTION OF

May 23, 2001

Office of the Commander

CERTIFIED MAIL -RETURN RECEIPT REQUESTED 7099 3220 0005 0607 2644

Ms. Karen Wilde-Rogers
Executive Secretary
Colorado Commission of Indian Affairs
130 State Capitol
Denver, Colorado 80203

Dear Ms. Wilde-Rogers:

The United States Department of the Army has published two Draft Environmental Impact Statements that assess the potential impacts of the design, construction, operation, and closure of a chemical weapons disposal facility at Pueblo Chemical Depot, Colorado, as follows:

a. The Army Program Manager for Assembled Chemical Weapons Assessment (PMACWA) is developing a programmatic Environmental Impact Statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies that are alternatives to incineration for the destruction of the U.S. chemical weapons stockpile. The technologies currently under consideration are (1) neutralization followed by supercritical water oxidation and (2) neutralization followed by biodegradation. Additional technologies are currently being evaluated and may also be addressed in the programmatic EIS. The PMACWA EIS will address pilot testing these technologies at one or more U.S. chemical stockpile locations – Anniston Army Depot (Alabama), Blue Grass Army Depot (Kentucky), Pine Bluff Arsenal (Arizona), and Pueblo Chemical Depot (Colorado).

b. The Army Program Manager for Chemical Demilitarization (PMCD) is developing a site-specific EIS to address the impacts of constructing and operating an incineration facility to completely dispose of the chemical munitions stockpile at Pueblo Chemical Depot. The PMCD EIS will assess and compare the impacts of two incineration technologies as well as the two neutralization technologies identified by the ACWA program.

The Pueblo Chemical Depot is one of eight sites in the continental United States where chemical agents are currently stored. In response to a Congressional mandate to destroy the nation's stockpile of chemical warfare agents and munitions (Title 14, Part B, Section 1412 of Public Law 99-145, as amended in Public Laws 100-456, and 102-190), chemical agent and munitions stored at Pueblo Chemical Depot must be destroyed. The demilitarization of the agent and munitions via incineration and available alternative technologies will be evaluated to assess the potential site-specific health and environmental impacts.

A Notice of Availability of this document was published in the Federal Register on May 11, 2001. The 45-day public comment period, which began with the publication of the

Notice of Availability, will end on June 25, 2001. Public availability sessions will be held as follows:

- June 6, 2001 – Pueblo Convention Center, 11:30 a.m. to 3:00 p.m., and 6:00 p.m., to 9:00 p.m.
- June 7, 2001 – Avondale Elementary School, 11:30 a.m. to 3:00 p.m., and 6:00 p.m. to 9:00 p.m.

Comments received will be addressed in the Final Environmental Impact Statements. Your comments on these two studies will be factored into the Department of Defense's disposal technology selection process for Pueblo.

Electronic copies of the two Draft Environmental Impact Statements are enclosed for your convenience. We welcome your comments. Comments may be sent by mail, fax, or e-mail to the following:

- PMACWA study: Mr. Jon Ware, Program Manager for Assembled Chemical Weapons Assessment EIS, 9700 South Cass Avenue., P.O. Box 8369, Argonne, IL 60439-4871. You may also fax comments to 1-630-252-4611 or e-mail them to acwacomment@anl.gov.

- PMCD study: Mr. Greg Mahall, Program Manager for Chemical Demilitarization EIS, Building. 4585 Parrish Road., Aberdeen Proving Ground (EA), MD 21010-4005. You may also fax comments to 410-436-5122 or e-mail them to gregory.mahall@pmcd.apgea.army.mil.

If you have any questions you may contact the above listed representatives or Mr. Brad Still of my staff at (719) 549-4883, or email him at stilljb@pcd-emh1.pcd.army.mil.

Sincerely,

John J. Megnia
Lieutenant Colonel, U.S. Army
Commanding

Enclosures

Copy Furnished:

Mr. Jon Ware, ACWA, Environmental Team Leader, ATTN: AMSSB-PM-ACWA, Building E5101, Room 101, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 2101-5424
Ms. Penny Robitalle, Program Manager for Chemical Demilitarization, Corner of Hoadley and Parrish Roads, Aberdeen Proving Ground, MD 21010-4005
Document Tracking Center, Pueblo Chemical Depot, 45825 Highway 96 East, Pueblo,

DEPARTMENT OF THE ARMY
PUEBLO CHEMICAL DEPOT
45825 HIGHWAY 96 EAST
PUEBLO, COLORADO 81006-9330

REPLY TO
ATTENTION OF

May 23, 2001

Office of the Commander

CERTIFIED MAIL -RETURN RECEIPT REQUESTED 7099 3220 0005 0607 2637

Mr. Ernest House
Chairman, Ute Mountain Ute Tribe
General Delivery
Towoac, Colorado 81334

Dear Mr. House:

The United States Department of the Army has published two Draft Environmental Impact Statements that assess the potential impacts of the design, construction, operation, and closure of a chemical weapons disposal facility at Pueblo Chemical Depot, Colorado, as follows:

a. The Army Program Manager for Assembled Chemical Weapons Assessment (PMACWA) is developing a programmatic Environmental Impact Statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies that are alternatives to incineration for the destruction of the U.S. chemical weapons stockpile. The technologies currently under consideration are (1) neutralization followed by supercritical water oxidation and (2) neutralization followed by biodegradation. Additional technologies are currently being evaluated and may also be addressed in the programmatic EIS. The PMACWA EIS will address pilot testing these technologies at one or more U.S. chemical stockpile locations – Anniston Army Depot (Alabama), Blue Grass Army Depot (Kentucky), Pine Bluff Arsenal (Arizona), and Pueblo Chemical Depot (Colorado).

b. The Army Program Manager for Chemical Demilitarization (PMCD) is developing a site-specific EIS to address the impacts of constructing and operating an incineration facility to completely dispose of the chemical munitions stockpile at Pueblo Chemical Depot. The PMCD EIS will assess and compare the impacts of two incineration technologies as well as the two neutralization technologies identified by the ACWA program.

The Pueblo Chemical Depot is one of eight sites in the continental United States where chemical agents are currently stored. In response to a Congressional mandate to destroy the nation's stockpile of chemical warfare agents and munitions (Title 14, Part B, Section 1412 of Public Law 99-145, as amended in Public Laws 100-456, and 102-190), chemical agent and munitions stored at Pueblo Chemical Depot must be destroyed. The demilitarization of the agent and munitions via incineration and available alternative technologies will be evaluated to assess the potential site-specific health and environmental impacts.

A Notice of Availability of this document was published in the Federal Register on May 11, 2001. The 45-day public comment period, which began with the publication of the

-2-

Notice of Availability, will end on June 25, 2001. Public availability sessions will be held as follows:

- June 6, 2001 – Pueblo Convention Center, 11:30 a.m. to 3:00 p.m., and 6:00 p.m., to 9:00 p.m.
- June 7, 2001 – Avondale Elementary School, 11:30 a.m. to 3:00 p.m., and 6:00 p.m. to 9:00 p.m.

Comments received will be addressed in the Final Environmental Impact Statements. Your comments on these two studies will be factored into the Department of Defense's disposal technology selection process for Pueblo.

Electronic copies of the two Draft Environmental Impact Statements are enclosed for your convenience. We welcome your comments. Comments may be sent by mail, fax, or e-mail to the following:

- PMACWA study: Mr. Jon Ware, Program Manager for Assembled Chemical Weapons Assessment EIS, 9700 South Cass Avenue., P.O. Box 8369, Argonne, IL 60439-4871. You may also fax comments to 1-630-252-4611 or e-mail them to acwacomment@anl.gov.

- PMCD study: Mr. Greg Mahall, Program Manager for Chemical Demilitarization EIS, Building. 4585 Parrish Road., Aberdeen Proving Ground (EA), MD 21010-4005. You may also fax comments to 410-436-5122 or e-mail them to gregory.mahall@pmcd.apgea.army.mil.

If you have any questions you may contact the above listed representatives or Mr. Brad Still of my staff at (719) 549-4883, or email him at stilljb@pcd-emh1.pcd.army.mil.

Sincerely,

John J. Megnia
Lieutenant Colonel, U.S. Army
Commanding

Enclosures

Copy Furnished:

✓Mr. Jon Ware, ACWA, Environmental Team Leader, ATTN: AMSSB-PM-ACWA, Building E5101, Room 101, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 2101-5424
Ms. Penny Robitalle, Program Manager for Chemical Demilitarization, Corner of Hoadley and Parrish Roads, Aberdeen Proving Ground, MD 21010-4005
Document Tracking Center, Pueblo Chemical Depot, 45825 Highway 96 East, Pueblo,

DEPARTMENT OF THE ARMY
PUEBLO CHEMICAL DEPOT
45825 HIGHWAY 96 EAST
PUEBLO, COLORADO 81006-9330

REPLY TO
ATTENTION OF

May 23, 2001

Office of the Commander

CERTIFIED MAIL -RETURN RECEIPT REQUESTED 7099 3220 0005 0607 2620

Ms. Vida Peabody
Acting Chairwoman
Southern Ute Indian Tribe
Post Office Box 737
Ignacio, Colorado 81137

Dear Ms. Peabody:

The United States Department of the Army has published two Draft Environmental Impact Statements that assess the potential impacts of the design, construction, operation, and closure of a chemical weapons disposal facility at Pueblo Chemical Depot, Colorado, as follows:

a. The Army Program Manager for Assembled Chemical Weapons Assessment (PMACWA) is developing a programmatic Environmental Impact Statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies that are alternatives to incineration for the destruction of the U.S. chemical weapons stockpile. The technologies currently under consideration are (1) neutralization followed by supercritical water oxidation and (2) neutralization followed by biodegradation. Additional technologies are currently being evaluated and may also be addressed in the programmatic EIS. The PMACWA EIS will address pilot testing these technologies at one or more U.S. chemical stockpile locations – Anniston Army Depot (Alabama), Blue Grass Army Depot (Kentucky), Pine Bluff Arsenal (Arizona), and Pueblo Chemical Depot (Colorado).

b. The Army Program Manager for Chemical Demilitarization (PMCD) is developing a site-specific EIS to address the impacts of constructing and operating an incineration facility to completely dispose of the chemical munitions stockpile at Pueblo Chemical Depot. The PMCD EIS will assess and compare the impacts of two incineration technologies as well as the two neutralization technologies identified by the ACWA program.

The Pueblo Chemical Depot is one of eight sites in the continental United States where chemical agents are currently stored. In response to a Congressional mandate to destroy the nation's stockpile of chemical warfare agents and munitions (Title 14, Part B, Section 1412 of Public Law 99-145, as amended in Public Laws 100-456, and 102-190), chemical agent and munitions stored at Pueblo Chemical Depot must be destroyed. The demilitarization of the agent and munitions via incineration and available alternative technologies will be evaluated to assess the potential site-specific health and environmental impacts.

A Notice of Availability of this document was published in the Federal Register on May 11, 2001. The 45-day public comment period, which began with the publication of the

-2-

Notice of Availability, will end on June 25, 2001. Public availability sessions will be held as follows:

- June 6, 2001 – Pueblo Convention Center, 11:30 a.m. to 3:00 p.m., and 6:00 p.m., to 9:00 p.m.
- June 7, 2001 – Avondale Elementary School, 11:30 a.m. to 3:00 p.m., and 6:00 p.m. to 9:00 p.m.

Comments received will be addressed in the Final Environmental Impact Statements. Your comments on these two studies will be factored into the Department of Defense's disposal technology selection process for Pueblo.

Electronic copies of the two Draft Environmental Impact Statements are enclosed for your convenience. We welcome your comments. Comments may be sent by mail, fax, or e-mail to the following:

- PMACWA study: Mr. Jon Ware, Program Manager for Assembled Chemical Weapons Assessment EIS, 9700 South Cass Avenue., P.O. Box 8369, Argonne, IL 60439-4871. You may also fax comments to 1-630-252-4611 or e-mail them to acwacomment@anl.gov.

- PMCD study: Mr. Greg Mahall, Program Manager for Chemical Demilitarization EIS, Building. 4585 Parrish Road., Aberdeen Proving Ground (EA), MD 21010-4005. You may also fax comments to 410-436-5122 or e-mail them to gregory.mahall@pmcd.apgea.army.mil.

If you have any questions you may contact the above listed representatives or Mr. Brad Still of my staff at (719) 549-4883, or email him at stilljb@pcd-emh1.pcd.army.mil.

Sincerely,

John J. Megnia
Lieutenant Colonel, U.S. Army
Commanding

Enclosures

Copy Furnished:

✓Mr. Jon Ware, ACWA, Environmental Team Leader, ATTN: AMSSB-PM-ACWA, Building E5101, Room 101, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 2101-5424

Ms. Penny Robitalle, Program Manager for Chemical Demilitarization, Corner of Hoadley and Parrish Roads, Aberdeen Proving Ground, MD 21010-4005

Document Tracking Center, Pueblo Chemical Depot, 45825 Highway 96 East, Pueblo,

DEPARTMENT OF THE ARMY
PUEBLO CHEMICAL DEPOT
45825 HIGHWAY 96 EAST
PUEBLO, COLORADO 81006-9330

REPLY TO ATTENTION OF

May 23, 2001

Office of the Commander

CERTIFIED MAIL -RETURN RECEIPT REQUESTED 7099 3220 0005 0607 2613

Ms. Geri Small
Chairwoman, Northern Cheyenne Tribe
Post Office Box 128
Lame Deer, Montana 59043

Dear Ms. Small:

The United States Department of the Army has published two Draft Environmental Impact Statements that assess the potential impacts of the design, construction, operation, and closure of a chemical weapons disposal facility at Pueblo Chemical Depot, Colorado, as follows:

a. The Army Program Manager for Assembled Chemical Weapons Assessment (PMACWA) is developing a programmatic Environmental Impact Statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies that are alternatives to incineration for the destruction of the U.S. chemical weapons stockpile. The technologies currently under consideration are (1) neutralization followed by supercritical water oxidation and (2) neutralization followed by biodegradation. Additional technologies are currently being evaluated and may also be addressed in the programmatic EIS. The PMACWA EIS will address pilot testing these technologies at one or more U.S. chemical stockpile locations – Anniston Army Depot (Alabama), Blue Grass Army Depot (Kentucky), Pine Bluff Arsenal (Arizona), and Pueblo Chemical Depot (Colorado).

b. The Army Program Manager for Chemical Demilitarization (PMCD) is developing a site-specific EIS to address the impacts of constructing and operating an incineration facility to completely dispose of the chemical munitions stockpile at Pueblo Chemical Depot. The PMCD EIS will assess and compare the impacts of two incineration technologies as well as the two neutralization technologies identified by the ACWA program.

The Pueblo Chemical Depot is one of eight sites in the continental United States where chemical agents are currently stored. In response to a Congressional mandate to destroy the nation's stockpile of chemical warfare agents and munitions (Title 14, Part B, Section 1412 of Public Law 99-145, as amended in Public Laws 100-456, and 102-190), chemical agent and munitions stored at Pueblo Chemical Depot must be destroyed. The demilitarization of the agent and munitions via incineration and available alternative technologies will be evaluated to assess the potential site-specific health and environmental impacts.

A Notice of Availability of this document was published in the Federal Register on May 11, 2001. The 45-day public comment period, which began with the publication of the

Notice of Availability, will end on June 25, 2001. Public availability sessions will be held as follows:

- June 6, 2001 – Pueblo Convention Center, 11:30 a.m. to 3:00 p.m., and 6:00 p.m., to 9:00 p.m.
- June 7, 2001 – Avondale Elementary School, 11:30 a.m. to 3:00 p.m., and 6:00 p.m. to 9:00 p.m.

Comments received will be addressed in the Final Environmental Impact Statements. Your comments on these two studies will be factored into the Department of Defense's disposal technology selection process for Pueblo.

Electronic copies of the two Draft Environmental Impact Statements are enclosed for your convenience. We welcome your comments. Comments may be sent by mail, fax, or e-mail to the following:

- PMACWA study: Mr. Jon Ware, Program Manager for Assembled Chemical Weapons Assessment EIS, 9700 South Cass Avenue., P.O. Box 8369, Argonne, IL 60439-4871. You may also fax comments to 1-630-252-4611 or e-mail them to acwacomment@anl.gov.

- PMCD study: Mr. Greg Mahall, Program Manager for Chemical Demilitarization EIS, Building. 4585 Parrish Road., Aberdeen Proving Ground (EA), MD 21010-4005. You may also fax comments to 410-436-5122 or e-mail them to gregory.mahall@pmcd.apgea.army.mil.

If you have any questions you may contact the above listed representatives or Mr. Brad Still of my staff at (719) 549-4883, or email him at stilljb@pcd-emh1.pcd.army.mil.

Sincerely,

John J. Megnia
Lieutenant Colonel, U.S. Army
Commanding

Enclosures

Copy Furnished:

Mr. Jon Ware, ACWA, Environmental Team Leader, ATTN: AMSSB-PM-ACWA, Building E5101, Room 101, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 2101-5424
Ms. Penny Robitalle, Program Manager for Chemical Demilitarization, Corner of Hoadley and Parrish Roads, Aberdeen Proving Ground, MD 21010-4005
Document Tracking Center, Pueblo Chemical Depot, 45825 Highway 96 East, Pueblo,

DEPARTMENT OF THE ARMY
PUEBLO CHEMICAL DEPOT
45825 HIGHWAY 96 EAST
PUEBLO, COLORADO 81006-9330

REPLY TO
ATTENTION OF

May 23, 2001

Office of the Commander

CERTIFIED MAIL -RETURN RECEIPT REQUESTED 7099 3220 0005 0607 2606

Mr. Anthony A. Addison, Sr.
Chairman, Northern Arapaho Tribe
Post Office Box 396
Fort Washakie, Wyoming 82514

Dear Mr. Addison:

The United States Department of the Army has published two Draft Environmental Impact Statements that assess the potential impacts of the design, construction, operation, and closure of a chemical weapons disposal facility at Pueblo Chemical Depot, Colorado, as follows:

a. The Army Program Manager for Assembled Chemical Weapons Assessment (PMACWA) is developing a programmatic Environmental Impact Statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies that are alternatives to incineration for the destruction of the U.S. chemical weapons stockpile. The technologies currently under consideration are (1) neutralization followed by supercritical water oxidation and (2) neutralization followed by biodegradation. Additional technologies are currently being evaluated and may also be addressed in the programmatic EIS. The PMACWA EIS will address pilot testing these technologies at one or more U.S. chemical stockpile locations – Anniston Army Depot (Alabama), Blue Grass Army Depot (Kentucky), Pine Bluff Arsenal (Arizona), and Pueblo Chemical Depot (Colorado).

b. The Army Program Manager for Chemical Demilitarization (PMCD) is developing a site-specific EIS to address the impacts of constructing and operating an incineration facility to completely dispose of the chemical munitions stockpile at Pueblo Chemical Depot. The PMCD EIS will assess and compare the impacts of two incineration technologies as well as the two neutralization technologies identified by the ACWA program.

The Pueblo Chemical Depot is one of eight sites in the continental United States where chemical agents are currently stored. In response to a Congressional mandate to destroy the nation's stockpile of chemical warfare agents and munitions (Title 14, Part B, Section 1412 of Public Law 99-145, as amended in Public Laws 100-456, and 102-190), chemical agent and munitions stored at Pueblo Chemical Depot must be destroyed. The demilitarization of the agent and munitions via incineration and available alternative technologies will be evaluated to assess the potential site-specific health and environmental impacts.

A Notice of Availability of this document was published in the Federal Register on May 11, 2001. The 45-day public comment period, which began with the publication of the

Notice of Availability, will end on June 25, 2001. Public availability sessions will be held as follows:

- June 6, 2001 – Pueblo Convention Center, 11:30 a.m. to 3:00 p.m., and 6:00 p.m., to 9:00 p.m.
- June 7, 2001 – Avondale Elementary School, 11:30 a.m. to 3:00 p.m., and 6:00 p.m. to 9:00 p.m.

Comments received will be addressed in the Final Environmental Impact Statements. Your comments on these two studies will be factored into the Department of Defense's disposal technology selection process for Pueblo.

Electronic copies of the two Draft Environmental Impact Statements are enclosed for your convenience. We welcome your comments. Comments may be sent by mail, fax, or e-mail to the following:

- PMACWA study: Mr. Jon Ware, Program Manager for Assembled Chemical Weapons Assessment EIS, 9700 South Cass Avenue., P.O. Box 8369, Argonne, IL 60439-4871. You may also fax comments to 1-630-252-4611 or e-mail them to acwacomment@anl.gov.

- PMCD study: Mr. Greg Mahall, Program Manager for Chemical Demilitarization EIS, Building. 4585 Parrish Road., Aberdeen Proving Ground (EA), MD 21010-4005. You may also fax comments to 410-436-5122 or e-mail them to gregory.mahall@pmcd.apgea.army.mil.

If you have any questions you may contact the above listed representatives or Mr. Brad Still of my staff at (719) 549-4883, or email him at stilljb@pcd-emh1.pcd.army.mil.

Sincerely,

John J. Megnia
Lieutenant Colonel, U.S. Army
Commanding

Enclosures

Copy Furnished:

✓Mr. Jon Ware, ACWA, Environmental Team Leader, ATTN: AMSSB-PM-ACWA, Building E5101, Room 101, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 2101-5424

Ms. Penny Robitalle, Program Manager for Chemical Demilitarization, Corner of Hoadley and Parrish Roads, Aberdeen Proving Ground, MD 21010-4005

Document Tracking Center, Pueblo Chemical Depot, 45825 Highway 96 East, Pueblo,

DEPARTMENT OF THE ARMY
PUEBLO CHEMICAL DEPOT
45825 HIGHWAY 96 EAST
PUEBLO, COLORADO 81006-9330

REPLY TO
ATTENTION OF

May 23, 2001

Office of the Commander

CERTIFIED MAIL -RETURN RECEIPT REQUESTED 7099 3220 0005 0607 2590

Ms. Sara Misquez
President, Mescalero Apache Tribe
Post Office Box 227
Mescalero, New Mexico 88340

Dear Ms Misquez:

The United States Department of the Army has published two Draft Environmental Impact Statements that assess the potential impacts of the design, construction, operation, and closure of a chemical weapons disposal facility at Pueblo Chemical Depot, Colorado, as follows:

a. The Army Program Manager for Assembled Chemical Weapons Assessment (PMACWA) is developing a programmatic Environmental Impact Statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies that are alternatives to incineration for the destruction of the U.S. chemical weapons stockpile. The technologies currently under consideration are (1) neutralization followed by supercritical water oxidation and (2) neutralization followed by biodegradation. Additional technologies are currently being evaluated and may also be addressed in the programmatic EIS. The PMACWA EIS will address pilot testing these technologies at one or more U.S. chemical stockpile locations – Anniston Army Depot (Alabama), Blue Grass Army Depot (Kentucky), Pine Bluff Arsenal (Arizona), and Pueblo Chemical Depot (Colorado).

b. The Army Program Manager for Chemical Demilitarization (PMCD) is developing a site-specific EIS to address the impacts of constructing and operating an incineration facility to completely dispose of the chemical munitions stockpile at Pueblo Chemical Depot. The PMCD EIS will assess and compare the impacts of two incineration technologies as well as the two neutralization technologies identified by the ACWA program.

The Pueblo Chemical Depot is one of eight sites in the continental United States where chemical agents are currently stored. In response to a Congressional mandate to destroy the nation's stockpile of chemical warfare agents and munitions (Title 14, Part B, Section 1412 of Public Law 99-145, as amended in Public Laws 100-456, and 102-190), chemical agent and munitions stored at Pueblo Chemical Depot must be destroyed. The demilitarization of the agent and munitions via incineration and available alternative technologies will be evaluated to assess the potential site-specific health and environmental impacts.

A Notice of Availability of this document was published in the Federal Register on May 11, 2001. The 45-day public comment period, which began with the publication of the

-2-

Notice of Availability, will end on June 25, 2001. Public availability sessions will be held as follows:

- June 6, 2001 – Pueblo Convention Center, 11:30 a.m. to 3:00 p.m., and 6:00 p.m., to 9:00 p.m.
- June 7, 2001 – Avondale Elementary School, 11:30 a.m. to 3:00 p.m., and 6:00 p.m. to 9:00 p.m.

Comments received will be addressed in the Final Environmental Impact Statements. Your comments on these two studies will be factored into the Department of Defense's disposal technology selection process for Pueblo.

Electronic copies of the two Draft Environmental Impact Statements are enclosed for your convenience. We welcome your comments. Comments may be sent by mail, fax, or e-mail to the following:

- PMACWA study: Mr. Jon Ware, Program Manager for Assembled Chemical Weapons Assessment EIS, 9700 South Cass Avenue., P.O. Box 8369, Argonne, IL 60439-4871. You may also fax comments to 1-630-252-4611 or e-mail them to acwacomment@anl.gov.

- PMCD study: Mr. Greg Mahall, Program Manager for Chemical Demilitarization EIS, Building. 4585 Parrish Road., Aberdeen Proving Ground (EA), MD 21010-4005. You may also fax comments to 410-436-5122 or e-mail them to gregory.mahall@pmcd.apgea.army.mil.

If you have any questions you may contact the above listed representatives or Mr. Brad Still of my staff at (719) 549-4883, or email him at stilljb@pcd-emh1.pcd.army.mil.

Sincerely,

John J. Megnia
Lieutenant Colonel, U.S. Army
Commanding

Enclosures

Copy Furnished:

Mr. Jon Ware, ACWA, Environmental Team Leader, ATTN: AMSSB-PM-ACWA, Building E5101, Room 101, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 2101-5424

Ms. Penny Robitalle, Program Manager for Chemical Demilitarization, Corner of Hoadley and Parrish Roads, Aberdeen Proving Ground, MD 21010-4005

Document Tracking Center, Pueblo Chemical Depot, 45825 Highway 96 East, Pueblo,

DEPARTMENT OF THE ARMY
PUEBLO CHEMICAL DEPOT
45825 HIGHWAY 96 EAST
PUEBLO, COLORADO 81006-9330

REPLY TO ATTENTION OF

May 23, 2001

Office of the Commander

CERTIFIED MAIL -RETURN RECEIPT REQUESTED 7099 3220 0005 0607 2583

Mr. Billy Evans Horse
Chairman, Kiowa Tribe of Oklahoma
Post Office Box 369
Carnegie, Oklahoma 73015

Dear Mr. Horse:

The United States Department of the Army has published two Draft Environmental Impact Statements that assess the potential impacts of the design, construction, operation, and closure of a chemical weapons disposal facility at Pueblo Chemical Depot, Colorado, as follows:

a. The Army Program Manager for Assembled Chemical Weapons Assessment (PMACWA) is developing a programmatic Environmental Impact Statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies that are alternatives to incineration for the destruction of the U.S. chemical weapons stockpile. The technologies currently under consideration are (1) neutralization followed by supercritical water oxidation and (2) neutralization followed by biodegradation. Additional technologies are currently being evaluated and may also be addressed in the programmatic EIS. The PMACWA EIS will address pilot testing these technologies at one or more U.S. chemical stockpile locations – Anniston Army Depot (Alabama), Blue Grass Army Depot (Kentucky), Pine Bluff Arsenal (Arizona), and Pueblo Chemical Depot (Colorado).

b. The Army Program Manager for Chemical Demilitarization (PMCD) is developing a site-specific EIS to address the impacts of constructing and operating an incineration facility to completely dispose of the chemical munitions stockpile at Pueblo Chemical Depot. The PMCD EIS will assess and compare the impacts of two incineration technologies as well as the two neutralization technologies identified by the ACWA program.

The Pueblo Chemical Depot is one of eight sites in the continental United States where chemical agents are currently stored. In response to a Congressional mandate to destroy the nation's stockpile of chemical warfare agents and munitions (Title 14, Part B, Section 1412 of Public Law 99-145, as amended in Public Laws 100-456, and 102-190), chemical agent and munitions stored at Pueblo Chemical Depot must be destroyed. The demilitarization of the agent and munitions via incineration and available alternative technologies will be evaluated to assess the potential site-specific health and environmental impacts.

A Notice of Availability of this document was published in the Federal Register on May 11, 2001. The 45-day public comment period, which began with the publication of the

-2-

Notice of Availability, will end on June 25, 2001. Public availability sessions will be held as follows:

- June 6, 2001 – Pueblo Convention Center, 11:30 a.m. to 3:00 p.m., and 6:00 p.m., to 9:00 p.m.
- June 7, 2001 – Avondale Elementary School, 11:30 a.m. to 3:00 p.m., and 6:00 p.m. to 9:00 p.m.

Comments received will be addressed in the Final Environmental Impact Statements. Your comments on these two studies will be factored into the Department of Defense's disposal technology selection process for Pueblo.

Electronic copies of the two Draft Environmental Impact Statements are enclosed for your convenience. We welcome your comments. Comments may be sent by mail, fax, or e-mail to the following:

- PMACWA study: Mr. Jon Ware, Program Manager for Assembled Chemical Weapons Assessment EIS, 9700 South Cass Avenue., P.O. Box 8369, Argonne, IL 60439-4871. You may also fax comments to 1-630-252-4611 or e-mail them to acwacomment@anl.gov.

- PMCD study: Mr. Greg Mahall, Program Manager for Chemical Demilitarization EIS, Building. 4585 Parrish Road., Aberdeen Proving Ground (EA), MD 21010-4005. You may also fax comments to 410-436-5122 or e-mail them to gregory.mahall@pmcd.apgea.army.mil.

If you have any questions you may contact the above listed representatives or Mr. Brad Still of my staff at (719) 549-4883, or email him at stilljb@pcd-emh1.pcd.army.mil.

Sincerely,

John J. Megnia
Lieutenant Colonel, U.S. Army
Commanding

Enclosures

Copy Furnished:

✓Mr. Jon Ware, ACWA, Environmental Team Leader, ATTN: AMSSB-PM-ACWA, Building E5101, Room 101, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 2101-5424
Ms. Penny Robitalle, Program Manager for Chemical Demilitarization, Corner of Hoadley and Parrish Roads, Aberdeen Proving Ground, MD 21010-4005
Document Tracking Center, Pueblo Chemical Depot, 45825 Highway 96 East, Pueblo,

DEPARTMENT OF THE ARMY
PUEBLO CHEMICAL DEPOT
45825 HIGHWAY 96 EAST
PUEBLO, COLORADO 81006-9330

REPLY TO
ATTENTION OF

May 23, 2001

Office of the Commander

CERTIFIED MAIL -RETURN RECEIPT REQUESTED 7099 3220 0005 0607 2576

Ms. Claudia J. Vigil Muniz
President, Jicarilla Apache Tribe
Post Office Box 507
Dulce, New Mexico 87528

Dear Ms. Vigil Muniz:

The United States Department of the Army has published two Draft Environmental Impact Statements that assess the potential impacts of the design, construction, operation, and closure of a chemical weapons disposal facility at Pueblo Chemical Depot, Colorado, as follows:

a. The Army Program Manager for Assembled Chemical Weapons Assessment (PMACWA) is developing a programmatic Environmental Impact Statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies that are alternatives to incineration for the destruction of the U.S. chemical weapons stockpile. The technologies currently under consideration are (1) neutralization followed by supercritical water oxidation and (2) neutralization followed by biodegradation. Additional technologies are currently being evaluated and may also be addressed in the programmatic EIS. The PMACWA EIS will address pilot testing these technologies at one or more U.S. chemical stockpile locations – Anniston Army Depot (Alabama), Blue Grass Army Depot (Kentucky), Pine Bluff Arsenal (Arizona), and Pueblo Chemical Depot (Colorado).

b. The Army Program Manager for Chemical Demilitarization (PMCD) is developing a site-specific EIS to address the impacts of constructing and operating an incineration facility to completely dispose of the chemical munitions stockpile at Pueblo Chemical Depot. The PMCD EIS will assess and compare the impacts of two incineration technologies as well as the two neutralization technologies identified by the ACWA program.

The Pueblo Chemical Depot is one of eight sites in the continental United States where chemical agents are currently stored. In response to a Congressional mandate to destroy the nation's stockpile of chemical warfare agents and munitions (Title 14, Part B, Section 1412 of Public Law 99-145, as amended in Public Laws 100-456, and 102-190), chemical agent and munitions stored at Pueblo Chemical Depot must be destroyed. The demilitarization of the agent and munitions via incineration and available alternative technologies will be evaluated to assess the potential site-specific health and environmental impacts.

A Notice of Availability of this document was published in the Federal Register on May 11, 2001. The 45-day public comment period, which began with the publication of the

Notice of Availability, will end on June 25, 2001. Public availability sessions will be held as follows:

- June 6, 2001 – Pueblo Convention Center, 11:30 a.m. to 3:00 p.m., and 6:00 p.m., to 9:00 p.m.
- June 7, 2001 – Avondale Elementary School, 11:30 a.m. to 3:00 p.m., and 6:00 p.m. to 9:00 p.m.

Comments received will be addressed in the Final Environmental Impact Statements. Your comments on these two studies will be factored into the Department of Defense's disposal technology selection process for Pueblo.

Electronic copies of the two Draft Environmental Impact Statements are enclosed for your convenience. We welcome your comments. Comments may be sent by mail, fax, or e-mail to the following:

- PMACWA study: Mr. Jon Ware, Program Manager for Assembled Chemical Weapons Assessment EIS, 9700 South Cass Avenue., P.O. Box 8369, Argonne, IL 60439-4871. You may also fax comments to 1-630-252-4611 or e-mail them to acwacomment@anl.gov.

- PMCD study: Mr. Greg Mahall, Program Manager for Chemical Demilitarization EIS, Building. 4585 Parrish Road., Aberdeen Proving Ground (EA), MD 21010-4005. You may also fax comments to 410-436-5122 or e-mail them to gregory.mahall@pmcd.apgea.army.mil.

If you have any questions you may contact the above listed representatives or Mr. Brad Still of my staff at (719) 549-4883, or email him at stilljb@pcd-emh1.pcd.army.mil.

Sincerely,

John J. Megnia
Lieutenant Colonel, U.S. Army
Commanding

Enclosures

Copy Furnished:

Mr. Jon Ware, ACWA, Environmental Team Leader, ATTN: AMSSB-PM-ACWA, Building E5101, Room 101, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 2101-5424

Ms. Penny Robitalle, Program Manager for Chemical Demilitarization, Corner of Hoadley and Parrish Roads, Aberdeen Proving Ground, MD 21010-4005

Document Tracking Center, Pueblo Chemical Depot, 45825 Highway 96 East, Pueblo,

DEPARTMENT OF THE ARMY
PUEBLO CHEMICAL DEPOT
45825 HIGHWAY 96 EAST
PUEBLO, COLORADO 81006-9330

REPLY TO ATTENTION OF

May 23, 2001

Office of the Commander

CERTIFIED MAIL -RETURN RECEIPT REQUESTED 7099 3220 0005 0607 2569

Ms. Ruey Darrow
Chairwoman, Fort Sill Apache Tribe
Route 2, Box 121
Apache, Oklahoma 73006

Dear Ms. Darrow:

The United States Department of the Army has published two Draft Environmental Impact Statements that assess the potential impacts of the design, construction, operation, and closure of a chemical weapons disposal facility at Pueblo Chemical Depot, Colorado, as follows:

a. The Army Program Manager for Assembled Chemical Weapons Assessment (PMACWA) is developing a programmatic Environmental Impact Statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies that are alternatives to incineration for the destruction of the U.S. chemical weapons stockpile. The technologies currently under consideration are (1) neutralization followed by supercritical water oxidation and (2) neutralization followed by biodegradation. Additional technologies are currently being evaluated and may also be addressed in the programmatic EIS. The PMACWA EIS will address pilot testing these technologies at one or more U.S. chemical stockpile locations – Anniston Army Depot (Alabama), Blue Grass Army Depot (Kentucky), Pine Bluff Arsenal (Arizona), and Pueblo Chemical Depot (Colorado).

b. The Army Program Manager for Chemical Demilitarization (PMCD) is developing a site-specific EIS to address the impacts of constructing and operating an incineration facility to completely dispose of the chemical munitions stockpile at Pueblo Chemical Depot. The PMCD EIS will assess and compare the impacts of two incineration technologies as well as the two neutralization technologies identified by the ACWA program.

The Pueblo Chemical Depot is one of eight sites in the continental United States where chemical agents are currently stored. In response to a Congressional mandate to destroy the nation's stockpile of chemical warfare agents and munitions (Title 14, Part B, Section 1412 of Public Law 99-145, as amended in Public Laws 100-456, and 102-190), chemical agent and munitions stored at Pueblo Chemical Depot must be destroyed. The demilitarization of the agent and munitions via incineration and available alternative technologies will be evaluated to assess the potential site-specific health and environmental impacts.

A Notice of Availability of this document was published in the Federal Register on May 11, 2001. The 45-day public comment period, which began with the publication of the

-2-

Notice of Availability, will end on June 25, 2001. Public availability sessions will be held as follows:

- June 6, 2001 – Pueblo Convention Center, 11:30 a.m. to 3:00 p.m., and 6:00 p.m., to 9:00 p.m.
- June 7, 2001 – Avondale Elementary School, 11:30 a.m. to 3:00 p.m., and 6:00 p.m. to 9:00 p.m.

Comments received will be addressed in the Final Environmental Impact Statements. Your comments on these two studies will be factored into the Department of Defense's disposal technology selection process for Pueblo.

Electronic copies of the two Draft Environmental Impact Statements are enclosed for your convenience. We welcome your comments. Comments may be sent by mail, fax, or e-mail to the following:

- PMACWA study: Mr. Jon Ware, Program Manager for Assembled Chemical Weapons Assessment EIS, 9700 South Cass Avenue., P.O. Box 8369, Argonne, IL 60439-4871. You may also fax comments to 1-630-252-4611 or e-mail them to acwacomment@anl.gov.

- PMCD study: Mr. Greg Mahall, Program Manager for Chemical Demilitarization EIS, Building. 4585 Parrish Road., Aberdeen Proving Ground (EA), MD 21010-4005. You may also fax comments to 410-436-5122 or e-mail them to gregory.mahall@pmcd.apgea.army.mil.

If you have any questions you may contact the above listed representatives or Mr. Brad Still of my staff at (719) 549-4883, or email him at stilljb@pcd-emh1.pcd.army.mil.

Sincerely,

John J. Megnia
Lieutenant Colonel, U.S. Army
Commanding

Enclosures

Copy Furnished:

Mr. Jon Ware, ACWA, Environmental Team Leader, ATTN: AMSSB-PM-ACWA, Building E5101, Room 101, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 2101-5424
Ms. Penny Robitalle, Program Manager for Chemical Demilitarization, Corner of Hoadley and Parrish Roads, Aberdeen Proving Ground, MD 21010-4005
Document Tracking Center, Pueblo Chemical Depot, 45825 Highway 96 East, Pueblo,

DEPARTMENT OF THE ARMY
PUEBLO CHEMICAL DEPOT
45825 HIGHWAY 96 EAST
PUEBLO, COLORADO 81006-9330

REPLY TO ATTENTION OF

May 23, 2001

Office of the Commander

CERTIFIED MAIL -RETURN RECEIPT REQUESTED 7099 3220 0005 0607 2552

Mr. Johnny Wauqua
Chairman, Commanche Tribe of Oklahoma
Post Office Box 908
Lawton, Oklahoma 73502

Dear Mr. Wauqua:

The United States Department of the Army has published two Draft Environmental Impact Statements that assess the potential impacts of the design, construction, operation, and closure of a chemical weapons disposal facility at Pueblo Chemical Depot, Colorado, as follows:

a. The Army Program Manager for Assembled Chemical Weapons Assessment (PMACWA) is developing a programmatic Environmental Impact Statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies that are alternatives to incineration for the destruction of the U.S. chemical weapons stockpile. The technologies currently under consideration are (1) neutralization followed by supercritical water oxidation and (2) neutralization followed by biodegradation. Additional technologies are currently being evaluated and may also be addressed in the programmatic EIS. The PMACWA EIS will address pilot testing these technologies at one or more U.S. chemical stockpile locations – Anniston Army Depot (Alabama), Blue Grass Army Depot (Kentucky), Pine Bluff Arsenal (Arizona), and Pueblo Chemical Depot (Colorado).

b. The Army Program Manager for Chemical Demilitarization (PMCD) is developing a site-specific EIS to address the impacts of constructing and operating an incineration facility to completely dispose of the chemical munitions stockpile at Pueblo Chemical Depot. The PMCD EIS will assess and compare the impacts of two incineration technologies as well as the two neutralization technologies identified by the ACWA program.

The Pueblo Chemical Depot is one of eight sites in the continental United States where chemical agents are currently stored. In response to a Congressional mandate to destroy the nation's stockpile of chemical warfare agents and munitions (Title 14, Part B, Section 1412 of Public Law 99-145, as amended in Public Laws 100-456, and 102-190), chemical agent and munitions stored at Pueblo Chemical Depot must be destroyed. The demilitarization of the agent and munitions via incineration and available alternative technologies will be evaluated to assess the potential site-specific health and environmental impacts.

A Notice of Availability of this document was published in the Federal Register on May 11, 2001. The 45-day public comment period, which began with the publication of the

-2-

Notice of Availability, will end on June 25, 2001. Public availability sessions will be held as follows:

- June 6, 2001 – Pueblo Convention Center, 11:30 a.m. to 3:00 p.m., and 6:00 p.m., to 9:00 p.m.
- June 7, 2001 – Avondale Elementary School, 11:30 a.m. to 3:00 p.m., and 6:00 p.m. to 9:00 p.m.

Comments received will be addressed in the Final Environmental Impact Statements. Your comments on these two studies will be factored into the Department of Defense's disposal technology selection process for Pueblo.

Electronic copies of the two Draft Environmental Impact Statements are enclosed for your convenience. We welcome your comments. Comments may be sent by mail, fax, or e-mail to the following:

- PMACWA study: Mr. Jon Ware, Program Manager for Assembled Chemical Weapons Assessment EIS, 9700 South Cass Avenue., P.O. Box 8369, Argonne, IL 60439-4871. You may also fax comments to 1-630-252-4611 or e-mail them to acwacomment@anl.gov.

- PMCD study: Mr. Greg Mahall, Program Manager for Chemical Demilitarization EIS, Building. 4585 Parrish Road., Aberdeen Proving Ground (EA), MD 21010-4005. You may also fax comments to 410-436-5122 or e-mail them to gregory.mahall@pmcd.apgea.army.mil.

If you have any questions you may contact the above listed representatives or Mr. Brad Still of my staff at (719) 549-4883, or email him at stilljb@pcd-emh1.pcd.army.mil.

Sincerely,

John J. Megnia
Lieutenant Colonel, U.S. Army
Commanding

Enclosures

Copy Furnished:

Mr. Jon Ware, ACWA, Environmental Team Leader, ATTN: AMSSB-PM-ACWA, Building E5101, Room 101, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 2101-5424

Ms. Penny Robitalle, Program Manager for Chemical Demilitarization, Corner of Hoadley and Parrish Roads, Aberdeen Proving Ground, MD 21010-4005

Document Tracking Center, Pueblo Chemical Depot, 45825 Highway 96 East, Pueblo,

DEPARTMENT OF THE ARMY
PUEBLO CHEMICAL DEPOT
45825 HIGHWAY 96 EAST
PUEBLO, COLORADO 81006-9330

REPLY TO ATTENTION OF

May 23, 2001

Office of the Commander

CERTIFIED MAIL -RETURN RECEIPT REQUESTED 7099 3220 0005 0607 2545

Mr. Gregg Bourland
Chairman, Cheyenne River Lakota Tribe
Eagle Butte, South Dakota 57625

Dear Mr. Bourland:

The United States Department of the Army has published two Draft Environmental Impact Statements that assess the potential impacts of the design, construction, operation, and closure of a chemical weapons disposal facility at Pueblo Chemical Depot, Colorado, as follows:

a. The Army Program Manager for Assembled Chemical Weapons Assessment (PMACWA) is developing a programmatic Environmental Impact Statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies that are alternatives to incineration for the destruction of the U.S. chemical weapons stockpile. The technologies currently under consideration are (1) neutralization followed by supercritical water oxidation and (2) neutralization followed by biodegradation. Additional technologies are currently being evaluated and may also be addressed in the programmatic EIS. The PMACWA EIS will address pilot testing these technologies at one or more U.S. chemical stockpile locations – Anniston Army Depot (Alabama), Blue Grass Army Depot (Kentucky), Pine Bluff Arsenal (Arizona), and Pueblo Chemical Depot (Colorado).

b. The Army Program Manager for Chemical Demilitarization (PMCD) is developing a site-specific EIS to address the impacts of constructing and operating an incineration facility to completely dispose of the chemical munitions stockpile at Pueblo Chemical Depot. The PMCD EIS will assess and compare the impacts of two incineration technologies as well as the two neutralization technologies identified by the ACWA program.

The Pueblo Chemical Depot is one of eight sites in the continental United States where chemical agents are currently stored. In response to a Congressional mandate to destroy the nation's stockpile of chemical warfare agents and munitions (Title 14, Part B, Section 1412 of Public Law 99-145, as amended in Public Laws 100-456, and 102-190), chemical agent and munitions stored at Pueblo Chemical Depot must be destroyed. The demilitarization of the agent and munitions via incineration and available alternative technologies will be evaluated to assess the potential site-specific health and environmental impacts.

A Notice of Availability of this document was published in the Federal Register on May 11, 2001. The 45-day public comment period, which began with the publication of the

Notice of Availability, will end on June 25, 2001. Public availability sessions will be held as follows:

- June 6, 2001 – Pueblo Convention Center, 11:30 a.m. to 3:00 p.m., and 6:00 p.m., to 9:00 p.m.
- June 7, 2001 – Avondale Elementary School, 11:30 a.m. to 3:00 p.m., and 6:00 p.m. to 9:00 p.m.

Comments received will be addressed in the Final Environmental Impact Statements. Your comments on these two studies will be factored into the Department of Defense's disposal technology selection process for Pueblo.

Electronic copies of the two Draft Environmental Impact Statements are enclosed for your convenience. We welcome your comments. Comments may be sent by mail, fax, or e-mail to the following:

- PMACWA study: Mr. Jon Ware, Program Manager for Assembled Chemical Weapons Assessment EIS, 9700 South Cass Avenue., P.O. Box 8369, Argonne, IL 60439-4871. You may also fax comments to 1-630-252-4611 or e-mail them to acwacomment@anl.gov.

- PMCD study: Mr. Greg Mahall, Program Manager for Chemical Demilitarization EIS, Building. 4585 Parrish Road., Aberdeen Proving Ground (EA), MD 21010-4005. You may also fax comments to 410-436-5122 or e-mail them to gregory.mahall@pmcd.apgea.army.mil.

If you have any questions you may contact the above listed representatives or Mr. Brad Still of my staff at (719) 549-4883, or email him at stilljb@pcd-emh1.pcd.army.mil.

Sincerely,

John J. Megnia
Lieutenant Colonel, U.S. Army
Commanding

Enclosures

Copy Furnished:

✓Mr. Jon Ware, ACWA, Environmental Team Leader, ATTN: AMSSB-PM-ACWA, Building E5101, Room 101, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 2101-5424
Ms. Penny Robitalle, Program Manager for Chemical Demilitarization, Corner of Hoadley and Parrish Roads, Aberdeen Proving Ground, MD 21010-4005
Document Tracking Center, Pueblo Chemical Depot, 45825 Highway 96 East, Pueblo,

DEPARTMENT OF THE ARMY
PUEBLO CHEMICAL DEPOT
45825 HIGHWAY 96 EAST
PUEBLO, COLORADO 81006-9330

REPLY TO
ATTENTION OF

May 23, 2001

Office of the Commander

CERTIFIED MAIL -RETURN RECEIPT REQUESTED 7099 3220 0005 0607 2538

Mr. James Pedro
Chairman, Cheyenne and Arapahoe Tribes of Oklahoma
Post Office Box 38
Concho, Oklahoma 73022

Dear Mr. Pedro:

The United States Department of the Army has published two Draft Environmental Impact Statements that assess the potential impacts of the design, construction, operation, and closure of a chemical weapons disposal facility at Pueblo Chemical Depot, Colorado, as follows:

a. The Army Program Manager for Assembled Chemical Weapons Assessment (PMACWA) is developing a programmatic Environmental Impact Statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies that are alternatives to incineration for the destruction of the U.S. chemical weapons stockpile. The technologies currently under consideration are (1) neutralization followed by supercritical water oxidation and (2) neutralization followed by biodegradation. Additional technologies are currently being evaluated and may also be addressed in the programmatic EIS. The PMACWA EIS will address pilot testing these technologies at one or more U.S. chemical stockpile locations – Anniston Army Depot (Alabama), Blue Grass Army Depot (Kentucky), Pine Bluff Arsenal (Arizona), and Pueblo Chemical Depot (Colorado).

b. The Army Program Manager for Chemical Demilitarization (PMCD) is developing a site-specific EIS to address the impacts of constructing and operating an incineration facility to completely dispose of the chemical munitions stockpile at Pueblo Chemical Depot. The PMCD EIS will assess and compare the impacts of two incineration technologies as well as the two neutralization technologies identified by the ACWA program.

The Pueblo Chemical Depot is one of eight sites in the continental United States where chemical agents are currently stored. In response to a Congressional mandate to destroy the nation's stockpile of chemical warfare agents and munitions (Title 14, Part B, Section 1412 of Public Law 99-145, as amended in Public Laws 100-456, and 102-190), chemical agent and munitions stored at Pueblo Chemical Depot must be destroyed. The demilitarization of the agent and munitions via incineration and available alternative technologies will be evaluated to assess the potential site-specific health and environmental impacts.

A Notice of Availability of this document was published in the Federal Register on May 11, 2001. The 45-day public comment period, which began with the publication of the

-2-

Notice of Availability, will end on June 25, 2001. Public availability sessions will be held as follows:

- June 6, 2001 – Pueblo Convention Center, 11:30 a.m. to 3:00 p.m., and 6:00 p.m., to 9:00 p.m.
- June 7, 2001 – Avondale Elementary School, 11:30 a.m. to 3:00 p.m., and 6:00 p.m. to 9:00 p.m.

Comments received will be addressed in the Final Environmental Impact Statements. Your comments on these two studies will be factored into the Department of Defense's disposal technology selection process for Pueblo.

Electronic copies of the two Draft Environmental Impact Statements are enclosed for your convenience. We welcome your comments. Comments may be sent by mail, fax, or e-mail to the following:

- PMACWA study: Mr. Jon Ware, Program Manager for Assembled Chemical Weapons Assessment EIS, 9700 South Cass Avenue., P.O. Box 8369, Argonne, IL 60439-4871. You may also fax comments to 1-630-252-4611 or e-mail them to acwacomment@anl.gov.

- PMCD study: Mr. Greg Mahall, Program Manager for Chemical Demilitarization EIS, Building. 4585 Parrish Road., Aberdeen Proving Ground (EA), MD 21010-4005. You may also fax comments to 410-436-5122 or e-mail them to gregory.mahall@pmcd.apgea.army.mil.

If you have any questions you may contact the above listed representatives or Mr. Brad Still of my staff at (719) 549-4883, or email him at stilljb@pcd-emh1.pcd.army.mil.

Sincerely,

John J. Megnia
Lieutenant Colonel, U.S. Army
Commanding

Enclosures

Copy Furnished:

Mr. Jon Ware, ACWA, Environmental Team Leader, ATTN: AMSSB-PM-ACWA, Building E5101, Room 101, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 2101-5424
Ms. Penny Robitalle, Program Manager for Chemical Demilitarization, Corner of Hoadley and Parrish Roads, Aberdeen Proving Ground, MD 21010-4005
Document Tracking Center, Pueblo Chemical Depot, 45825 Highway 96 East, Pueblo,

DEPARTMENT OF THE ARMY
PUEBLO CHEMICAL DEPOT
45825 HIGHWAY 96 EAST
PUEBLO, COLORADO 81006-9330

REPLY TO ATTENTION OF

May 23, 2001

Office of the Commander

CERTIFIED MAIL -RETURN RECEIPT REQUESTED 7099 3220 0005 0607 2521

Mr. Gene Maroquin
Chairman, Apache Tribe of Oklahoma
Post Office Box 1220
Anadarko, Oklahoma 73005

Dear Mr. Maroquin:

The United States Department of the Army has published two Draft Environmental Impact Statements that assess the potential impacts of the design, construction, operation, and closure of a chemical weapons disposal facility at Pueblo Chemical Depot, Colorado, as follows:

a. The Army Program Manager for Assembled Chemical Weapons Assessment (PMACWA) is developing a programmatic Environmental Impact Statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies that are alternatives to incineration for the destruction of the U.S. chemical weapons stockpile. The technologies currently under consideration are (1) neutralization followed by supercritical water oxidation and (2) neutralization followed by biodegradation. Additional technologies are currently being evaluated and may also be addressed in the programmatic EIS. The PMACWA EIS will address pilot testing these technologies at one or more U.S. chemical stockpile locations – Anniston Army Depot (Alabama), Blue Grass Army Depot (Kentucky), Pine Bluff Arsenal (Arizona), and Pueblo Chemical Depot (Colorado).

b. The Army Program Manager for Chemical Demilitarization (PMCD) is developing a site-specific EIS to address the impacts of constructing and operating an incineration facility to completely dispose of the chemical munitions stockpile at Pueblo Chemical Depot. The PMCD EIS will assess and compare the impacts of two incineration technologies as well as the two neutralization technologies identified by the ACWA program.

The Pueblo Chemical Depot is one of eight sites in the continental United States where chemical agents are currently stored. In response to a Congressional mandate to destroy the nation's stockpile of chemical warfare agents and munitions (Title 14, Part B, Section 1412 of Public Law 99-145, as amended in Public Laws 100-456, and 102-190), chemical agent and munitions stored at Pueblo Chemical Depot must be destroyed. The demilitarization of the agent and munitions via incineration and available alternative technologies will be evaluated to assess the potential site-specific health and environmental impacts.

A Notice of Availability of this document was published in the Federal Register on May 11, 2001. The 45-day public comment period, which began with the publication of the

-2-

Notice of Availability, will end on June 25, 2001. Public availability sessions will be held as follows:

- June 6, 2001 – Pueblo Convention Center, 11:30 a.m. to 3:00 p.m., and 6:00 p.m., to 9:00 p.m.
- June 7, 2001 – Avondale Elementary School, 11:30 a.m. to 3:00 p.m., and 6:00 p.m. to 9:00 p.m.

Comments received will be addressed in the Final Environmental Impact Statements. Your comments on these two studies will be factored into the Department of Defense's disposal technology selection process for Pueblo.

Electronic copies of the two Draft Environmental Impact Statements are enclosed for your convenience. We welcome your comments. Comments may be sent by mail, fax, or e-mail to the following:

- PMACWA study: Mr. Jon Ware, Program Manager for Assembled Chemical Weapons Assessment EIS, 9700 South Cass Avenue., P.O. Box 8369, Argonne, IL 60439-4871. You may also fax comments to 1-630-252-4611 or e-mail them to acwacomment@anl.gov.

- PMCD study: Mr. Greg Mahall, Program Manager for Chemical Demilitarization EIS, Building. 4585 Parrish Road., Aberdeen Proving Ground (EA), MD 21010-4005. You may also fax comments to 410-436-5122 or e-mail them to gregory.mahall@pmcd.apgea.army.mil.

If you have any questions you may contact the above listed representatives or Mr. Brad Still of my staff at (719) 549-4883, or email him at stilljb@pcd-emh1.pcd.army.mil.

Sincerely,

John J. Megnia
Lieutenant Colonel, U.S. Army
Commanding

Enclosures

Copy Furnished:

Mr. Jon Ware, ACWA, Environmental Team Leader, ATTN: AMSSB-PM-ACWA, Building E5101, Room 101, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 2101-5424
Ms. Penny Robitalle, Program Manager for Chemical Demilitarization, Corner of Hoadley and Parrish Roads, Aberdeen Proving Ground, MD 21010-4005
Document Tracking Center, Pueblo Chemical Depot, 45825 Highway 96 East, Pueblo,

DEPARTMENT OF THE ARMY
PUEBLO CHEMICAL DEPOT
45825 HIGHWAY 96 EAST
PUEBLO, COLORADO 81006-9330

REPLY TO ATTENTION OF

May 24, 2001

Office of the Commander

CERTIFIED MAIL -RETURN RECEIPT REQUESTED 7099 3220 0005 0607 2514

Mr. Leonard Atole
Jicarilla Apache Tribe
Post Office Box 507
Dulce, New Mexico 87528

Dear Mr. Atole:

The United States Department of the Army has published two Draft Environmental Impact Statements that assess the potential impacts of the design, construction, operation, and closure of a chemical weapons disposal facility at Pueblo Chemical Depot, Colorado, as follows:

a. The Army Program Manager for Assembled Chemical Weapons Assessment (PMACWA) is developing a programmatic Environmental Impact Statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies that are alternatives to incineration for the destruction of the U.S. chemical weapons stockpile. The technologies currently under consideration are (1) neutralization followed by supercritical water oxidation and (2) neutralization followed by biodegradation. Additional technologies are currently being evaluated and may also be addressed in the programmatic EIS. The PMACWA EIS will address pilot testing these technologies at one or more U.S. chemical stockpile locations – Anniston Army Depot (Alabama), Blue Grass Army Depot (Kentucky), Pine Bluff Arsenal (Arizona), and Pueblo Chemical Depot (Colorado).

b. The Army Program Manager for Chemical Demilitarization (PMCD) is developing a site-specific EIS to address the impacts of constructing and operating an incineration facility to completely dispose of the chemical munitions stockpile at Pueblo Chemical Depot. The PMCD EIS will assess and compare the impacts of two incineration technologies as well as the two neutralization technologies identified by the ACWA program.

The Pueblo Chemical Depot is one of eight sites in the continental United States where chemical agents are currently stored. In response to a Congressional mandate to destroy the nation's stockpile of chemical warfare agents and munitions (Title 14, Part B, Section 1412 of Public Law 99-145, as amended in Public Laws 100-456, and 102-190), chemical agent and munitions stored at Pueblo Chemical Depot must be destroyed. The demilitarization of the agent and munitions via incineration and available alternative technologies will be evaluated to assess the potential site-specific health and environmental impacts.

A Notice of Availability of this document was published in the Federal Register on May 11, 2001. The 45-day public comment period, which began with the publication of the

Notice of Availability, will end on June 25, 2001. Public availability sessions will be held as follows:

- June 6, 2001 – Pueblo Convention Center, 11:30 a.m. to 3:00 p.m., and 6:00 p.m., to 9:00 p.m.
- June 7, 2001 – Avondale Elementary School, 11:30 a.m. to 3:00 p.m., and 6:00 p.m. to 9:00 p.m.

Comments received will be addressed in the Final Environmental Impact Statements. Your comments on these two studies will be factored into the Department of Defense's disposal technology selection process for Pueblo.

Electronic copies of the two Draft Environmental Impact Statements are enclosed for your convenience. We welcome your comments. Comments may be sent by mail, fax, or e-mail to the following:

- PMACWA study: Mr. Jon Ware, Program Manager for Assembled Chemical Weapons Assessment EIS, 9700 South Cass Avenue., P.O. Box 8369, Argonne, IL 60439-4871. You may also fax comments to 1-630-252-4611 or e-mail them to acwacomment@anl.gov.

- PMCD study: Mr. Greg Mahall, Program Manager for Chemical Demilitarization EIS, Building. 4585 Parrish Road., Aberdeen Proving Ground (EA), MD 21010-4005. You may also fax comments to 410-436-5122 or e-mail them to gregory.mahall@pmcd.apgea.army.mil.

If you have any questions you may contact the above listed representatives or Mr. Brad Still of my staff at (719) 549-4883, or email him at stilljb@pcd-emh1.pcd.army.mil.

Sincerely,

John J. Megnia
Lieutenant Colonel, U.S. Army
Commanding

Enclosures

Copy Furnished:

Mr. Jon Ware, ACWA, Environmental Team Leader, ATTN: AMSSB-PM-ACWA, Building E5101, Room 101, 5183 Blackhawk Road, Aberdeen Proving Ground, MD 2101-5424
Ms. Penny Robitalle, Program Manager for Chemical Demilitarization, Corner of Hoadley and Parrish Roads, Aberdeen Proving Ground, MD 21010-4005
Document Tracking Center, Pueblo Chemical Depot, 45825 Highway 96 East, Pueblo,

Recd 5-14-01

COLORADO
HISTORICAL
SOCIETY

The Colorado History Museum 1300 Broadway Denver, Colorado 80203-2137

May 4, 2001

Kathryn R. Cain
Chief, Environmental Management Division
Department of the Army
Pueblo Chemical Depot
45825 Highway 96 East
Pueblo, CO 81006-9330

RE: Chemical Weapons Disposal Facility

Dear Ms. Cain:

Thank you for your correspondence dated March 21, 2001, concerning the above project. We regret the delay in our response.

A search of the Colorado Inventory of Cultural Resources indicated that Igloo Block G (5PE2158), which has been determined eligible for inclusion in the National Register of Historic Places appears to be located within the area of potential effects of the proposed alternative facility footprints. In addition, the following National Register eligible districts are adjacent to the proposed utility lines: Administration and Officers Quarters Historic District (5PE2154), Warehouse District (5PE2155), Standard Magazine Area Historic District (5PE2156) and Block J Historic District (5PE2159).

Archival documentation of the above resources has been accomplished pursuant to a Programmatic Agreement entitled *Utilization and Eventual Disposal of Above Ground Facilities at Pueblo Chemical Depot, Colorado*. However, we encourage the Army to avoid affecting the qualities of significance of these historic properties, if possible. Finally, if subsurface archaeological resources are encountered during ground disturbing activities, it will be necessary to halt the work until such resources can be evaluated in consultation with our office.

If we may be of further assistance, please contact Kaaren Hardy, our Intergovernmental Services Director, at 303/866-3398.

Sincerely,

Mark Wolfe

For Georgianna Contiguglia
State Historic Preservation Officer

"Embracing Our Future through Our Intriguing Past"
Archaeology and Historic Preservation Month - May 2001

OFFICE OF ARCHAEOLOGY AND HISTORIC PRESERVATION
303-866-3392 • Fax 303-866-2711 • E-mail: oahp@chs.state.co.us • Internet:http://www.coloradohistory-oahp.org

CONSULTATION LETTERS
AND RESPONSES FOR BGAD

DEPARTMENT OF THE ARMY
BLUE GRASS ARMY DEPOT
2091 KINGSTON HIGHWAY
RICHMOND, KENTUCKY
40475-5060

Reply to
Attention of

May 7, 2001

Environmental Office

Mr. David L. Morgan, State Historic Preservation Officer
Kentucky Heritage Council
300 Washington Street
Frankfort, KY 40601

RE: Notification of an Environmental Impact Statement at the Blue Grass Army Depot in Madison County, Kentucky

Dear Mr. Morgan:

The U.S. Department of the Army is evaluating the potential impacts associated with the design, construction, and operation of a chemical munitions disposal facility at the Blue Grass Army Depot (BGAD) in Madison County, Kentucky. As part of the decision-making process for this action, two parallel National Environmental Policy Act (NEPA) documents are being prepared by two Department of Defense (DOD) programs to address distinct but related actions.

(1) The DOD Assembled Chemical Weapons Assessment (ACWA) is developing an environmental impact statement (EIS) to address the potential impacts of constructing and operating a full-scale pilot facility for testing two or more technologies that are alternatives to incineration for the destruction of the U.S. chemical weapon stockpile. The technologies currently under consideration are (1) neutralization followed by supercritical water oxidation (SCWO); (2) neutralization followed by biodegradation; (3) neutralization followed by SCWO and gas-phase chemical reduction; and (4) electrochemical oxidation. The ACWA will address pilot testing these technologies at one or more U.S. chemical stockpile locations – Anniston Army Depot (AL), BGAD (KY), Pine Bluff Arsenal (AR), and Pueblo Chemical Depot (CO).

(2) The U.S. Army Program Manager Chemical Demilitarization (PMCD) is developing a site-specific EIS to address the impacts of constructing and operating a facility to dispose of the chemical munitions stockpile at BGAD. The PMCD EIS will assess and compare the impacts of incineration technologies as well as the four alternative technologies identified by the ACWA program.

The enclosed maps show the location of BGAD and the alternative facility footprint locations at BGAD. On April 14, 2000, ACWA issued a Notice of Intent to prepare an EIS for its action (*Federal Register* Vol. 65, No. 73, page 20139). A public scoping meeting for the ACWA EIS was held on May 18, 2000 in Richmond, Kentucky. PMCD issued its Notice of Intent on Dec. 4, 2000 (*Federal Register* Vol. 65, No. 233, page 75677); the public scoping meeting for the PMCD EIS was held in Richmond, Kentucky on January 9, 2001.

Argonne National Laboratory (ANL) is assisting ACWA in preparing the ACWA EIS and will be evaluating potential impacts to cultural resources as part of their analysis. Oak Ridge National Laboratory (ORNL) is assisting with the site-specific EIS for BGAD. For the ACWA EIS, an archaeologist from ANL has researched available survey documents for BGAD. ORNL will use the information compiled by ANL for the site-specific EIS.

Currently, the proposed areas for the facility have not been completely surveyed for archaeological sites. No sites were recorded during a 1983 survey of the southern part of Area A, but the southern part of Area B has been identified in the BGAD Cultural Resources Management Plan (prepared by Geo-Marine, Inc. in 1996) as an area with a high potential for containing archaeological sites. It therefore appears that construction has the potential to affect cultural resources, but whether the effect will be adverse will depend on the project site and results of any required survey.

The Army is initiating consultations about the proposed projects with points of contact (Tribal Historic Preservation Officers or designated representatives) from the Native American Tribes, Councils, and Nations listed below, as well as with the Kentucky Heritage Council.

Absentee-Shawnee Tribe of Oklahoma (Chairperson and NAGPRA Contact)
Eastern Shawnee Tribe of Oklahoma (Chief)
Eastern Band of Cherokee Indians (Principal Chief and NAGPRA Contact)
Cherokee Nation of Oklahoma (Principal Chief and NAGPRA Contact)
United Keetoowah Band of Cherokee (Chief and NAGPRA Contact)
Chickasaw Nation of Oklahoma (Governor and NAGPRA Contact)
Georgia Tribe of Eastern Cherokee (NAGPRA Contact)

We would appreciate receiving information on concerns or issues you may have regarding either proposed project. We are especially interested in your assistance in identifying properties of known religious or cultural significance that may be affected by the construction and operation of the proposed facility(ies). Sensitive information will remain confidential as stipulated under 36 CFR Part 800.11. Please submit comments to Joe Elliott at the return address within 30 days. Your time and consideration are greatly appreciated.

In the meantime, if you have any questions or require further clarification regarding either project please contact Joe Elliott at (859) 625-6021 or elliott.joe@bluegrass.army.mil.

Sincerely,

Jackey L. Edwards
Colonel, U.S. Army
Commanding Officer

Enclosures

APPENDIX G:

SOCIOECONOMICS

APPENDIX G:

SOCIOECONOMICS

Appendix G contains two main sections. Section G.1 briefly describes the methods and data sources that were used to perform the socioeconomic analyses. Section G.2 presents tables containing fiscal data that were collected from each of the counties, cities, and school districts in the regions of influence (ROIs, as defined below) at each of the four sites: Anniston Army Depot (ANAD) in Alabama, Pine Bluff Arsenal (PBA) in Arkansas, Pueblo Chemical Depot (PCD) in Colorado, and Blue Grass Army Depot (BGAD) in Kentucky.

G.1 IMPACT ASSESSMENT METHODS

Socioeconomic analyses assessed the potential impacts from constructing and operating an ACWA facility on population, employment, income, housing, community services, and traffic in the ROI surrounding each site. This ROI includes counties in which the majority of site employees currently live (Table G.1). Impacts on agriculture from accidents at the site were assessed for an ROI that includes all counties partially or completely within a 30-mi (50-km) radius of the site. Impacts from accidents on loss of business activity were assessed for counties partially or completely within the protective action zone (PAZ) designated by the Chemical Stockpile Emergency Preparedness Program (CSEPP) at each site (Table G.1).

G.1.1 Impacts on Regional Employment and Income

The impacts of ACWA facilities on regional employment and income were assessed by using regional economic multipliers, together with detailed data on life-cycle project expenditures for construction and operations. Multipliers capture the indirect (off-site) effects of on-site activities associated with construction and operation of each ACWA facility.

Multipliers were derived from IMPLAN input-output economic accounts for the ROI (MIG Inc. 2001).[1] The accounts show the flow of commodities from producers to industries and institutional consumers. They also show consumption activities by workers and owners of capital and imports from outside the region. The IMPLAN model includes up to 528 sectors representing industries in agriculture, mining, construction, manufacturing, wholesale and retail trade, utilities, finance, insurance and real estate, and consumer and business services. The model also includes information for each sector on employee compensation; proprietary and property income; personal consumption expenditures; federal, state, and local expenditures; inventory and capital information; and imports and exports.

---

[1] Mig Inc., 2001, IMPLAN data files, Stillwater, Minn.

TABLE G.1 Jurisdictions Included in the Regions of Influence at Each Potential ACWA Facility Location

Location	ANAD	PBA	PCD	BGAD
Construction and Operations				
Counties	Calhoun Etowah Talladega	Grant Jefferson Lincoln Pulaski	Pueblo	Clark Estill Fayette Jackson Madison
Cities	Anniston Attalla Gadsden Glencoe Hokes Bluff Jacksonville Lincoln Ohatchee Oxford Piedmont Rainbow City Southside Talladega Weaver	Altheimer Gould Grady Jacksonville Little Rock Pine Bluff Poyen Sheriden Sherwood Star City Wabbaseka White Hall	Pueblo	Berea Irvine Lexington McKee Richmond Winchester
School districts	Anniston Attalla Calhoun County Etowah County Gadsden Jacksonville Oxford Piedmont Talladega City Talladega County	Altheimer Gould Grady Little Rock North Little Rock Pine Bluff Poyen Pulaski County Sheriden Star City Watson Chapel White Hall	District 60 District 70	Clark County Estill County Fayette County Jackson County Madison County

TABLE G.1 (Cont.)

Location	ANAD	PBA	PCD	BGAD
Accidents				
Agricultural ROI counties	Blount Calhoun Cherokee Clay Cleburne Etowah Jefferson Randolph Shelby St. Clair Talladega	Arkansas Cleveland Dallas Grant Hot Spring Jefferson Lincoln Lonoke Pulaski Saline	Crowley El Paso Lincoln Otero Pueblo	Bath Bourbon Boyle Clark Estill Fayette Garrard Jessamine Jackson Laurel Lee Lincoln Madison Menifee Mercer Montgomery Owsley Powell Pulaski Rockcastle Wolfe Woodford
Loss-of-business PAZ counties	Calhoun Clay Cleburne Etowah St. Clair Talladega	Arkansas Cleveland Dallas Grant Jefferson Lincoln Lonoke Pulaski Saline	Pueblo	Madison

Data on life-cycle expenditures associated with the construction and operation of each ACWA facility were derived from engineering-cost data provided by the construction and engineering contractors likely to build the facility. These data showed, for both construction and operation, details on individual cost components in terms of labor, materials, any subcontracts, and taxes. The data covered both direct expenditures (fabrication, installation, certification, testing) and indirect expenditures (contractor field expenses, contractor overhead and bond, construction management and project management expenditures, architectural and engineering expenditures). Data for these categories for the year in which these expenditures would occur were mapped into the relevant Standard Industrial Classification (SIC) codes to be used with multipliers from the IMPLAN model specified for the ROI counties.

Information on the expected pattern of expenditures within the ROI for the various items of equipment, materials labor, and subcontracts in each cost category was used to adjust total project expenditures. The extent of procurement within the ROI was estimated from data based on ROI employment in the relevant ROI sectors, together with ROI unemployment rates, or from data provided by the engineering and construction contractors.

IMPLAN multipliers for each sector in which regional spending occurs and data on expenditures were used to estimate impacts on ROI employment and income. Impacts on employment were described in terms of the total number of jobs created in the region in the peak year of construction and in the first year of operation. The relative impact of the increase in employment in the ROI was calculated by comparing total ACWA facility construction employment over the period in which construction occurs with baseline ROI employment forecasts over the same period. Impacts were expressed in terms of percentage point differences in the average annual employment growth rate with and without ACWA project construction. Forecasts were based on data provided by the U.S. Department of Commerce (DOC).

G.1.2 Impacts on Population

An important factor to consider in assessing the potential impacts from an ACWA facility is the number of workers, including their families and children, who would migrate into the ROI, either temporarily or permanently, as a result of the construction and operation of the facility. The capacity of regional labor markets to supply workers in the appropriate occupations required for facility construction and operation in sufficient numbers is closely related to the occupational profile of the ROI and occupational unemployment rates. To estimate the in-migration that would occur to satisfy direct labor requirements, the analysis developed estimates of available labor in each direct labor category that were based on ROI unemployment rates applied to each occupational category. Data on in-migration associated with indirect labor requirements were derived from estimates of available workers in the ROI economy that would be able to satisfy the demand for labor by industry sectors in which ACWA facility spending would initially occur. The national average household size was used to calculate the number of additional family members who would accompany direct and indirect in-migrating workers.

Impacts on population were described in terms of the total number of in-migrants arriving in the region in the peak year of construction and in the first year of operation. The relative impact of the increase in population in the ROI was calculated by comparing total ACWA facility construction in-migration over the period in which construction occurs with baseline ROI population forecasts over the same period. Impacts were expressed in terms of the percentage point difference in the average annual population growth rate with and without project construction. Forecasts were based on data provided by the U.S. Bureau of the Census.

G.1.3 Impacts on Local Housing Markets

The in-migration of direct and indirect workers during construction and operation could substantially affect the housing market in the ROI. The analysis considers these impacts by estimating the increase in demand for rental housing units in the peak year of construction and the increase in demand for owner-occupied units in the first year of operation. The impacts on housing were described in terms of the number of rental units required in the peak year of construction and the number of owner-occupied units required in the first year of operations. The relative impact on existing housing in the ROI was estimated by calculating the impact of ACWA-related housing demand on the forecasted number of vacant rental housing units in the peak year of construction and on the forecasted number of vacant owner-occupied units in the first year of operations. Forecasts were based on data provided by the U.S. Bureau of the Census.

G.1.4 Impacts on Community Services

In-migration associated with the construction and operation of an ACWA facility could translate into increased demand for educational services and public services (police, fire protection, health services, etc.) in the ROI. Estimates of the total number of in-migrating workers and their families were used to calculate the impact of ACWA facility construction and operation on the core ROI county (or countries) in which the majority of new workers would locate. Impacts of the facility on county, city, and school district revenues and expenditures were calculated by using baseline data provided in each jurisdiction’s annual comprehensive financial reports forecasted for the peak year of construction and the first year of operations and were based on per capita revenues and expenditures for each jurisdiction. Population forecasts were based on data provided by the U.S. Bureau of the Census.

Impacts of ACWA facility in-migration on community service employment were also calculated for the core ROI county (or counties) in which the majority of new workers would locate. The analysis used the estimates of the number of in-migrating workers and families to calculate the number of new sworn police officers, firefighters, and general government employees that would be required to maintain the existing levels of service for each community. Calculations were based on the existing number of employees per 1,000 persons for each community service. To analyze the impact on educational employment, the numbers of teachers in each school district that would be required to maintain existing teacher-student ratios across all student age groups were estimated. Impacts on health care employment were estimated by calculating (1) the number of physicians in each county required to maintain the existing level of service (calculations were based on the existing number of physicians per 1,000 persons), and (2) the number of additional staffed hospital beds required to maintain the existing level of service (calculations were based on the existing number of staffed beds per 1,000 persons). Information on existing employment and levels of service was collected from the individual jurisdictions providing each service.

G.1.5 Impacts on Transportation

Impacts from an ACWA facility on transportation in the ROI were described in terms of the impacts that the increase in traffic would have on the major road segments used by existing employees to commute to and from the site. The analysis allocated the trips made by construction workers to individual road segments on the basis of the residential distribution of existing site workers. The impact on the existing annual average number of daily trips was then calculated, and the impact on the level of service provided by each individual segment was estimated. Traffic information was collected from state and county transportation departments.

G.1.6 Impacts of Accidents

Impacts from an accidental release of chemical agent were estimated in terms of losses in agricultural output and losses in business activity resulting from temporary evacuation. Because it is not possible to determine the geographical extent of any accidental release or the magnitude of damage to crops and livestock, a number of assumptions were made. The analysis assumed that all agricultural activity up to 30 mi (50 km) away from the facility could be affected by an accidental release. All counties lying either partially or completely within this region were included in the impact analysis. The analysis also assumed that any output affected would be quarantined, either by federal or state authorities or through voluntary action by producers, to avoid possible stigma effects. Because it is not possible to predict the likely wind speed and direction and the amount of chemical agent that would be released, it is also not possible to determine the volume of agricultural output that could be lost. The precise nature and location of specific crops and livestock are also unknown, since any given field could conceivably be used for a range of crops and animals over the duration of facility operations.

Because of these uncertainties, the analysis calculated the impacts for a number of loss scenarios in the 30-mi (50-km) agricultural ROI: 100% loss of output, 75% loss, and 50% loss. Impacts on the economy of the counties in the ROI were estimated by using data on crop and livestock output, payroll, and employment for each county in the ROI provided by the U.S. Department of Agriculture (USDA) and DOC, and by using the relevant regional economic multipliers from the IMPLAN model. Impacts on output, income, and employment were estimated for each loss scenario.

Loss of business activity was assumed to occur over a short period associated with the evacuation of employees from businesses located in the county (or counties) in the PAZ. Because the duration of any evacuation cannot be determined, the impacts from the loss of activity for a single day were estimated. Because the extent of lost output in the PAZ cannot be determined, three loss scenarios were assumed: 100% loss of activity, 75% loss, and 50% loss. Impacts over multiple days could be calculated according to the length and extent of the evacuation. Impacts were estimated for output, income, and employment for each loss scenario by using IMPLAN economic accounts for the county (or counties) included in the PAZ.

G.2 ROI FISCAL DATA

TABLE G.2 Local Government Financial Characteristics in ANAD Region of Influence (millions of $)

	Calhoun County			
Category	Calhoun County	City of Anniston	City of Jacksonville	Town of Ohatchee
Revenues				
Taxes	4.2	19.9	3.8	0.2
Licenses and permits	0.3	2.9	0.7	0
Intergovernmental	1.1	0.2	0.5	0
Charges for services	1.5	1.4	0.7	0
Fines and forfeits	0	0	0.3	0.1
Miscellaneous	0.8	1.3	0.7	0.1
Total[a]	7.9	25.7	6.7	0.5
Expenditures				
General government	3.8	2.6	1.3	0.2
Public safety	3.0	7.6	1.9	0.2
Highways and streets	0	4.6	0.8	0
Health, welfare, and sanitation	0.2	2.3	2.4	0
Culture and recreation	0.1	2.5	1.2	0
Debt service	0	0	0.7	0
Intergovernmental	0	0	0	0
Other	0.1	2.2	0.1	0
Total[a]	7.3	21.8	6.7	0.4
Revenues minus expenditures	0.6	3.9	0	0.1

TABLE G.2 (Cont.)

	Calhoun County			Etowah County		
Category	City of Oxford	City of Piedmont	City of Weaver	City of Attalla	City of Gadsden	City of Glencoe
Revenues						
Taxes	14.5	1.3	0.3	3.7	30.0	1.0
Licenses and permits	1.6	0.3	0.2	0.5	4.3	0.3
Intergovernmental	0.1	0.3	0.1	0.5	0.2	0
Charges for services	1.8	0.3	0.2	0	0.9	0.2
Fines and forfeits	0.2	0.1	0	0.4	0.6	0.2
Miscellaneous	1.4	0.6	0.1	0.1	0.4	0.1
Total[a]	19.8	3.0	0.9	5.2	36.3	1.8
Expenditures						
General government	1.5	0.4	0.2	0.6	4.6	0.3
Public safety	1.7	1.0	0.5	2.3	14.6	0.4
Highways and streets	3.0	0.7	0.1	1.2	3.7	0.2
Health, welfare, and sanitation	1.9	0.1	0.2	0.2	1.7	0.1
Culture and recreation	0.9	0.4	0	0.4	4.3	0.1
Debt service	0	0	0	0	0.1	0
Intergovernmental	0	0	0	0	0	0
Other	1.4	0.1	0.1	0.3	5.4	0
Total[a]	10.6	3.3	1.0	5.3	34.3	1.5
Revenues minus expenditures	9.1	–0.3	–0.1	–0.2	2.0	0.4

TABLE G.2 (Cont.)

	Etowah County			Talladega County		
Category	Rainbow City	City of Hokes Bluff	City of Southside	Talladega County	City of Talladega	City of Lincoln
Revenues						
Taxes	4.8	0.7	0.8	2.1	5.8	869,203
Licenses and permits	0.6	0.2	0.3	0.1	1.3	186,187
Intergovernmental	0.2	0.2	0.1	0.8	0.2	23,220
Charges for services	0.3	0.2	0.3	1.4	1.3	1,99'
Fines and forfeits	0.1	0.1	0.1	0	0.6	
Miscellaneous	0.1	0	0	0.2	0.1	140,224
Total[a]	6.1	1.4	1.5	4.5	9.4	
Expenditures						
General government	1.2	0.3	0.4	2.1	0.8	0.5
Public safety	2.2	0.4	0.7	2.3	4.1	0.7
Highways and streets	0.4	0	0	0	2.4	0
Health, welfare, and sanitation	0.3	0.2	0.3	0	0.2	0
Culture and recreation	0.5	0	0.1	0	1.6	0
Debt service		0.1	0.3	0	0	0
Intergovernmental	0	0	0	0	0	0
Other	0.6	0.3	0	0.2	0.2	0
Total[a]	5.2	1.2	1.8	4.7	9.2	1.2
Revenues minus expenditures	0.9	0.2	–0.3	0.2	0.1	0

[a] The sum of individual row entries and column totals may not correspond due to independent rounding.

Sources: Calhoun County Commission, *Report on the Calhoun County Commission*, Sept. 30, 1998. City of Anniston, *Comprehensive Annual Financial Report*, Sept. 30, 1999. City of Jacksonville, *Audit Report*, Sept. 30, 1998. Town of Ohatchee, *Financial Statement and Auditors Report*, Sept. 30, 1998. City of Piedmont, *Financial Statements and Auditors Report*, Sept. 30, 1999. City of Weaver, *Financial Statements*, Sept. 30, 1999. City of Attalla, *Audited Financial Statements*, Sept. 30, 1999. City of Gadsden, *Annual Financial Report*, Sept. 30, 1999. City of Glencoe, *Financial Statements and Supplementary Information with Independent Auditors Report*, Sept. 30, 1999. City of Rainbow City, *Audited Financial Statements*, Sept. 30, 1999. City of Hokes Bluff, Alabama, *Financial Statements and Supplementary Information with Independent Auditors Report, for the Year Ended September 30, 1999.* City of Southside, Alabama, *Financial Statements and Supplementary Information, Year Ended September 30, 1999.* Talladega County Commission, *Combined Statements of Revenues and Expenditures for the Year Ended September 30, 1999.* City of Oxford, Alabama, *Financial Statements and Auditors Reports*, Sept. 30, 1999. Talladega County Commission, *Combined Statement of Revenues and Expenditures*, Sept. 30, 1999. City of Talladega, *Financial Report*, Sept. 30, 1998. City of Lincoln, *Independent Auditors Report*, Sept. 30, 1998.

TABLE G.3 School District Financial Characteristics in ANAD Region of Influence (millions of $)

	Calhoun County				
Category	Calhoun County	City of Anniston	City of Jacksonville	City of Piedmont	City of Oxford
Revenues					
Local sources	5.5	3.4	1.1	0.5	1.9
State sources	37.2	12.2	6.3	4.4	10.6
Federal sources	0	0	0.2	0	0
Other	0	0	0	0.1	0.1
Total[a]	42.7	15.6	7.6	5.1	12.6
Expenditures					
Administration and instruction	34.2	9.8	6.4	4.5	10.7
Services	6.8	4.6	1.0	0.4	1.6
Debt service	0	0	0	0	0
Other	2.6	0.1	0.1	0.2	0.9
Total[a]	43.7	14.6	7.4	5.1	13.2
Revenues minus expenditures	–1.0	1.0	0.2	0	–0.6

	Etowah County			Talladega County	
Category	Etowah County	City of Gadsden	City of Attalla	Talladega County	City of Talladega
Revenues					
Local sources	4.9	5.3	1.3	7.4	3.0
State sources	31.1	19.8	7.6	29.9	12.6
Federal sources	0	0	0	0	0.1
Other	0	0	0	0	0
Total[a]	36.0	25.2	9.0	37.3	15.7
Expenditures					
Administration and instruction	30.7	21.9	7.3	27.1	12.5
Services	4.3	2.9	1.0	5.0	3.3
Debt service	0	0	0	0	0
Other	0.4	0.2	0.1	1.9	0
Total[a]	35.4	25.0	8.4	34.0	15.8
Revenues minus expenditures	0.7	0.3	0.6	3.3	0.1

TABLE G.3 (Cont.)

---

[a] The sum of individual row entries and column totals may not correspond due to independent rounding.

Sources: Calhoun County Board of Education, *Independent Auditors Report*, Sept. 1999. City of Anniston, *General Purpose Financial Statements and Independent Auditors Report*, Sept. 30, 1999. City of Jacksonville, *General Purpose Financial Statements and Independent Auditors Report*, Sept. 30, 1999. Piedmont City Board of Education, *Financial Statement and Auditors Report*, Sept. 30, 1999. Oxford City of Board of Education, *Financial Statement and Auditors Report*, Sept. 30, 1999. Etowah County Board of Education, *Independent Auditors Report*, Sept. 1999. Gadsden City Board of Education, *General Purpose Financial Statements and Supplementary Information*, Sept. 30, 1999. City of Attalla, *General Purpose Financial Statements and Supplementary Information*, Sept. 30, 1999. Talladega County Board of Education, *Independent Auditors Report*, Sept. 1999. Talladega City, *Single Audit Reports*, Sept. 1999.

TABLE G.4 Local Government Financial Characteristics in BGAD Region of Influence (millions of $)

	Clark County		Estill County		Fayette County
Category	City of Winchester	Clark County	City of Irvine Estill	Estill County	Lexington/ Fayette County
Revenues					
Taxes	5.5	2.7	0.5	0.8	140.1
Licenses and permits	0.8	0[b]	0	0	31.0
Intergovernmental	0.8	0.4	0	0.1	1.4
Charges for services	0	0	0.2	0	15.1
Fines and forfeits	0	0	0	0	0.3
Miscellaneous	0.8	0.4	0.2	0.4	3.9
Total[a]	7.8	3.5	0.9	1.2	191.8
Expenditures					
General government	1.5	1.3	0.4	0.6	21.3
Public safety	3.8	1.0	0.3	0.3	71.3
Highways and streets	0.8	0	0.1	0	24.9
Health, welfare, and sanitation	0.8	0.9	0	0.1	6.2
Culture and recreation	0	0.2	0	0	20.0
Debt service	0	0	0	0	11.4
Intergovernmental	0.5	0	0	0	4.6
Other	0	0	0	0.1	1.3
Total[a]	7.5	3.4	0.7	1.0	161.0
Revenues minus expenditures	0.3	0.1	0.2	0.2	30.8

TABLE G.4 (Cont.)

Category	Jackson County: City of McKee	Jackson County: Jackson County	Madison County: City of Berea	Madison County: City of Richmond	Madison County: Madison County
Revenues					
Taxes	0	NA[b]	0.2	1.3	2.3
Licenses and permits	0	NA	4.8	9.5	0
Intergovernmental	0	NA	0.2	1.0	0.3
Charges for services	0	NA	0.3	1.2	0
Fines and forfeits	0	NA	0	0.1	0
Miscellaneous	0.1	NA	0.3	0.5	0.5
Total[a]	0.2	NA	5.7	13.6	3.1
Expenditures					
General government	ND[b]	0.3	0.7	5.2	1.8
Public safety	ND	0	1.8	4.9	0.9
Highways and streets	ND	0	0.3	0.7	0
Health, welfare, and sanitation	ND	0	0.5	0.9	0.2
Culture and recreation	ND	0	0.5	1.8	0
Debt service	ND	0	0	0	0.1
Intergovernmental	ND	0	0	0	0
Other	ND	0.3	0.7	0	0.3
Total[a]	0.1	0.6	4.5	13.5	3.2
Revenues minus expenditures	0.1	NA	1.3	0.2	–0.2

[a] The sum of individual row entries and column totals may not correspond due to independent rounding.

[b] ND = No details were provided; data were available but not broken down. NA = not available. Zero = actual value after rounding.

Sources: City of Winchester, Kentucky, *Audited General Purpose Financial Statements for the Year Ended June 30, 1999.* Report of the Auditor of Public Accounts, *Audit Examination of the Clark County Fiscal Court, Fiscal Year Ended June 30, 1998.* City of Irvine, Estill County, Lexington-Fayette Urban County Government, *Comprehensive Annual Financial Report for the Year Ended June 30, 1999.* City of Berea, Kentucky, *Audited Financial Statements and Supplemental Financial Information for the Year Ended June 30, 1999.* City of Richmond, Kentucky, *General Purpose Financial Statements,* June 30, 1999. Report of the Auditor of Public Accounts, *Audit Examination of the Madison County Fiscal Court, Fiscal Year Ended June 30, 1998.*

TABLE G.5 School District Financial Characteristics in BGAD Region of Influence (millions of $)

Category	Clark County Schools	Estill County Schools	Fayette County Schools	Jackson County Schools	Madison County Schools[b]
Revenues					
Local sources	6.7	1.7	104.5	1.1	11.3
State sources	13.0	9.4	62.0	9.2	25.6
Federal sources	0	0	0	0	0
Other	0.5	0	0	0.2	0
Total[a]	20.2	11.1	166.4	10.5	36.9
Expenditures					
Administration and instruction	15.0	8.1	106.5	6.7	27.9
Services	5.5	3.0	64.7	3.4	10.3
Debt service	0	0	0	0	0
Other					
Total[a]	20.5	11.1	171.2	10.1	38.3
Revenues minus expenditures	–0.3	–0.1	–4.8	0.4	–1.3

[a] The sum of individual row entries and column totals may not correspond due to independent rounding.

[b] Includes Berea Independent School District.

Sources: Clark County School District , *Financial Statements, Supplemental Information and Independent Auditors Reports, Year Ended June 30, 1999.* Estill County Board of Education, *Financial Reports and Independent Auditors Report,* June 30, 1999. Fayette County School District, *Financial Statements, Supplementary Information, and Independent Auditors Reports, Year Ended June 30, 1999.* Jackson County School District, *Audited Financial Statements and Supplemental Schedules for the Year Ended June 30, 1999.* Berea Board of Education, *Financial Statements,* June 30, 1999. Madison County School District, *Annual Report,* June 30, 1999.

TABLE G.6 Local Government Financial Characteristics in PBA Region of Influence (millions of $)

	Grant County				Jefferson County			
Category	Grant County	City of Sheridan	Town of Poyen	Jefferson County	City of Altheimer	City of Pine Bluff	Town of Wabbaseka	City of White Hall
Revenues								
Taxes	0.6	0.1	0	5.4	0.2	16.2	0.1	0.8
Licenses and permits	0	0	0	0		0.6	0	0.1
Intergovernmental	0.4	0.1	0	0.6	0	1.8	0	0.1
Charges for services	0.5	0.2	0	2.3	0	2.4	0	0
Fines and forfeits	0.2	0.1	0	0.6	0	1.5	0	0
Miscellaneous	0.1	0	0	0.3	0.1	0.4	0	
Total[a]	1.7	0.5	0	9.5	0.3	23.6	0.1	1.1
Expenditures								
General government	0.7	0.1	0	3.4	0.1	3.1	0.1	0.2
Public safety	0.6	0.3	0	4.7	0.1	14.3	0	0.4
Highways and streets	0	0	0	0	0	0.1	0	0
Health, welfare, and sanitation	0	0.2	0	0.1	0.1	2.1	0	0
Culture and recreation	0.1	0.4	0	0	0	0	0	0
Debt service	0	0	0	0	0	0	0	0
Intergovernmental	0	0	0	0	0	0	0	0
Other	0	0.1	0	0	0	1.6	0	0
Total[a]	1,5	1.1	0	8.6	0.3	21.3	0.1	0.8
Revenues minus expenditures	0.1	–0.5	0	0.8	–0.1	2.3	0	0.3

	Lincoln County				Pulaski County			
Category	Lincoln County	City of Star City	City of Gould	City of Grady	Pulaski County	City of Jacksonville	City of Little Rock	City of Sherwood
Revenues								
Taxes	0.5	0.4	0.1	0	25.6	0	59.4	6.8
Licenses and permits	0	0	0	0	0	0.1	5.8	0.4
Intergovernmental	0.3	0.1	0	0	11.0	0.7	2.0	0.5
Charges for services	0.5	0	0	0	8.8	1.7	22.1	0
Fines and forfeits	0.1	0	0	0.1	1.0	0.5	2.8	2.5
Miscellaneous	0.2	0	0	0	1.9	0.1	2.2	0.7
Total[a]	1.6	0.5	0.2	0.2	48.4	3.2	94.3	10.9
Expenditures								
General government	0.6	0.1	0.1	0.1	17.5	2.1	17.4	2.7
Public safety	0.6	0.2	0.1	0.1	29.0	5.7	53.8	3.8
Highways and streets	0	0	0	0	0	0.3	0.8	1.2
Health, welfare, and sanitation	0.1	0	0	0	0.3	0	3.8	1.0
Culture and recreation		0	0	0	0	1.3	6.0	0.9
Debt service	0	0	0	0	0.8	0	0	0
Intergovernmental	0	0	0	0	0	0	0	0
Other	0.2	0	0	0	1.4	0	0	1.6
Total[a]	1.4	0.5	0.2	0.2	49.1	9.4	81.7	11.2
Revenues minus expenditures	0.2	0	0	0	–0.7	–6.3	12.5	–0.3

TABLE G.6 (Cont.)

---

[a] The sum of individual row entries and column totals may not correspond due to independent rounding.

Sources: Grant County, *General Purpose Financial Statements,* Dec. 31, 1998. City of Sheridan, *Audit Report,* Dec. 31, 1998. Town of Poyen, *Compilation Report,* Dec. 31, 1997. Jefferson County, *General Purpose Financial Statements,* Dec. 31, 1998. City of Altheimer, *Compiled Financial Statements,* Dec. 31, 1998. City of Pine Bluff, *Comprehensive Annual Financial Report,* Dec. 31, 1999. City of White Hall, *General Purpose Financial Statements,* Dec. 31, 1998. Lincoln County, *General Purpose Financial Statements,* Dec. 31, 1998. City of Star City, *Audit Report,* Dec. 31, 1998. City of Gould, *Audit Report,* Dec. 31, 1997. City of Grady, *Compiled Financial Statements,* Dec. 31, 1998. Pulaski County, *General Purpose Financial Statements,* Dec. 31, 1998. City of Jacksonville, *Comprehensive Annual Financial Report,* Dec. 31, 1999. City of Little Rock, *Comprehensive Annual Financial Report,* Dec. 31, 1998. City of Sherwood, *Financial Statements and Supplemental Information,* Dec. 31, 1998.

TABLE G.7 School District Financial Characteristics in PBA Region of Influence (millions of $)

	Grant County		Jefferson County			
Category	Poyen	Sheridan	Altheimer	Pine Bluff	Watson Chapel	White Hall
Revenues						
Local sources	0.3	0	1.1	9.6	1.4	6.3
State sources	1.9	0	2.0	22.9	12.0	7.7
Federal sources	0	0	0	0	0	0
Other	0.1	0	0.1	0.9	0	0.3
Total[a]	2.3	0	3.1	33.5	13.5	14.4
Expenditures						
Administration and instruction	1.3	a	1.6	18.4	8.6	8.3
Services	1.0	a	1.1	12.8	5.2	4.5
Debt service	0.1	a	0	0.3	0	0
Other	0	a	0	0.6	0.1	0
Total[a]	2.5	0	2.6	32.2	13.9	12.9
Revenues minus expenditures	–0.1	0	0.5	1.3	–0.4	1.6

	Lincoln County			Pulaski County		
Category	Star City	Gould	Grady	Pulaski County	Little Rock	North Little Rock
Revenues						
Local sources	1.5	0.3	0.4	35.9	64.7	14.4
State sources	5.4	1.1	1.4	73.7	78.1	32.8
Federal sources	0	0	0	0.6	0.1	0.1
Other	0.1	0	0	0	0	0
Total[a]	6.9	1.5	1.9	110.1	143.0	47.2
Expenditures						
Administration and instruction	4.0	0.7	0.9	81.4	94.4	31.8
Services	2.0	0.6	0.9	22.8	40.5	16.1
Debt service	0	0	0.1	0	0.1	0
Other	0	0	0	2.1	0	0
Total[a]	6.1	1.3	1.9	106.3	137.5	47.9
Revenues minus expenditures	0.8	0.1	–0.1	3.8	5.5	–0.6

TABLE G.7 (Cont.)

[a] The sum of individual row entries and column totals may not correspond due to independent rounding.

[b] No details were provided.

Sources: Town of Poyen, *Audit Report*, June 30, 1998. City of Sheridan, *General Purpose Financial Statements*, June 30, 1998. Altheimer, *General Purpose Financial Statements*, June 30, 1998. Dollarway, Pine Bluff, and Watson Chapel, *Accountants Report and Financial Statement*, June 30, 1998. White Hall, *Audit Report*, June 30, 1998. Star City, *Audit Report*, June 30, 1998. Gould, *Audit Report*, June 30, 1998. Grady, *Annual Financial Report*, June 30, 1998. Pulaski County, *General Purpose Financial Statements and Supplementary Information*, June 30, 1999. Little Rock, *General Purpose Financial Statements*, June 30, 1999. North Little Rock, *Financial Statements and Supplementary Information*, June 30, 1999.

APPENDIX H:

METHODOLOGY FOR ASSESSING THE CONSEQUENCES FROM ACCIDENTS

APPENDIX H:

METHODOLOGY FOR ASSESSING THE CONSEQUENCES FROM ACCIDENTS

The analysis of accidents in this environmental impact statement (EIS) provides an estimate of the upper range of the potential impacts that might occur as a result of a hypothetical accident associated with the proposed action (ACWA pilot testing) or with the no action alternative (continued storage of the chemical weapons). The accidents selected for analysis were the accidents that were shown to have the highest risk in previous Army analyses (SAIC 1996, 1997a-c). The highest-risk accidents are defined as those with the highest combined consequence (in terms of human fatalities) and probability of occurrence.

For proposed operations and for existing continued storage conditions (no action), the highest-risk accidents would involve the release of chemical agent; release of other materials would result in lower consequences and risks. In general, the accidents considered in this EIS would have a fairly low frequency of occurrence, on the order of 2×10^{-3} per year or less (i.e., one occurrence in about 500 years or less). In most cases, the effects of any emergency response or spill mitigation actions that would likely occur following an accidental release were not taken into consideration in the impact assessment. These actions would reduce the number of fatalities and injuries that might occur below the numbers estimated here.

Because detailed information on facility process design and related process hazards for assembled chemical weapon (ACW) destruction systems is not yet available (and may not be available until the systems have been pilot tested), this EIS does not present a detailed process safety analysis or risk assessment. These types of analyses assess each process and estimate the probabilities of process failures at each step in each process. The probabilities and accident consequences are multiplied to obtain risk estimates. (Risk is defined as the product of probability and consequence.) The presentation of the single highest-risk accident consequences for each site in this EIS is intended to aid in the comparison of potential accident impacts for the proposed action and no action alternatives, and it should not be considered a detailed process safety analysis.

H.1 SCENARIOS

An assessment of accident consequences was conducted for both externally and internally initiated events for the ACW destruction systems. Externally initiated events could include earthquakes, aircraft crashes, or lightning strikes; internally initiated events could include handling accidents, process equipment failure, or operator error.

For this ACWA EIS, two possible scenarios were identified as being highest-risk during pilot testing activities (proposed action). (1) For ANAD and PBA, the scenario is a handling accident in a GB- or VX-rocket-containing storage igloo, with a subsequent fire and release of agent from all the munitions in the igloo. (2) For PCD and BGAD, it is an earthquake impacting the unpack area in the pilot testing facility. During continued storage (no action), the highest risk accident identified for ANAD, PBA, and BGAD is a lightning strike on a GB- or VX-rocket-containing igloo, with a subsequent fire and release of agent from all the munitions in the igloo. However, for PCD, the highest-risk continued storage accident is an aircraft crash into a storage igloo. For all four sites, the continued storage accident modeled would result in the entire contents of a single storage igloo being subject to release.

For ANAD and PBA, the consequences of the highest-risk accidents during continued storage (no action) and pilot facility operations (proposed action) would be the same, because under both alternatives, the entire contents of a single GB or VX rocket storage igloo are assumed to be subject to release. There is one special case for ANAD, which is mustard-only processing. If Neut/Bio was selected as the ACWA technology to be used at ANAD, then the pilot facility accident would be an earthquake impacting the unpack area during mustard processing (since no GB or VX would be processed, and therefore the handling accident would not be applicable), and the accident consequences from the no action and proposed action alternatives would differ.

For the earthquake pilot facility accident scenarios, data given in the ANAD, PCD, and BGAD Phase I quantitative risk assessments for a baseline incineration facility (SAIC 1996, 1997a,b) were used to estimate the maximum amount of agent that could be released during an earthquake. The ACWA technology providers would use a modified baseline process for ACW access (General Atomics 1999; Parsons and Allied Signal 1999; AEA/CH2M Hill 2000; Foster-Wheeler 2000); therefore, it was assumed that the unpack area configuration would not deviate significantly from that of the baseline. For ANAD and PCD, it was assumed that the maximum number of munitions in the unpack area would be the contents of four on-site containers (ONCs) containing 155-mm projectiles at the time of the crash. For BGAD, it was assumed that the maximum number of munitions in the unpack area would be the contents of four ONCs containing either VX M55 rockets, GB 8-in. projectiles, or mustard 155-mm projectiles at the time of the earthquake. (These assumptions resulted in the largest possible amounts of chemical agent present in the unpack area among the munition types present at each facility.) Additionally, for each of the four facilities, the accident modeling assumed that the pilot facility or impacted storage igloo would be at the location closest to areas of highest on-post or off-post population density.

Impacts from accidents occurring during transport of agent from the storage igloos to the pilot testing facility were not assessed for this EIS, because the impacts would be less than those from the accidents considered. Accident scenarios and probabilities from on-post transportation are discussed in a PEIS support document (GA Technologies 1987).

ONCs are used for transportation of munitions at the Tooele Chemical Agent Disposal Facility, but the Army is investigating the feasibility of using modified ammunition vans (MAVs). A change in the transport system used might also entail changes in the dimensions and capacity of the unpack area or a similarly functioning building or area. Such changes should not invalidate the impact estimates for pilot facility earthquake accidents given here, because the assumption about the number of ONCs stored in the unpack area represents a high-end estimate of the amount of agent that could be released in an earthquake. These accident impact estimates should be representative for either type of transportation system.

For the continued storage accident scenarios, it was assumed that the lightning strike or aircraft crash could lead to the release of the entire contents of a storage igloo. For these scenarios, the maximum amount of agent at risk was obtained from estimates of the maximum amount of agent stored in any single igloo at each of the four storage locations (Burdell 2000a; DeMers 1999; Hancock 2000; Harris 2000). For the lightning strikes into rocket storage igloo scenarios (for ANAD, BGAD, and PBA), it was assumed that 100% of the agent released would be involved in the resulting fire, on the basis of current assumptions made in the Army's modeling in support of the quantitative risk assessments being conducted under the PMCD Program. For the PCD aircraft crash scenario, it was assumed that after the airplane crashed into an igloo, the resulting fire would cause 25% of the munitions to detonate and 75% to burn. It was also assumed that the fire would consume all but 5%, 2.5%, or 10% of the HD, VX, or GB agent (respectively) in the burned munitions (Innovative Emergency Management 1993). The remaining agent would be lofted by the heat of the fire through the breach in the structure caused by the accident and dispersed into the atmosphere.

H.2 METHODS OF ANALYSIS

Potential accidental releases of chemical agent to the atmosphere and the impact distances associated with the releases were analyzed with the D2PC atmospheric dispersion model (Whitacre et al. 1987). The model simulates several agent/munition release modes (detonation, fire, and/or evaporation), downwind dispersion, dosages, and deposition. Although no explicit formulation or treatment of fire or explosion phenomena is incorporated into D2PC, the model relies on experimental data that are input either by the user or from an empirical database within the code. The D2PC model, developed by the U.S. Army Chemical Research, Development, and Engineering Center (now the U.S. Army Edgewood Chemical and Biological Center), has been used by the Army primarily to support and evaluate emergency preparedness and response at its eight chemical depots. It has also been used in assessing chemical agent accident impacts in all of the EISs with Records of Decision (RODs) prepared by the Program Manager for Chemical Demilitarization (PMCD). The estimated consequences derived with D2PC, along with the modeling assumptions used in the analysis conducted for this EIS, should be considered conservative. Highlights of some of these and other assumptions and model limitations are given below:

- The model assumes steady-state diffusion over open, flat terrain. It does not account for topography, vegetation, or buildings. The effects of terrain and vegetation can create more turbulence, or mixing, which reduces the expected downwind dispersion distances.

- The assessment assumes that wind speed and direction are uniform over the entire accidental release dispersion period modeled. In reality, wind shifts would probably cause the plume to meander (drift) as it moved downwind. Meandering would spread (dilute) the plume over a wider area and reduce the expected hazard distance of the plume.[1] Typically for Chemical Stockpile Emergency Preparedness Program (CSEPP) planning exercises, an additional degree of conservatism is added by using a "wedge" covering an angle left and right of the centerline to help ensure that the estimated area contains the entire hazard width. A 40° to 60° wedge (20° to 30° each side of the plume center) is recommended: 40° for stability classes D, E, or F, and 60° for stability classes A, B, or C.[2] The wedge angle was not used in the accident impact assessments conducted for this EIS.

- The model estimates the peak, centerline concentration and dosage. Exposure to a plume away from the center would be expected to produce fewer effects.

- The D2PC model assumes total exposure and dosage; that is, it assumes that a person exposed to the chemical agent at a given distance stays at that location and is exposed to dosages equivalent to exposures for a person at center of the plume until the entire plume passes.

- The model assumes a (default) constant breathing rate (25 L/min) equivalent to moderate work activity. Lower breathing rates would reduce a person's intake of the chemical agent, thereby reducing the effects of exposure.

- D2PC assumes the exposure occurs outdoors, without mitigation from sheltering structures.

- While terrain conditions usually mitigate the effects of a release, at least two specific terrain conditions exist that could cause D2PC to underestimate the effects:

    1. A plume trapped in a depression (low-lying area) with insufficient wind to ventilate the area, and

    2. A plume released into a narrow valley that restricts the natural spreading (and dilution) of the plume.

---

[1] Imagine that the plume is following a line of fixed length. If the line is wavy, going left and right, it will cover a wider area, but it will not go as far downwind as if the line were straight.

[2] The effective wedge angle may end up much larger than 40° or 60° because a wedge line through any portion of a zone would cause a protective action to be taken for the entire zone.

The Army has completed the development, validation, and verification of a new model (D2Puff) intended to address many of the above limitations with D2PC. Accreditation and conditional approval of the D2Puff model for use at continental U.S. Chemical Stockpile sites was issued on June 22, 2000. The conditions for approval (i.e., training for use by hazard analyst in emergency operations centers [EOCs] during CSEPP exercises) are to be met over a transition period during which D2PC would remain in use. The Army's goal is to fully accredit the use of the D2Puff model, which is an ongoing process. The model is approved for use at five of the eight sites in training, exercises, and planning, but not in response situations. Most of the hazard analysts at each of the Army chemical depots have now been trained to use the new model. The new model is installed at Umatilla, Deseret, Blue Grass, Pine Bluff, and Anniston. As of 2001, the only fully accredited model for use at all of the CSEPP sites is the D2PC model. This includes use in actual emergency situations. Although the Army's goal is to replace the D2PC model with D2Puff, D2PC will continue to be used as directed by the Department of the Army's Safety Office in support of the CSEPP for the foreseeable future. Given this status, the accident consequence assessments reported in this EIS continue to be based on estimates from the D2PC model.

Impacts were estimated on the basis of atmospheric dispersion of the chemical agents mustard, GB, and VX under credible bounding meteorological conditions that would inhibit the vertical and horizontal dispersion, or rate of growth, of the vapor cloud. The bounding meteorology represents credible conditions that could transport agent for long distances downwind from the release point. A slightly stable atmosphere (stability class E) and very light wind speeds (on the order of 1 m/s) were chosen as the bounding meteorological conditions (referred to below as E-1). These conditions are typical at night. Although these conditions are consistent with the modeling performed in support of previous PMCD EIS accident assessments, the EPA is now recommending slightly less conservative assumptions for worst-case accidents (Class E and 1.5 m/s) in guidance issued under the EPA's Risk Management Program (EPA 1999). The impacts under typical daytime conditions with neutral atmospheric stability (stability class D) and a wind speed of 3 m/s (referred to below as D-3) were also assessed. When D-3 meteorological conditions are assumed, the size of the estimated plume is smaller, but the amount of agent deposited within the plume area is greater in locations close to the release point. In conducting D2PC modeling, it was assumed that no plume depletion by agent deposition would occur. This is a conservative assumption for estimating the area potentially affected by an accidental release, because assuming that more agent remains in the plume allows farther plume travel before concentrations are diluted below the toxicological endpoint levels. The D2PC model default mixing height assumptions were used for modeling D-3 meteorological conditions, and per EPA guidance (EPA 1995), an unlimited mixing height was assumed for modeling E-1 meteorological conditions. A mixing height of 5,000 m is used as a default in D2PC to represent unlimited mixing.

For modeling mustard agent instantaneous releases, the "time after functioning" (TAF) parameter was assumed to be 20 hours. (The TAF was applicable only for accident modeling involving mustard agent instantaneous releases; it is defined as the time after detonation required to remove the agent source by decontaminating it or by containing it so it would no longer enter the atmosphere [Whitacre et al. 1987]).

The developers of the D2PC model have limited its application to accident release scenarios that could produce impacts at distances of less than or equal to about 30 mi (50 km). This distance is consistent with EPA guidance (EPA 1996) on the application of straight-line Gaussian models, with the limitations inherent in the experimental data used in developing and validating these models, and with the historical model regulatory applications.

H.3 EXPOSURES AND DEPOSITION

For each of the accident scenarios assessed, the impacts of agent release were modeled by using D2PC-generated plumes with dosages estimated to result in adverse impacts for a certain percentage of the human population exposed (i.e., LCt_{50} = dosage corresponding to 50% lethality; LCt_{01} = dosage corresponding to 1% lethality; no deaths = dosage below which no deaths are expected in the human population exposed; no effects = dosage below which no adverse impacts are expected in the human population exposed). The assumed dosages corresponding to these distances for each of the chemical agents assessed are provided in Table H.1. The distances to which these various plumes were predicted to extend and the amount of agent deposited within the plumes were used in this EIS as the starting point for the analysis of impacts on the various resources of concern under the proposed action and no action alternatives.

The LCt_{50} dosage levels used in the accident impact assessment were obtained from documentation for the quantitative risk assessments for the stockpile sites conducted for the chemical stockpile disposal program (SAIC 1997d) and related documents (Goodheer 1994; Burton 2001). The draft ACWA EIS had also included accident assessments that used values recommended by the National Research Council (see Table H.1). However, these assessments were not included in this final version, because this version used revised LCt_{50} dosage values that were much more similar to those recommended by the National Research Council, and because the National Research Council's suggested values have not been formally approved for use by the Army. The LCt_{01}, no deaths, and no effects dosage levels used are the default values given in documentation for the D2PC model (Innovative Emergency Management 1993). All the dosage values are based on the responses of healthy young males breathing at the normal rate (25 L/min) for an adult performing moderate activity.

To estimate the potential maximum fatalities among the on-post and off-post populations from a specific accident, the 50%, 1%, and no deaths dose contours from the D2PC atmospheric dispersion model were overlain on the maximum on-post and off-post population angles centered on the destruction facility or storage facility locations closest to nearby population centers. The population within each contour was obtained either from year 2000 census data for the off-post population or from information on locations of noninvolved workers and on-post residents at the storage facilities (Burdell 2000b; Atkinson 2000; Holland 2000; Elliott 2001). To estimate the

TABLE H.1 Accident Impact Assessment Criteria Values for Mustard, GB, and VX[a]

Chemical Agent	Criteria Values (mg-min/m^3)			
	LCt_{50}[b]	LCT_{01}	No Deaths	No Effects
Mustard	600	150	100	2
GB	42	10	6	0.5
VX	18	4.3	2.5	0.4

[a] All values are applicable for breathing rates of 25 L/min or less. LCt_{50} criteria values (i.e., dosage corresponding to 50% lethality) are from Goodheer (1994), SAIC (1997d), and Burton (2001). Other criteria values are from Innovative Emergency Management (1993).

[b] LCt_{50} values of 900, <35, and <15 mg-min/m^3, for mustard, GB, and VX, respectively, are suggested by the National Research Council (1997). These values are applicable for breathing rates of 15 L/min. They were not used for accident assessment in this EIS because they have not been approved for use by the Army.

total potential number of fatalities associated with each accident, it was assumed that the fatality rate for individuals located within the 50% fatality plume would be 75%, the rate for individuals located between the 50% fatality plume and the 1% fatality plume would be 25%, and the rate for individuals located between the 1% fatality plume and the no deaths plume would be 0.5%. These assumptions are consistent with the standard fatality estimation methodology used in assessments of agent incineration impacts (U.S. Army 1997). Because the decrease in dose response is greater than linear with increased distance from the release location, the results derived from this approach will probably overestimate fatalities.

The impacts on involved workers (i.e., those working at the pilot facility) from accidents involving releases of agent were not assessed quantitatively. During an accident, involved workers might be subject to one or more of three sources of harm: severe physical forces, thermal (fire) forces, and exposure to releases of chemicals. The risk to involved workers would be very sensitive to the specific circumstances of each accident: the speed at which the accident developed, exact location and response of the workers, direction and amount of the release, physical and thermal forces causing or caused by the accident, meteorological conditions, and characteristics of the room or building if the accident occurred indoors. Impacts on involved workers under accident conditions would likely be dominated by physical forces from the accident itself, rather than by the effects of the material released.

H.4 ANALYSIS FOR SENSITIVE POPULATIONS

The toxicity levels used to estimate fatalities were originally developed for healthy adult males. If it is assumed that children and/or the elderly are substantially more susceptible to the effects of agent exposure than healthy adult males and all other conservative assumptions remain the same, then the estimated number of fatalities would increase. A method to estimate the increase in fatalities has been derived (U.S. Army 1997). The method involves estimating the proportion of the population within the D2PC-derived plume areas that are in the more "sensitive" (higher-risk) categories, and adjusting the estimated number of deaths in the plume area using that proportion. This method was also used in this EIS to estimate impacts to sensitive populations.

By using 1999 age-specific population data for the regions of influence (ROI) around each of the four ACW storage locations, it was determined that approximately 35%, 35%, 40%, and 30% of the ROI populations around the ANAD, PBA, PCD, and BGAD posts, respectively, would fall into the sensitive category (U.S. Bureau of the Census 2000). Sensitive was defined for this assessment as individuals under age 16 or over age 65. It was further assumed that the sensitive population would be up to 10 times more likely to die from exposure to chemical agent than the general population (U.S. Army 1997). Effectively, this resulted in the assumption that for the proportion of the population that was more sensitive to exposure, 100% lethality would occur within the plume area from the source to the LCt_{50} boundary, 100% lethality would also occur in the area between the LCt_{50} and LCt_{01} boundaries, and 5% lethality would occur in the area between the LCt_{01} and no deaths boundaries. These assumptions, when used to assess the impacts of accidental releases occurring under E-1 meteorological conditions, generally increased the number of estimated fatalities by a factor of 1.3 to 2.6, depending on the site-specific distributions of the populations around the hypothetical accident sites.

H.5 REFERENCES

AEA/CH2M Hill, 2000, *Draft Final PMACWA Demonstration II Test Program for Assessment of Technologies for Assembled Chemical Weapons Demilitarization,* DAAM01-98-006, prepared by AEA Technology Engineering Services, Inc., Sterling, Va., and CH2M Hill for U.S. Department of Defense, Program Manager Assembled Chemical Weapons Assessment, Aberdeen Proving Ground, Md., Nov.

Atkinson, L., 2000, personal communication from Atkinson (Pine Bluff Chemical Activity, Environment and Safety Division, Pine Bluff Arsenal, Pine Bluff, Ark.) to T. Allison (Argonne National Laboratory, Argonne, Ill.), June 29.

Burdell, A., 2000a, *Location of Maximum Inventories by Munition Type,* personal communication from Burdell (Anniston Army Depot, Anniston, Ala.) to M. Lazaro (Argonne National Laboratory, Argonne, Ill.), Aug.

Burdell, A.L., 2000b, *Development of an Environmental Impact Statement for the Potential Pilot-Scale Testing by the Program Manager Assembled Chemical Weapons Assessment (PMACWA)*, personal communication from Burdell (Anniston Army Depot, Anniston, Ala.) to M. Lazaro (Argonne National Laboratory, Argonne, Ill.), Sept. 4.

Burton, T.M., 2001, *Breathing Rates for Toxicity Data*, memorandum from Burton (U.S. Army Nuclear and Chemical Agency, Springfield, Va.) to Commander (Soldier and Biological Chemical Command, Aberdeen Proving Ground, Md.), May 24.

DeMers, G., 1999, fax on munitions from DeMers (Pueblo Chemical Depot, Pueblo, Colo.) to H. Hartmann (Argonne National Laboratory, Argonne, Ill.), Dec. 14.

Elliott, J., 2001, e-mail on BGAD and BGCA employment from Elliott (Blue Grass Army Depot, Richmond, Ky.) with attachment from V. Erwin (Blue Grass Army Depot, Richmond, Ky.) to K. Wescott (Argonne National Laboratory, Argonne, Ill.), Nov. 14.

EPA: see U.S. Environmental Protection Agency.

Foster Wheeler et al., 2000, *Draft Final PMACWA Demonstration II Test Program Technical Report*, prepared by Foster Wheeler Corporation, Eco Logic Inc., and Kraevner, Nov.

GA Technologies, 1987, *Risk Analysis of the Continued Storage of Chemical Munitions, Chemical Stockpile Disposal Program*, SAPEO-CDE-IS-87009, prepared by GA Technologies, Inc., San Diego, Calif., for Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Aug.

General Atomics, 1999, *Assembled Chemical Weapons Assessment (ACWA) Draft Test Technical Report*, DAAM01-98-D-003 129300/0, San Diego, Calif., June 30.

Goodheer, I., 1994, *Dose Response Data for the Tooele Chemical Agent Disposal Facility Quantitative Risk Assessment (TOCDF QRA)*, memorandum from Goodheer (U.S. Army Nuclear and Chemical Agency, Springfield, Va.) to Commander (U.S. Army Chemical Materiel Destruction Agency, Aberdeen Proving Ground, Md.), June 13.

Hancock, R.B., 2000, *Igloo Munitions Inventories*, e-mail from Hancock (BGCA Surety Officer, Blue Grass Army Depot, Lexington, Ky.) to H. Hartmann (Argonne National Laboratory, Argonne, Ill.), July 12.

Harris, S., 2000, *Igloo Munitions*, e-mail from Harris (Environmental Coordinator, Pine Bluff Chemical Activity Environmental and Safety Division, Pine Bluff, Ark.) to H. Hartmann (Argonne National Laboratory, Argonne, Ill.), Aug. 15.

Holland, M., 2000, *PCD Population Distribution*, e-mail from Holland (U.S. Army Corps of Engineers, Pueblo, Colo.) to H. Hartmann (Argonne National Laboratory, Argonne, Ill.), Apr. 26.

Innovative Emergency Management, 1993, *Reference Manual: D2PC and Hazard Analysis*, prepared by IEM and M. Myriski, U.S. Army, Edgewood Research, Development, and Engineering Center, Edgewood, Md., under contract DAHC35-92-0018.

National Research Council, 1997, *Review of Acute Human-Toxicity Estimates for Selected Chemical-Warfare Agents*, prepared by Subcommittee on Toxicity Values for Selected Nerve and Vesicant Agents, Washington, D.C., published by National Academy Press, Washington, D.C.

Parsons and Allied Signal, 1999, *Assessment of Technologies for Assembled Chemical Weapon Demilitarization*, draft demonstration test final report, prepared by Parsons, Infrastructure & Technology Group, Inc. and Allied Signal for U.S. Army Chemical and Biological Defense Command, July.

Science Applications International Corporation, 1996, *Pueblo Chemical Agent Disposal Facility Phase I Quantitative Risk Assessment*, Report SAIC-96/2602, prepared by SAIC, Abingdon, Md., for U.S. Army Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Nov.

Science Applications International Corporation, 1997a, *Anniston Chemical Agent Disposal Facility Phase I Quantitative Risk Assessment, Revision 1*, prepared by SAIC, Abingdon, Md., for U.S. Army Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., May.

Science Applications International Corporation, 1997b, *Blue Grass Chemical Agent Disposal Facility Phase I Quantitative Risk Assessment*, Report SAIC-96/1118, prepared by SAIC, Abingdon, Md., for U.S. Army Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Jan.

Science Applications International Corporation, 1997c, *Pine Bluff Chemical Agent Disposal Facility Phase I Quantitative Risk Assessment*, Report SAIC-96/1120, prepared by SAIC, Abingdon, Md., for U.S. Army Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., March.

Science Applications International Corporation, 1997d, *Chemical Agent Disposal Facility Quantitative Risk Assessment Methodology Manual*, Report SAIC-97/2643, prepared by SAIC, Abingdon, Md., for U.S. Army Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Apr.

U.S. Army, 1988, *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement*, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Jan.

U.S. Army, 1997, *Revised Final Environmental Impact Statement for Disposal of Chemical Agents and Munitions Stored at Pine Bluff Arsenal, Arkansas,* Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Apr.

U.S. Bureau of the Census, 2000, *1999 Population Estimates*, http://www.census.gov/population/www/estimates/co_ca.html.

U.S. Environmental Protection Agency, 1995, *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models,* EPA-454/B-95-003a and updated model (00101), Office of Air Quality Planning and Standards, Research Triangle Park, N.C., Sept.

U.S. Environmental Protection Agency, 1996, "Guidelines on Air Quality Models," *Code of Federal Regulations*, Title 40, Part 51, Chapter 1, Appendix W, Office of Air Quality and Planning Standards, Research Triangle Park, N.C., Aug.

U.S. Environmental Protection Agency, 1999, *Risk Management Program Guidance for Offsite Consequence Analysis*, EPA 550-B-99-009, Office of Solid Waste and Emergency Response, Chemical Emergency Preparedness and Prevention Office, Washington, D.C., Apr.

Whitacre, G.C., et al., 1987, *Personal Computer Program for Chemical Hazard Prediction (D2PC)*, CRDEC-TR-87021, U.S. Army, Armament Munitions Chemical Command, Chemical Research, Development, and Engineering Center, Aberdeen Proving Ground, Md., Jan.

APPENDIX I:

CONTRACTOR DISCLOSURE STATEMENT*

* In response to 32 CFR Part 651, this appendix has been added.

APPENDIX I:

CONTRACTOR DISCLOSURE STATEMENT

Argonne National Laboratory is the contractor assisting the U.S. Department of Defense (DOD)/Program Manager Assembled Chemical Weapons Assessment (PMACWA) in preparing the environmental impact statement (EIS) for the design, construction, and operation of ACWA pilot test facilities. DOD/PMACWA is responsible for reviewing and evaluating the information and determining the appropriateness and adequacy of incorporating any data, analyses, or results in the EIS. It also determines the scope and content of the EIS and supporting documents and furnishes direction to Argonne, as appropriate, in preparing all these documents.

The Council on Environmental Quality's regulations (40 CFR 1506.5(c)), which have been adopted by the DOD/Department of Army (32 CFR Part 651), require contractors who will prepare an EIS to execute a disclosure specifying that they have no financial interest or other interest in the outcome of the project. The term "financial interest or other interest in the outcome of the project" for the purposes of this disclosure is defined in the March 23, 1981, "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations," 46 *Federal Register* 18026–18028, in Questions 17a and 17b. Financial interest or other interest in the outcome of the project includes "any financial benefit such as promise of future construction or design work on the project, as well as indirect benefits the consultant is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)...."

In accordance with these regulations, Argonne National Laboratory hereby certifies that it has no financial interest or other interest in the outcome of the project.

Certified by:

Anthony J. Dvorak
Signature

Anthony J. Dvorak
Name

Director, Environmental Assessment Division
Title

March 29, 2002
Date