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

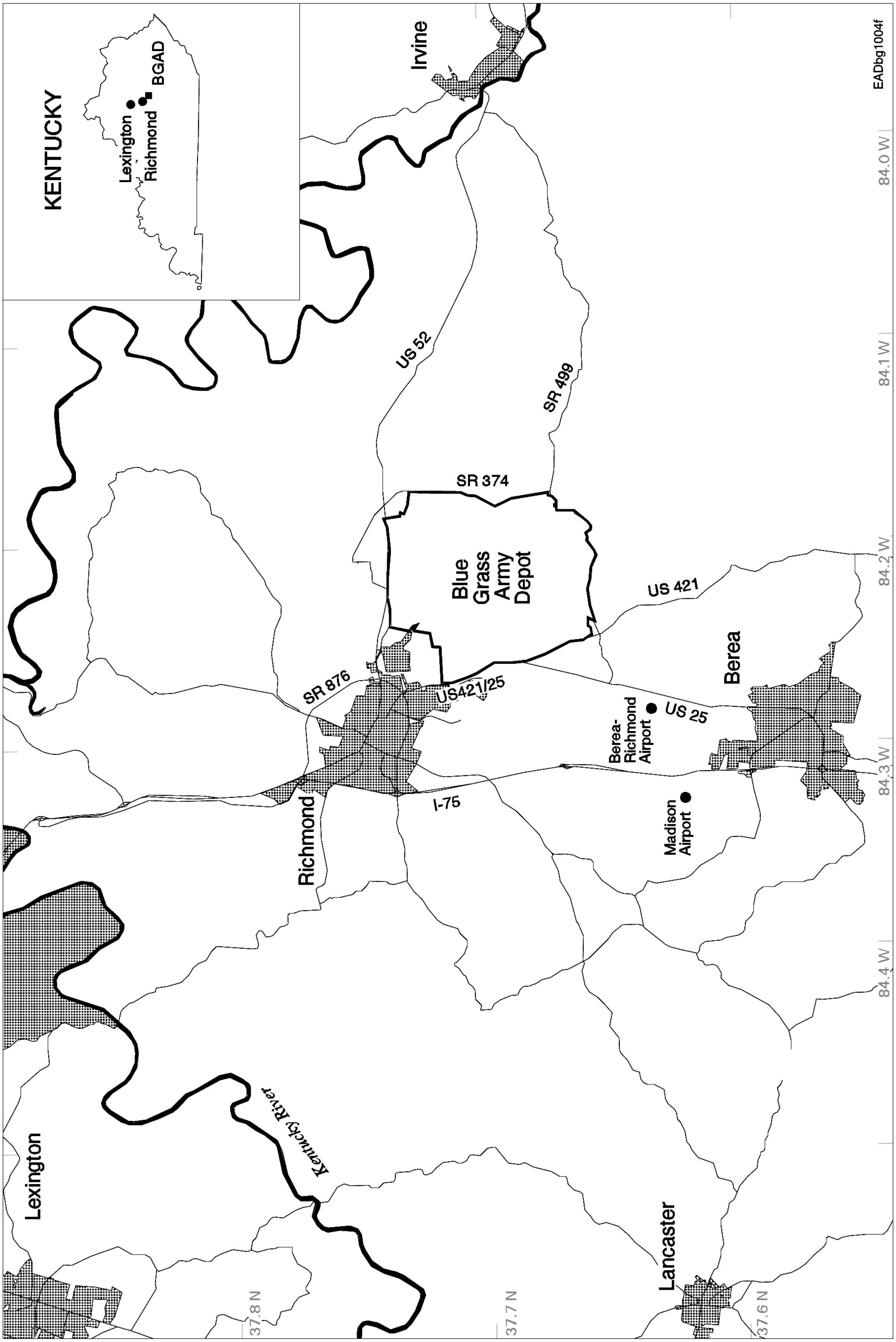

FIGURE 7.1-1 Location of BGAD

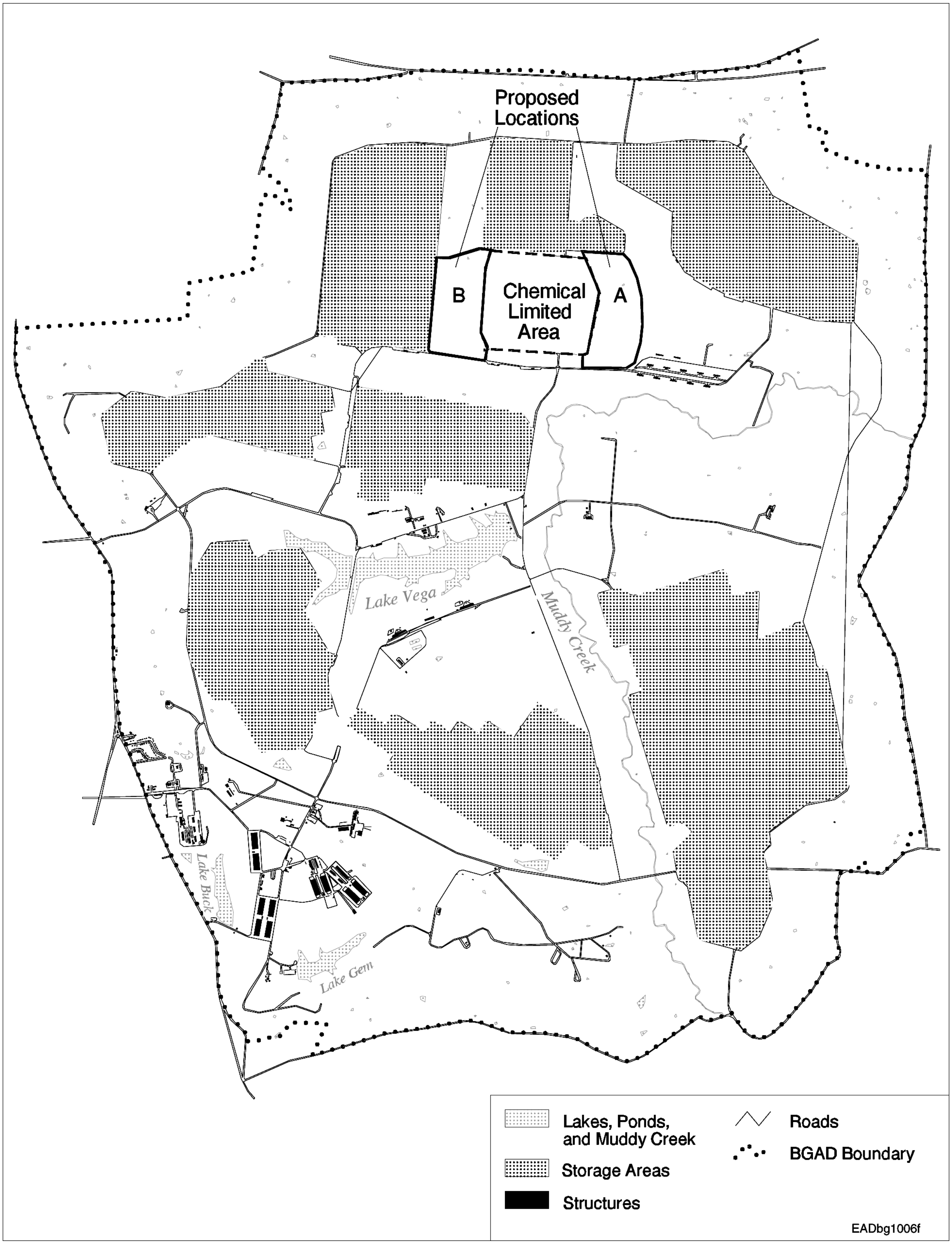

FIGURE 7.1-2 Facilities at BGAD

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

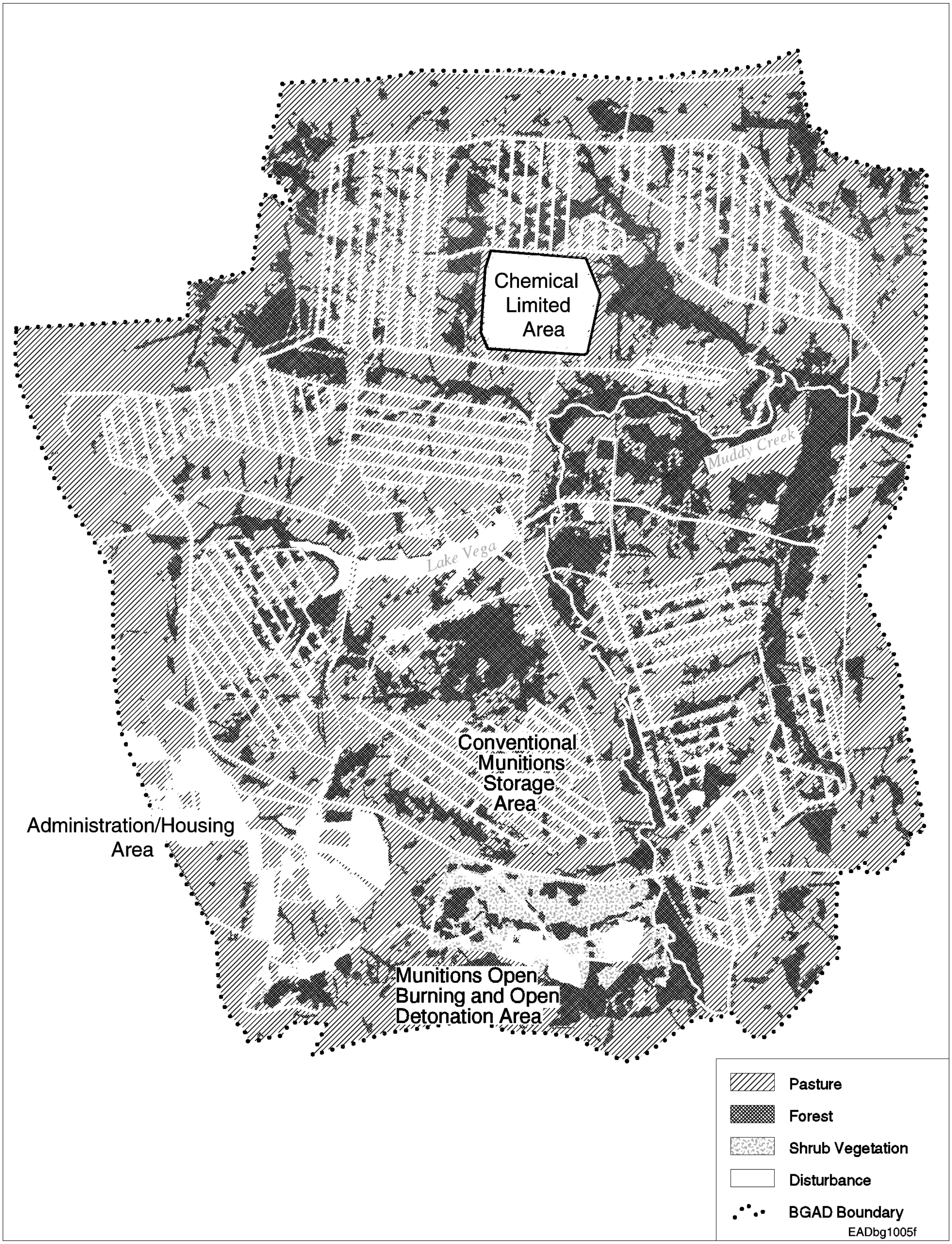

FIGURE 7.2-1 Land Use at BGAD

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]

	Area Disturbed (acres)	
Construction Activity	Proposed Area A	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.

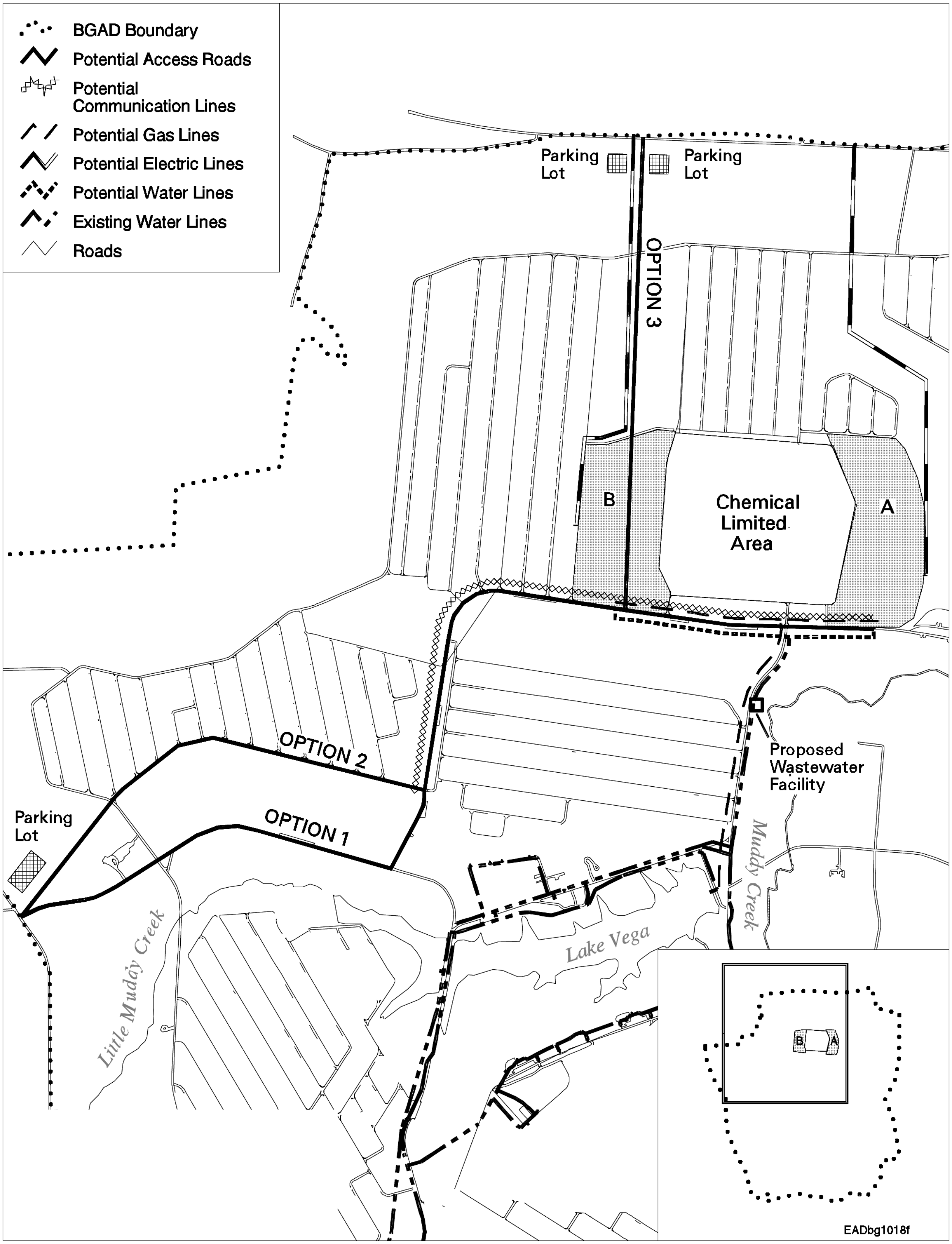

FIGURE 7.3-1 Proposed Utility and Road Access Corridors for the Proposed ACWA Pilot Test Facility at BGAD

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.

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[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]

	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		
Waste	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 $PM_{2.5}$.

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[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

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[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).

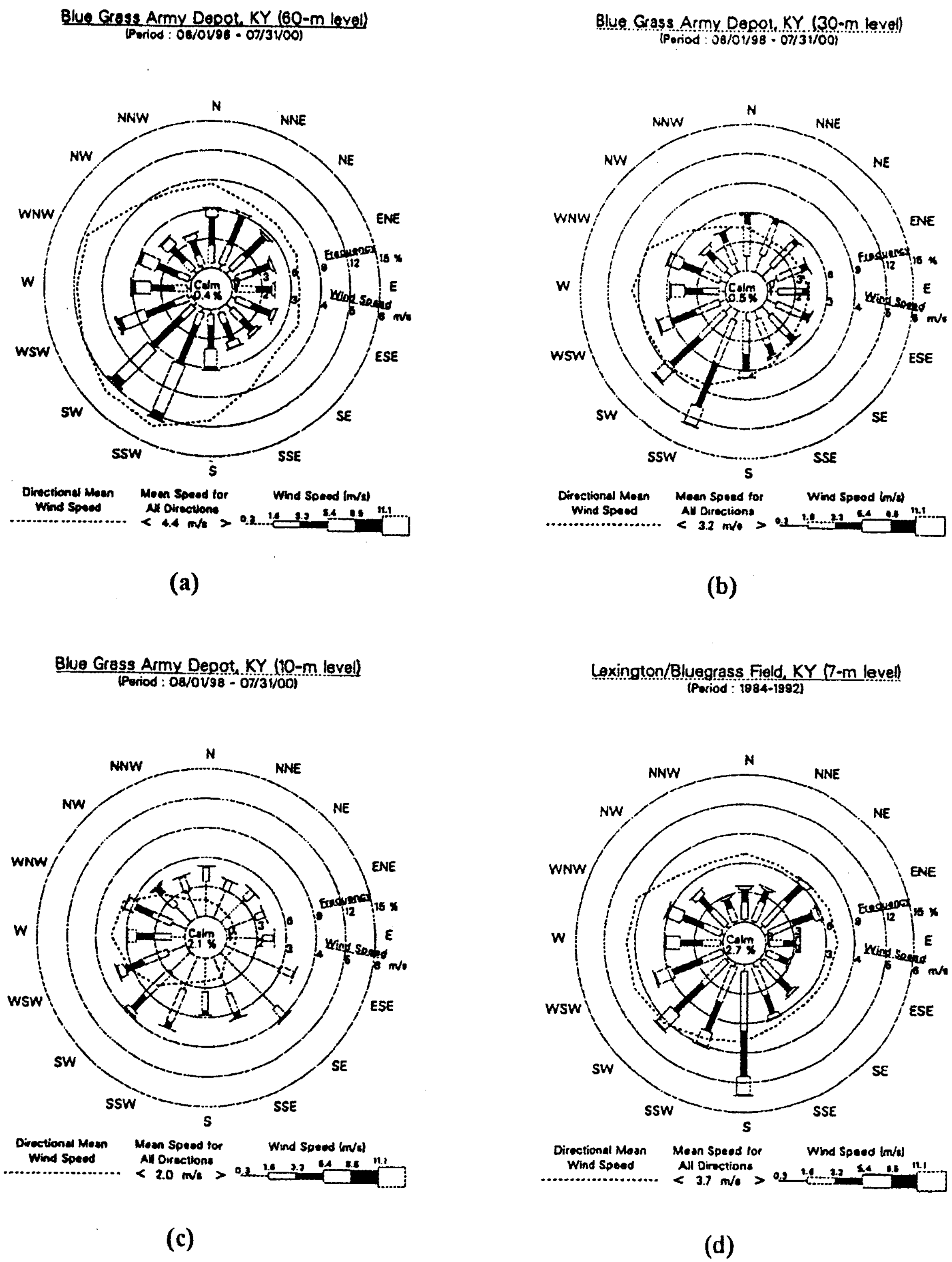

FIGURE 7.5-1 Annual Wind Roses for Three Heights Aboveground at the Demil Tower at BGAD from August 1998 through July 2000 (a = 60 m, b = 30 m, c = 10 m) and for One Height at Lexington Airport from 1984 through 1992 (d = 7 m) (Sources: Rhodes 2000 for a, b, c; EPA 2000a for d)

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 ≤ 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 2.2×10^{-4}/mi^2 per year) and 10 tornadoes were reported in Madison County (tornado event frequency of 4.9×10^{-4}/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.

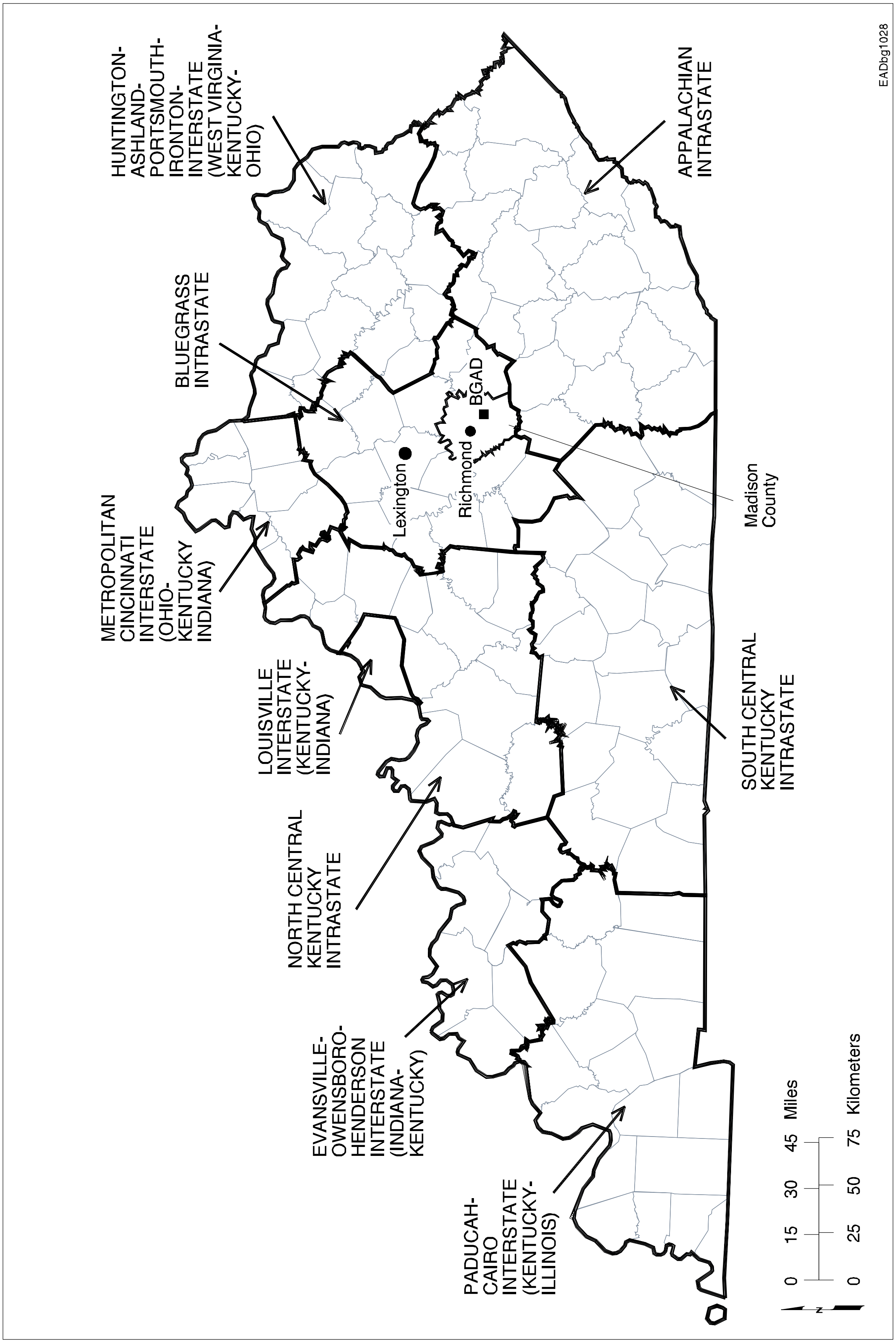

FIGURE 7.5-2 BGAD and Air Quality Control Regions in Kentucky

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.

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[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/m³)				
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 (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	6.8	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 ($\mu g/m^3$)					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	0.14	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

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[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.)

	Emissions (μg/s)[b]				
Compound[a]	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.)

Compound[a]	Emissions (µg/s)[b]				
	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.)

Compound[a]	Emissions (μg/s)[b]							
			Mustard Processing[c]		GB Processing[c]		VX Processing[c]	
	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 Zone	Noise Limits[a] ADNL (dBA)	Noise Limits[a] CDNL (dBC)	Population 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),

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[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.

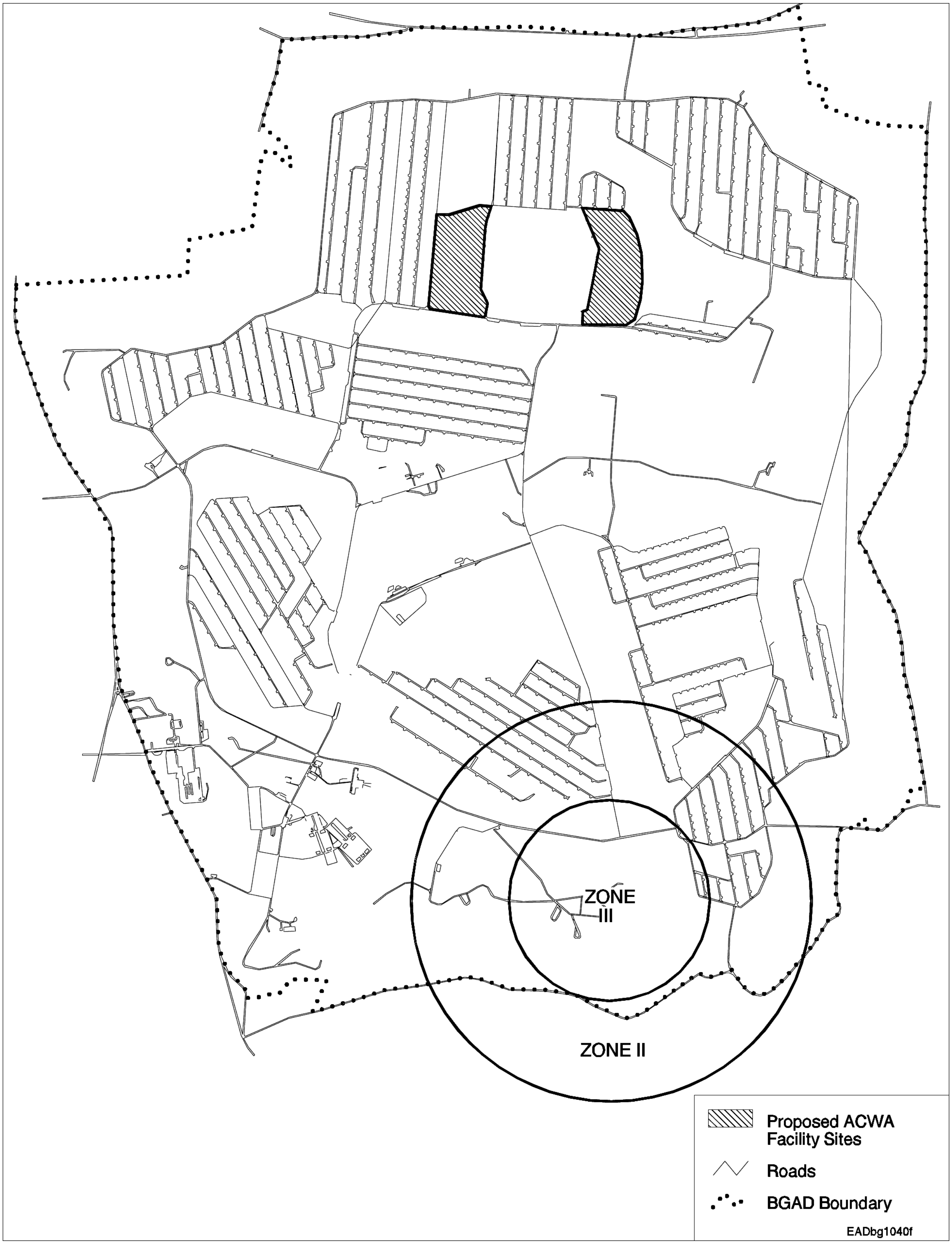

FIGURE 7.8-1 Noise-Sensitive Zones at BGAD (Source: Lexington-Blue Grass Army Depot 1987)

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.

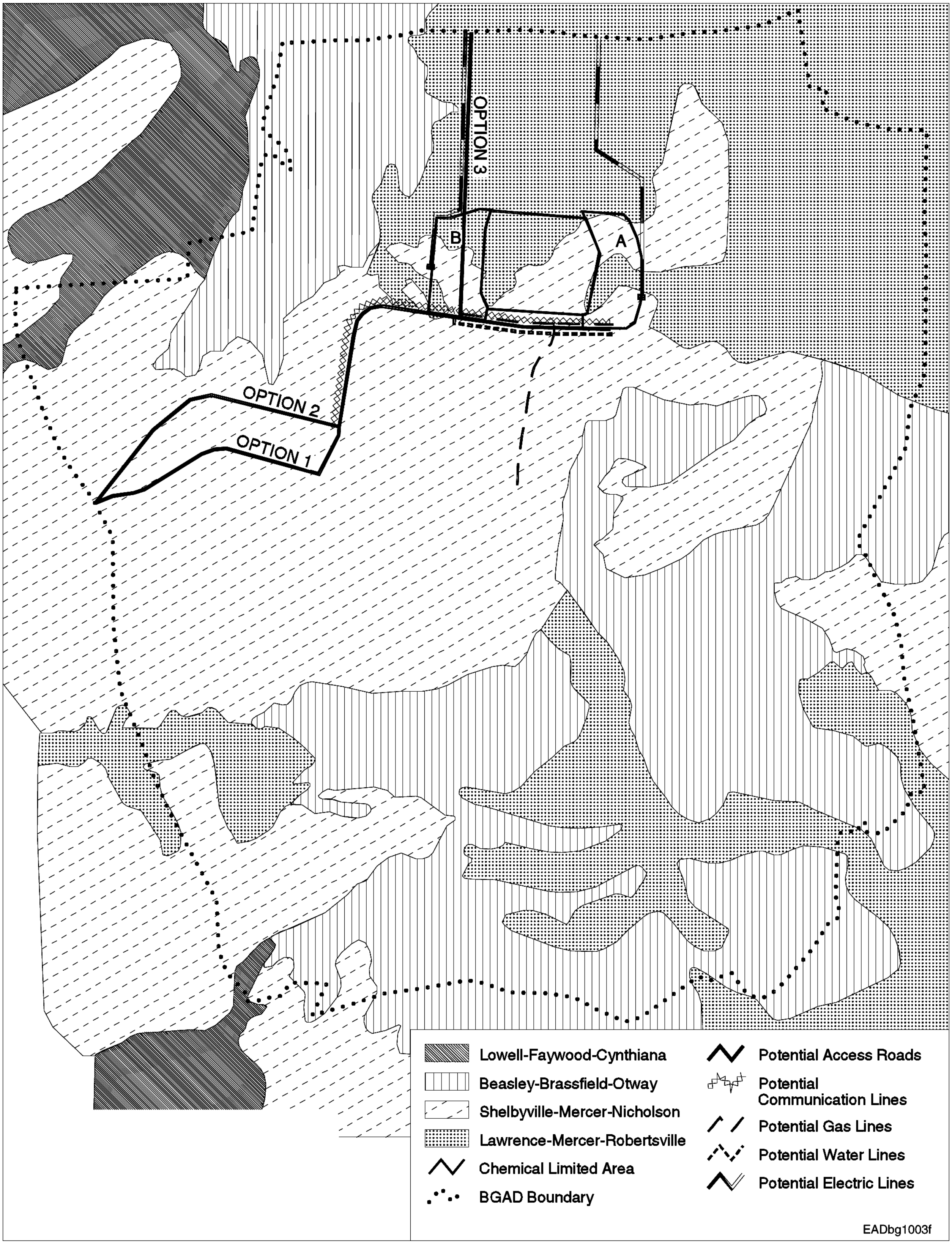

FIGURE 7.10-1 Soil Types at BGAD

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).

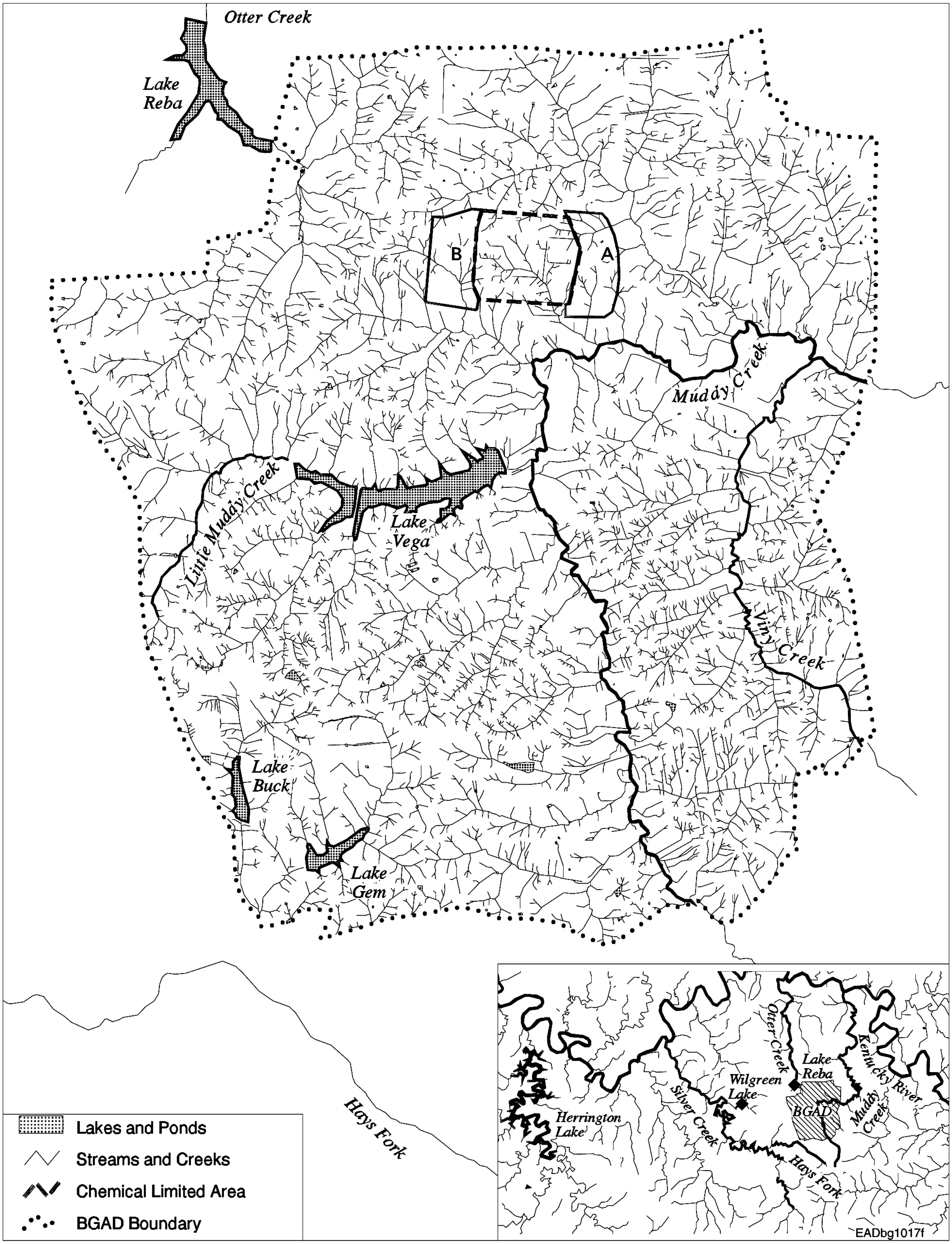

FIGURE 7.12-1 Surface Water Features at BGAD

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

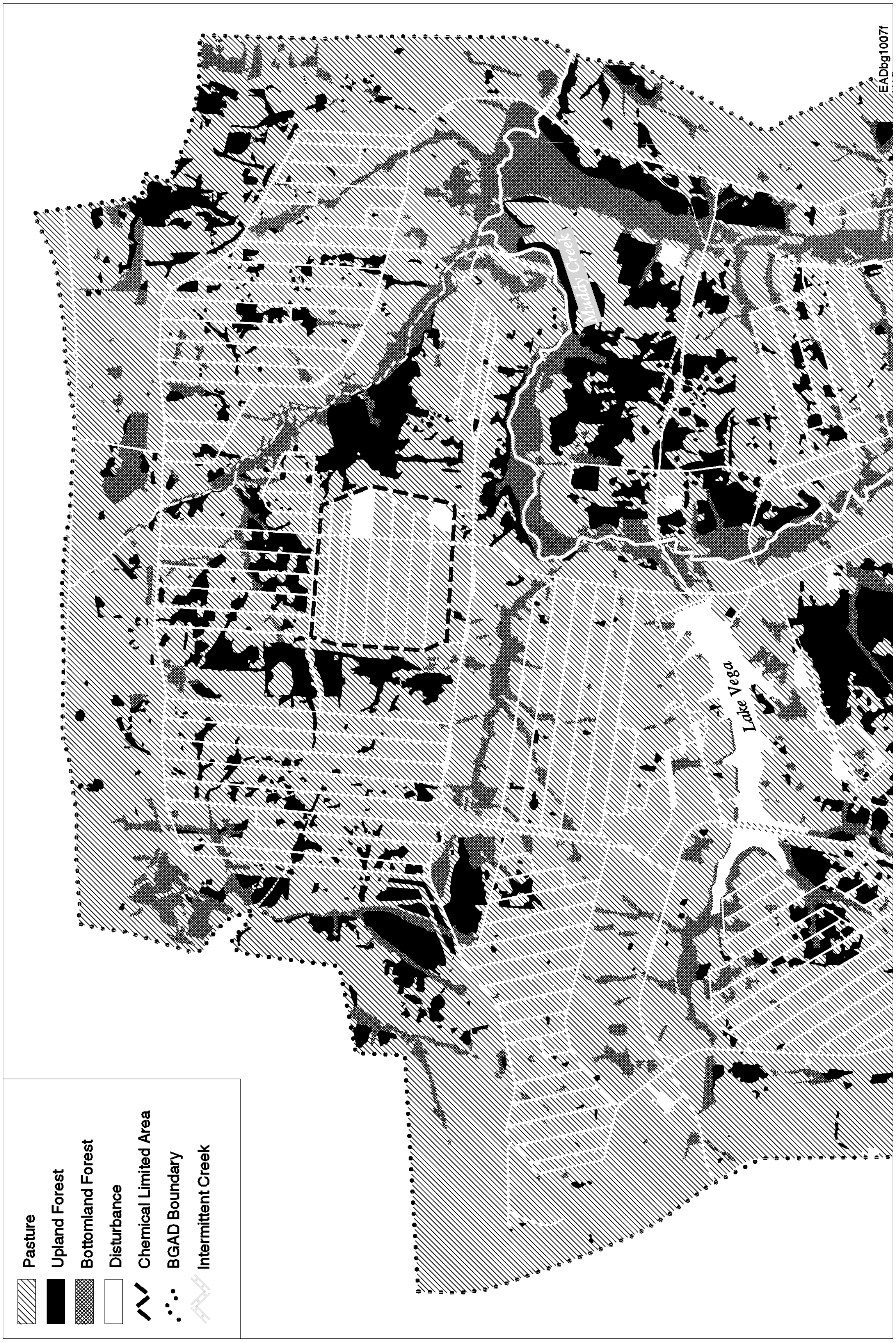

FIGURE 7.13-1 Vegetation at BGAD

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

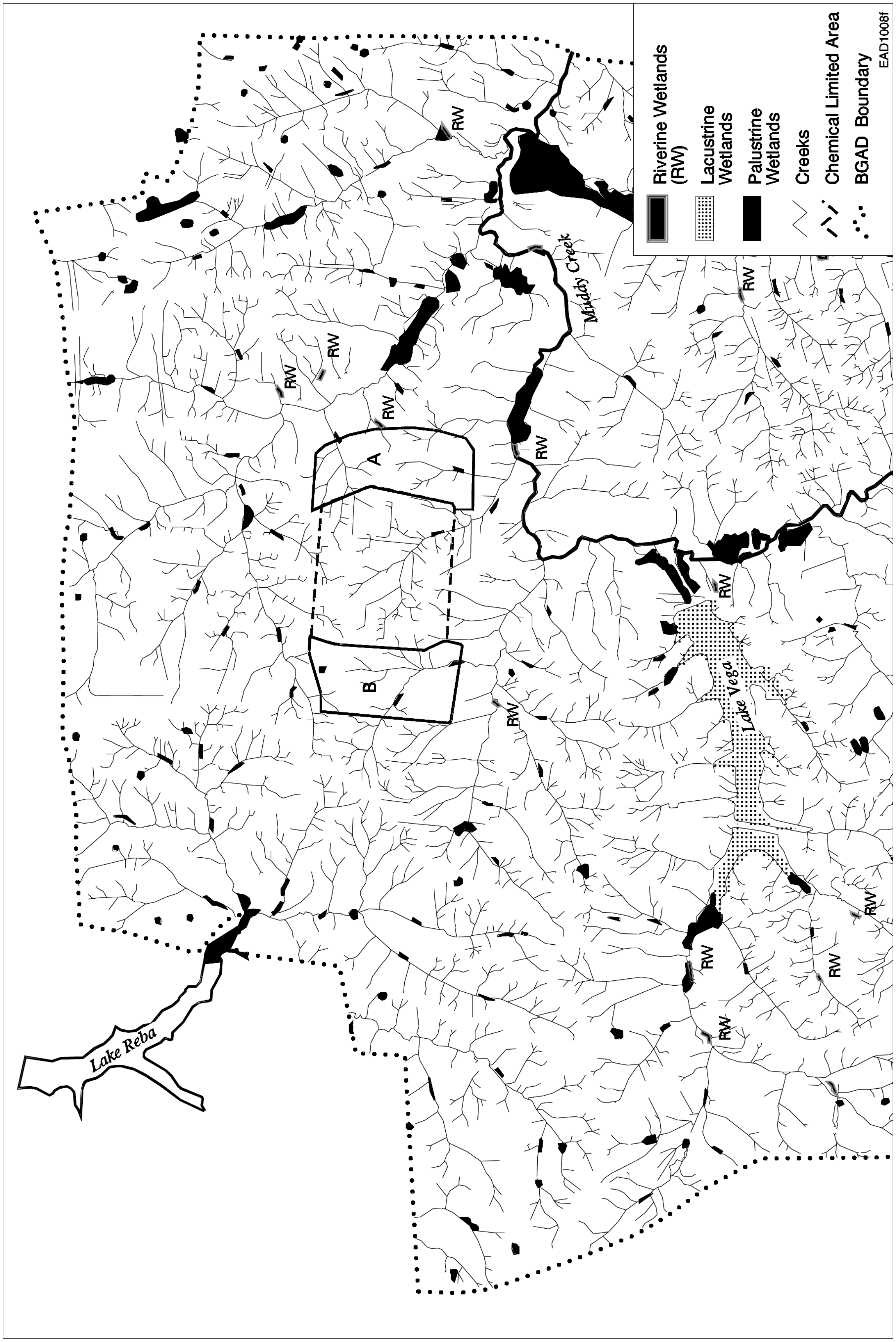

FIGURE 7.17-1 Wetlands at BGAD as Identified in U.S. Fish and Wildlife Service National Wetland Inventory Maps

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.

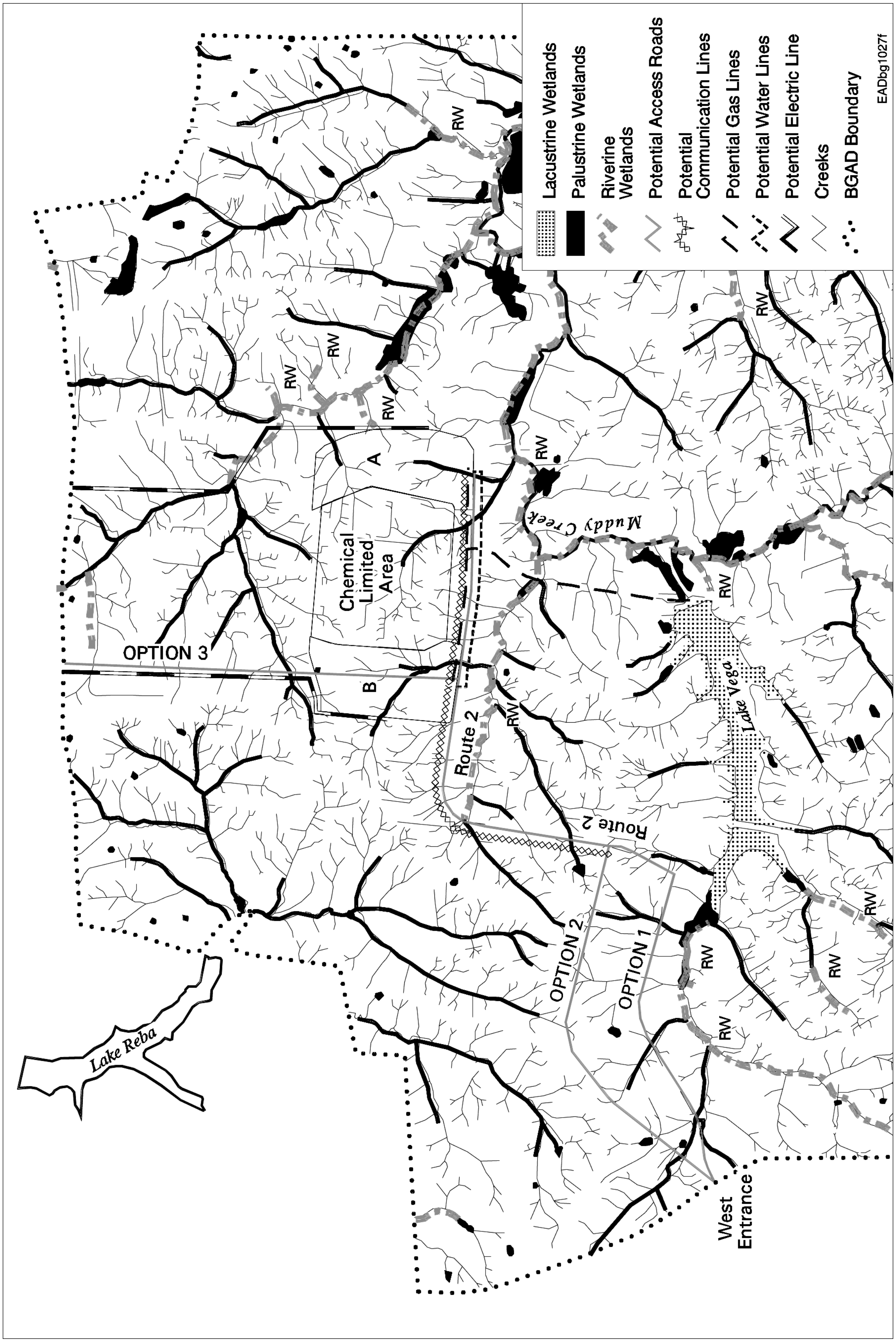

FIGURE 7.17-2 Wetlands and Potential Routes for Utility Corridors and Access Roads at BGAD

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).

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[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 Surveyed 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]

	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)[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.

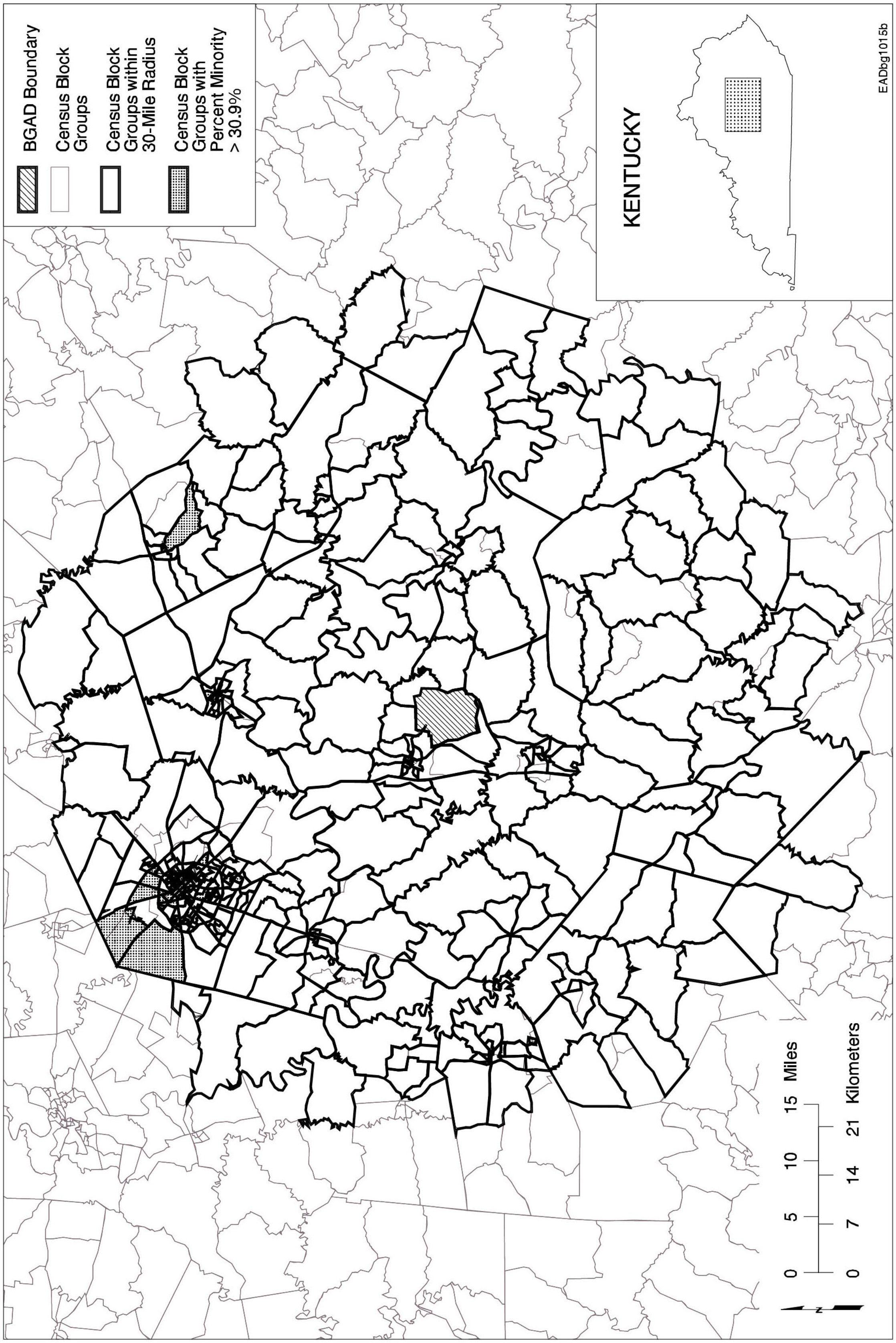

FIGURE 7.20-1 Census Block Groups within a 30-Mile (50-Kilometer) Radius of BGAD with Minority Populations Greater than the National Average in 2000 (Source: U.S. Bureau of the Census 2001d)

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.

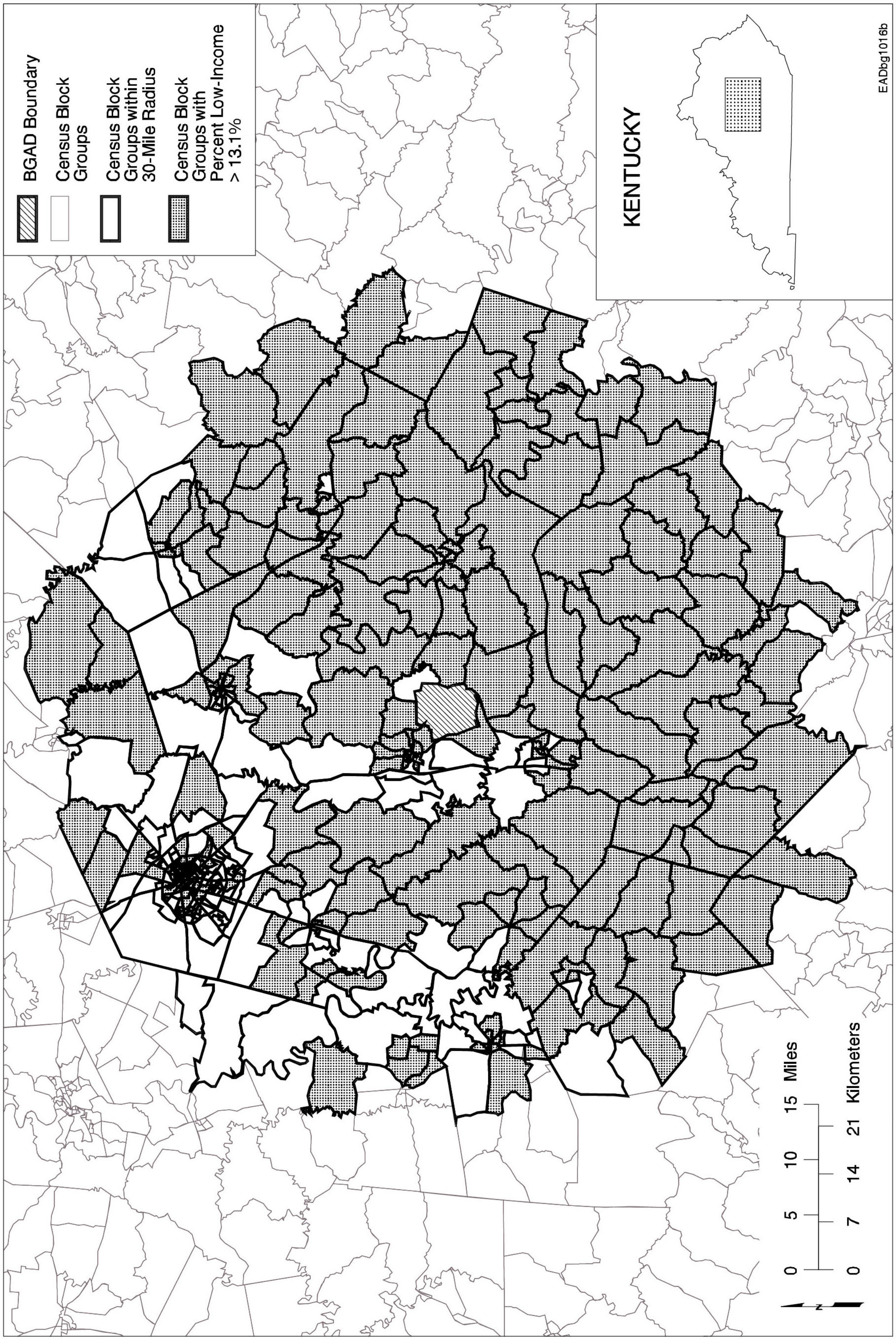

FIGURE 7.20-2 Census Block Groups within a 30-Mile (50-Kilometer) Radius of BGAD with Low-Income Popul.ations Greater than the National Average in 1989 (Source: U.S. Bureau of the Census 1992c)

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

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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/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	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]

	Distance (mi)			On-Post Population at Risk (no. of persons)[c]			
Accident Scenario[b]	To LCt_{50} Dose	To LCt_{01} Dose	To No Deaths Dose	Source to LCt_{50}	LCt_{50} to LCt_{01}	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

	Off-Post Public Population at Risk (no. of persons)[c]			
Accident Scenario[b]	Source to LCt_{50}	LCT_{50} to LCt_{01}	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]

	Distance (mi) with Hazard Quotient of <1[b]			
	Daytime Conditions		Nighttime Conditions	
Species	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 $\mu g/m^3$ 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 $\mu g/m^3$. Construction of an ACWA pilot test facility would contribute another 0.3 $\mu g/m^3$ (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 (μg/m³)				
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 μg/m³. Operating an ACWA pilot test facility would add, at most, 0.11 μg/m³. 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 (μg/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 μg/m^3. Operation of an ACWA pilot test facility and a baseline incinerator would contribute about 0.4 μg/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.