6 PUEBLO CHEMICAL DEPOT (PCD), COLORADO

6.1 INTRODUCTION

PCD is located in southeastern Colorado, approximately 14 mi (23 km) east of the center of the City of Pueblo in Pueblo County and about 2 mi (3 km) north of the Arkansas River (Figure 6.1-1). The installation encompasses approximately 23,000 acres (9,300 ha) and includes a variety of buildings, structures, and undeveloped areas.

6.1.1 Potential Sites and Facility Locations

Existing facilities at PCD include approximately 270 buildings used for administration, housing, maintenance, and storage (Figure 6.1-2). Most of these structures are located in the southern portion of the installation. In addition, PCD has earth-covered concrete igloos initially constructed for storage of conventional and chemical munitions. The storage igloos are located in Munitions Storage Areas A and B situated in the central and north central portions of the installation. Most of the igloos outside Munitions Storage Area A are empty; a small number (about 40) are leased to other organizations for storage. PCD also contains inactive demolition grounds and undeveloped perimeter zones.

An Assembled Chemical Weapons Assessment (ACWA) pilot test facility would require about 25 acres (10 ha) of land. In addition, during construction, land area would be required for a construction laydown area, temporary offices, parking, holding basins for surface water, and temporary utility installations. This additional land area could total 60 acres (24 ha). Together the facility and land area requirements could total 85 acres (34 ha) (Kimmell et al. 2001).

For the purposes of this *National Environmental Policy Act* (NEPA) assessment, it is assumed that any ACWA pilot test facility would be constructed within the chemical demilitarization (Chem Demil) area in the northeastern section of PCD near Munitions Storage Area A, where the chemical weapons are stored (Figure 6.1-2). The presence of certain physical features in the Chem Demil area — such as the installation's north boundary fence and the upper reaches of Haynes and Boone Creeks — limited the number of potential sites that could be used for ACWA Program facilities. The area appropriate for construction was limited even more to avoid areas adjacent to the installation boundary or within a surface water drainage area.

Three areas along the western, southern, and eastern edges of Munitions Storage Area A were considered appropriate for construction of ACWA pilot test facilities. These areas, labeled A, B, and C, are shown on Figure 6.1-2. Area A is approximately 180 acres (70 ha). Area B is approximately 120 acres (50 ha). Area C is approximately 180 acres (70 ha).

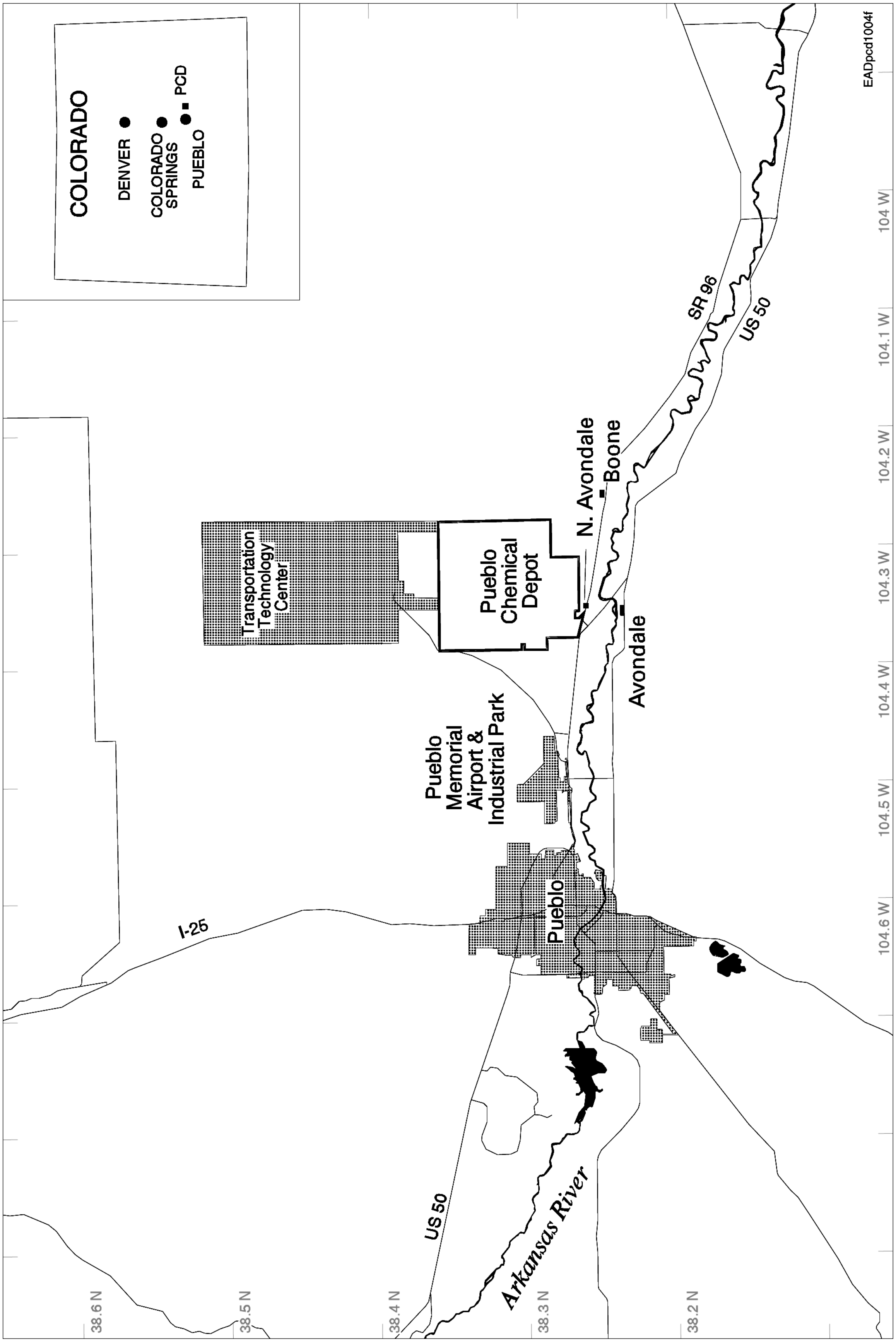

FIGURE 6.1-1 Location of PCD

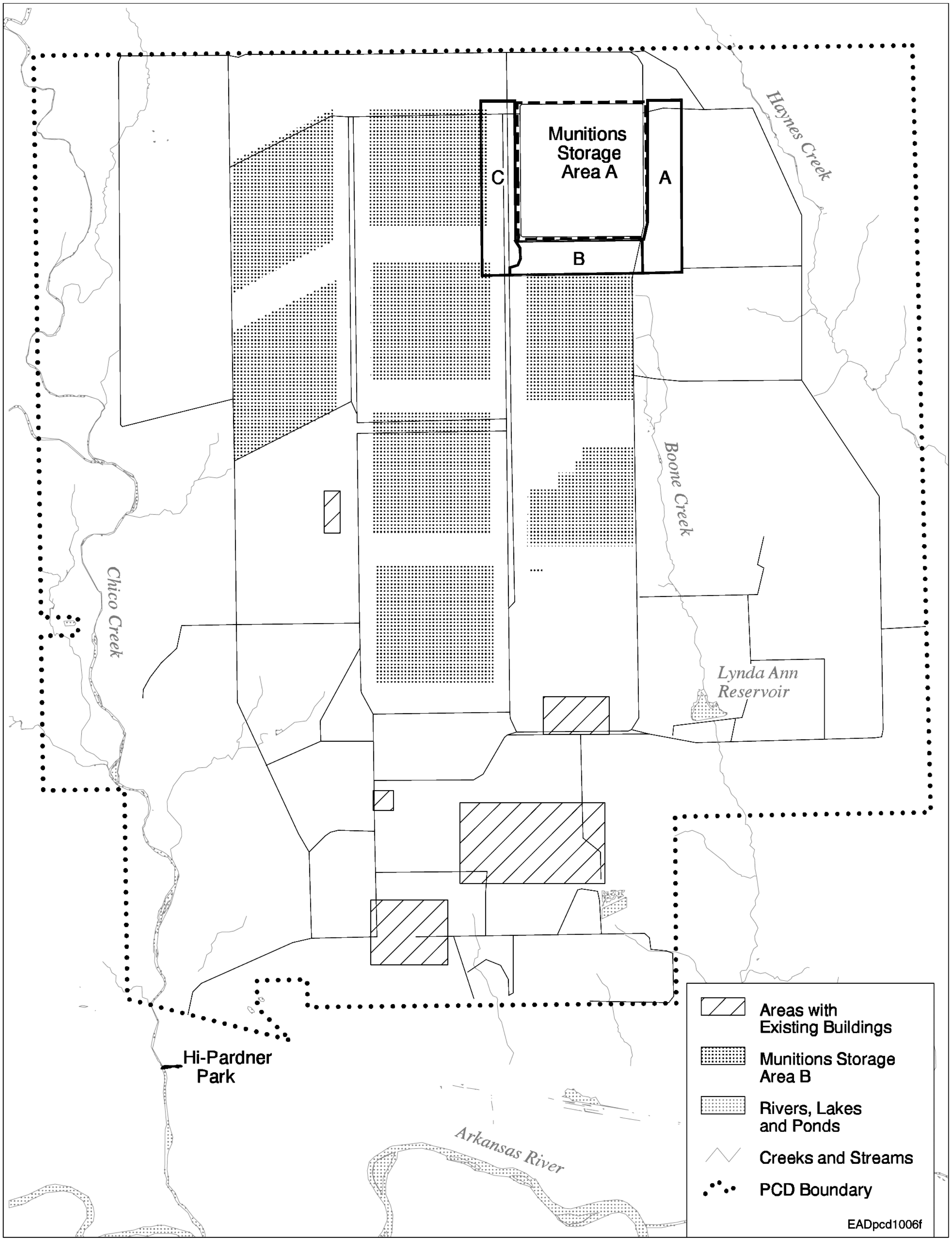

FIGURE 6.1-2 Facilities at PCD

In addition, the Army identified four potential routes for constructing supply lines for electric power, water, and natural gas. Any of these routes (labeled Corridors 1, 2, 3, and 4 on Figure 6.1-3) could serve any of the three areas.

6.1.2 Munitions Inventory

PCD currently houses 780,078 chemical munitions. The munitions stored at PCD are 105-mm and 155-mm projectiles and 4.2-in. mortar rounds, all filled with mustard agent (Table 6.1-1). Small quantities of nonstockpile chemical materiel are also stored at PCD. However, these are not ACWs and are not part of the ACWA Program.

6.2 LAND USE

6.2.1 Installation History and Uses

PCD is a part of the U.S. Army Soldier and Biological Chemical Command (SBCCOM). The current missions at PCD are to manage the on-post stockpile of chemical munitions, prepare for chemical munitions disposal under the Chemical Stockpile Disposal Program, manage environmental restoration activities, and provide limited maintenance to existing facilities. The U.S. Army first established PCD in 1942 as the Pueblo Ordnance Depot (POD). The depot's primary function at that time was the storage and shipment of ammunition, but it was also used as a medical supply depot.

In the early 1950s, during the Cold War, POD was a distribution center for military supplies for 78 installations in a nine-state region from the Dakotas to Arizona. During this time, POD expanded much of its storage capacity and facilities to accommodate a growing work force. Also during this time, POD began storing chemical munitions, such as distilled mustard, that were being produced at Rocky Mountain Arsenal in Denver, Colorado, and Redstone Arsenal in Huntsville, Alabama. Originally the chemical munitions were stored in the igloos in Munitions Storage Area B, but they were later moved to Munitions Storage Area A in the northeastern portion of POD. Nuclear weapons, such as atomic cannon ammunition, were stored in Munitions Storage Area B from 1954 until 1965.

Another expansion of POD occurred in the late 1950s with the addition of a new function for the depot: missile storage and maintenance. In 1961, POD was the "nation's prime depot for maintenance, rebuilding, and storage of the Army's three major missiles [the Redstone, Pershing, and Sergeant] and their systems" (Simmons and Simmons 1998). Hawk and LaCrosse missiles were also serviced at POD.

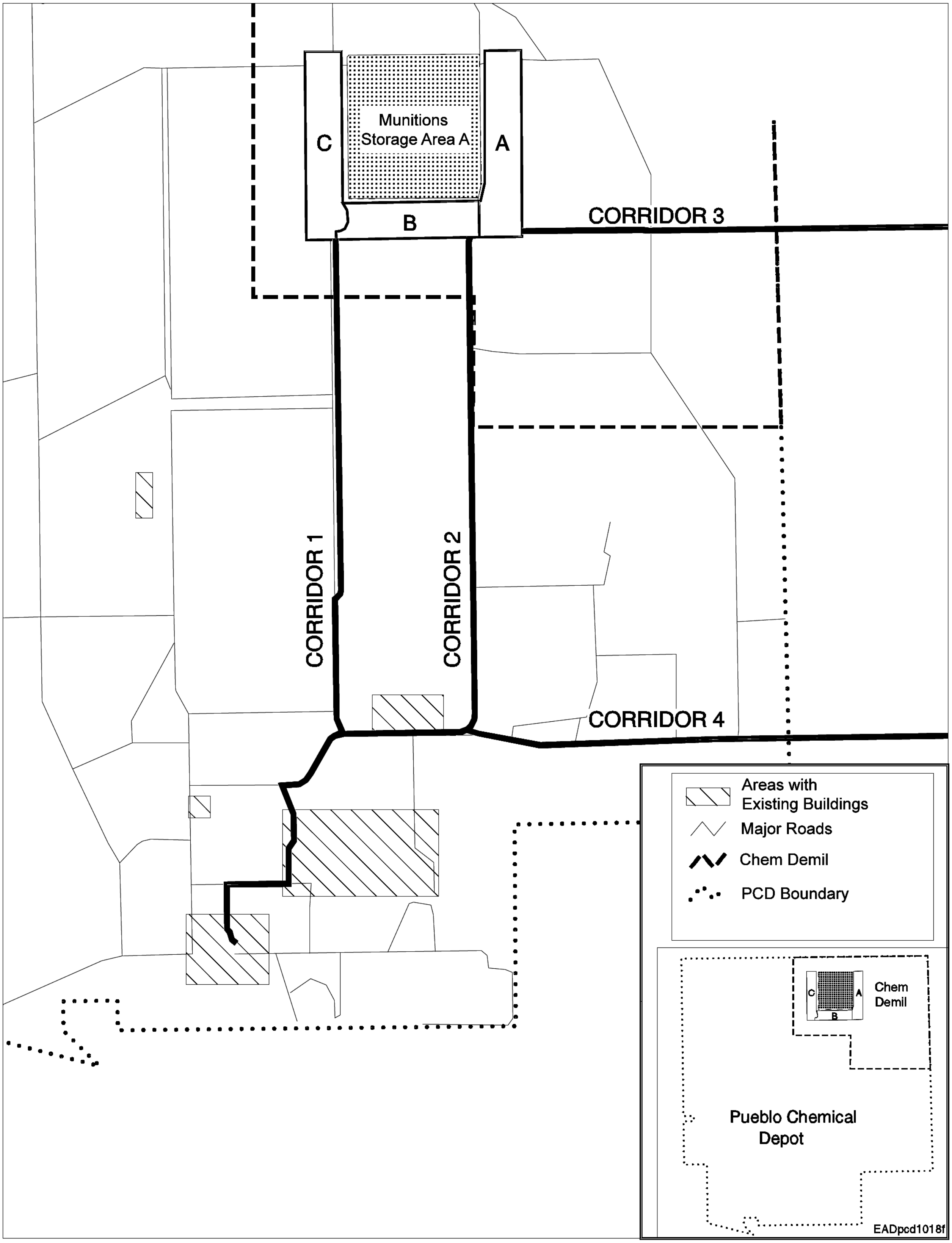

FIGURE 6.1-3 Proposed Utility and Road Access Corridors for an ACWA Pilot Test Facility at PCD

TABLE 6.1-1 Assembled Chemical Weapons Inventory at PCD

Type of Munition[a]	Agent	Total No. of Munitions	Total Weight of Agent (lb)[b]
M104 projectiles (155 mm)[c]	HD	33,062	386,820
M110 projectiles (155 mm)[c]	HD	266,492	3,117,960
M60 cartridges (105 mm)[d]	HD	383,418	1,138,760
M2 mortars (4.2 in.)[e]	HT	20,384	118,220
M2A1 mortars (4.2 in.)[e]	HD	76,722	460,340
Total		780,078	5,222,100

[a] Basic configurations are shown. Some of the munitions have been modified through maintenance activities.

[b] Numbers may vary due to roundoff errors. The agent numbers shown are those reported under the Chemical Weapons Convention (CWC) requirements (Chemical and Biological Defense Command [CBDCOM] 1997).

[c] Include an explosive burster with 0.41 lb of tetrytol with each munition.

[d] Include an explosive burster with 0.26 lb of tetrytol, a fuze, 2.8 lb of propellant, and a packing and shipping container with each munition.

[e] Include an explosive burster with 0.14 lb of tetrytol, a fuze, and a propelling charge with each munition.

POD was renamed Pueblo Army Depot (PAD) in 1962. Depot closures in South Dakota and Nebraska in the mid-1960s led to yet another expansion of PAD, making it one of the largest U.S. Army Materiel Command depots in the nation. Activities continued to diversify: the facility was used to maintain and rebuild vehicles and equipment; store, maintain, and distribute materials for fixed and floating bridges; and provide a repository for U.S. Army historical properties.

A phase-down of PAD was announced in 1974 in response to the end of the Vietnam War. Many activities were transferred to other facilities. PAD continued to act as a storage supply depot for ammunition and supplies and as a maintenance facility for the Pershing missile system. In 1976, PAD became a satellite facility to Tooele Army Depot, Utah, and was renamed Pueblo Depot Activity (PDA).

In 1988, the Base Realignment and Closure (BRAC) Commission recommended realignment of PAD (U.S. Army 1997a). All of PAD's missions, except storage and demilitarization of chemical weapons, were realigned (i.e., transferred to other installations).

The main mission of the depot today is the storage of a portion of the nation's chemical weapons stockpile. In 1996, PDA was renamed Pueblo Chemical Depot (PCD) to reflect its primary current mission. Notwithstanding the limitations in the authority of the 1988 BRAC legislation, final closure of the installation is anticipated after completion of chemical demilitarization.

6.2.2 Current and Planned On-Post Land Use

Past and present land use on PCD has been primarily for industrial and related purposes, with administrative purposes present as well (EDAW et al. 1994). Past and present land use has also included residential and recreational purposes to support personnel housed at the depot.

In 1995, the Pueblo Depot Activity Development Authority (PDADA) adopted a reuse development plan for PCD (EDAW et al. 1994). The plan was updated in June 2000 (PDADA 2000). In this plan, land reuse categories were assigned to all of the property located within the boundaries of PCD. Land reuse categories were designated for Chem Demil, industrial, residential, recreational, and wildlife management activities (Figure 6.2-1).

The reuse development plan considered 14 different uses for PCD and, in the process, maintained more than 5,200 acres (2,104 ha) in the northeastern portion of the installation for Chem Demil. The plan made the remaining part of the depot available for use by other entities, as summarized in Table 6.2-1. Tenants present at PCD include the Colorado National Guard 947th Engineering Company, a special forces unit, and PDADA. Other parties sublease space at PCD through PDADA. These sublessees include not-for profit, commercial, and state and local government entities.

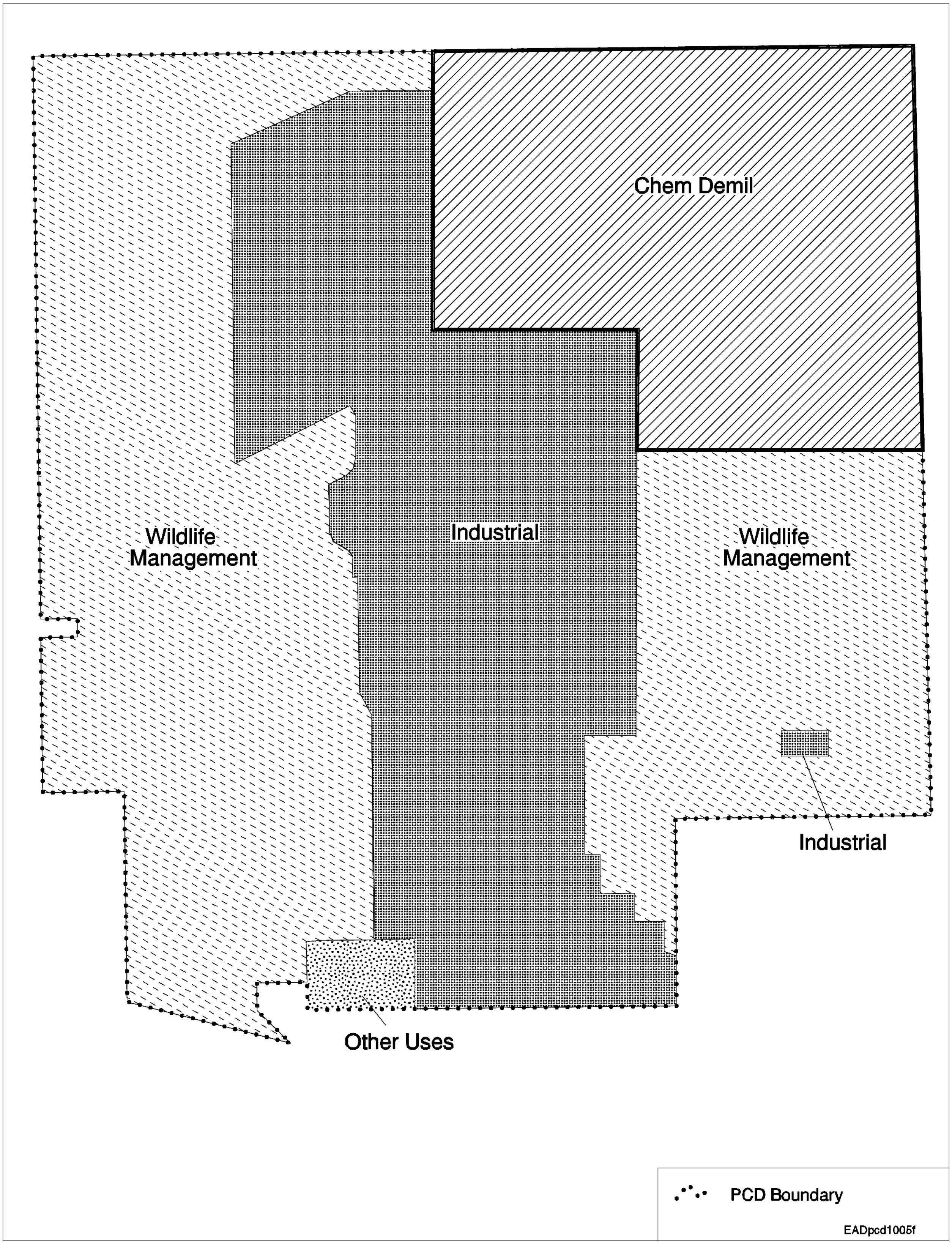

FIGURE 6.2-1 Land Use at PCD

TABLE 6.2-1 Potential Land Uses Considered under Base Realignment and Closure at PCD

Land Use Category	Approximate Total Area (acres)[a]	Approximate Area Required for Chemical Demilitarization (acres)[a]
General warehouse/industrial	700	10
Special materials warehouse	90	0
Material storage (igloos)	1,900	0
Material storage reserve (igloos)	4,500	1,500
Office/commercial/institutional	20	10
Light industrial	100	60
Open storage	300	0
Livestock grazing	6,500	3,300
Wildlife management	4,900	0
Open space	900	300
Residential	60	10
Land reserve	1,900	0
Recreation	10	5
Open storage reserve	900	0
Total	22,900	5,200

[a] 1 acre = 0.4 hectare.

Source: EDAW et al. (1994).

6.2.3 Current and Planned Off-Post Land Use

Most of the land surrounding PCD is undeveloped ranch land used for grazing. In 1997, Pueblo County contained 664 farms covering about 880,000 acres (360,000 ha) (U.S. Department of Agriculture [USDA] 1999). Cropland on these farms totaled about 90,000 acres (36,000 ha), with the remaining vast majority used for pasture.

Various private and public interests own the land surrounding PCD (EDAW et al. 1994) (Figure 6.2-2). The state of Colorado owns most of the land north of the installation, as well as parcels east and west of PCD. The Transportation Technology Center (TTC), which is owned by the Federal Railroad Administration and operated in the private sector by the Association of American Railroads, is situated on state lands adjacent to the north boundary of PCD. TTC's center for testing rail engines and cars lies about 2 mi (3 km) north of the PCD boundary. The federal government owns several small tracts east of the installation; these are managed by the Bureau of Land Management (BLM) in the U.S. Department of the Interior (DOI). Remaining land surrounding PCD is privately owned, including a private ranch adjacent to PCD boundary and north of Munitions Storage Area A.

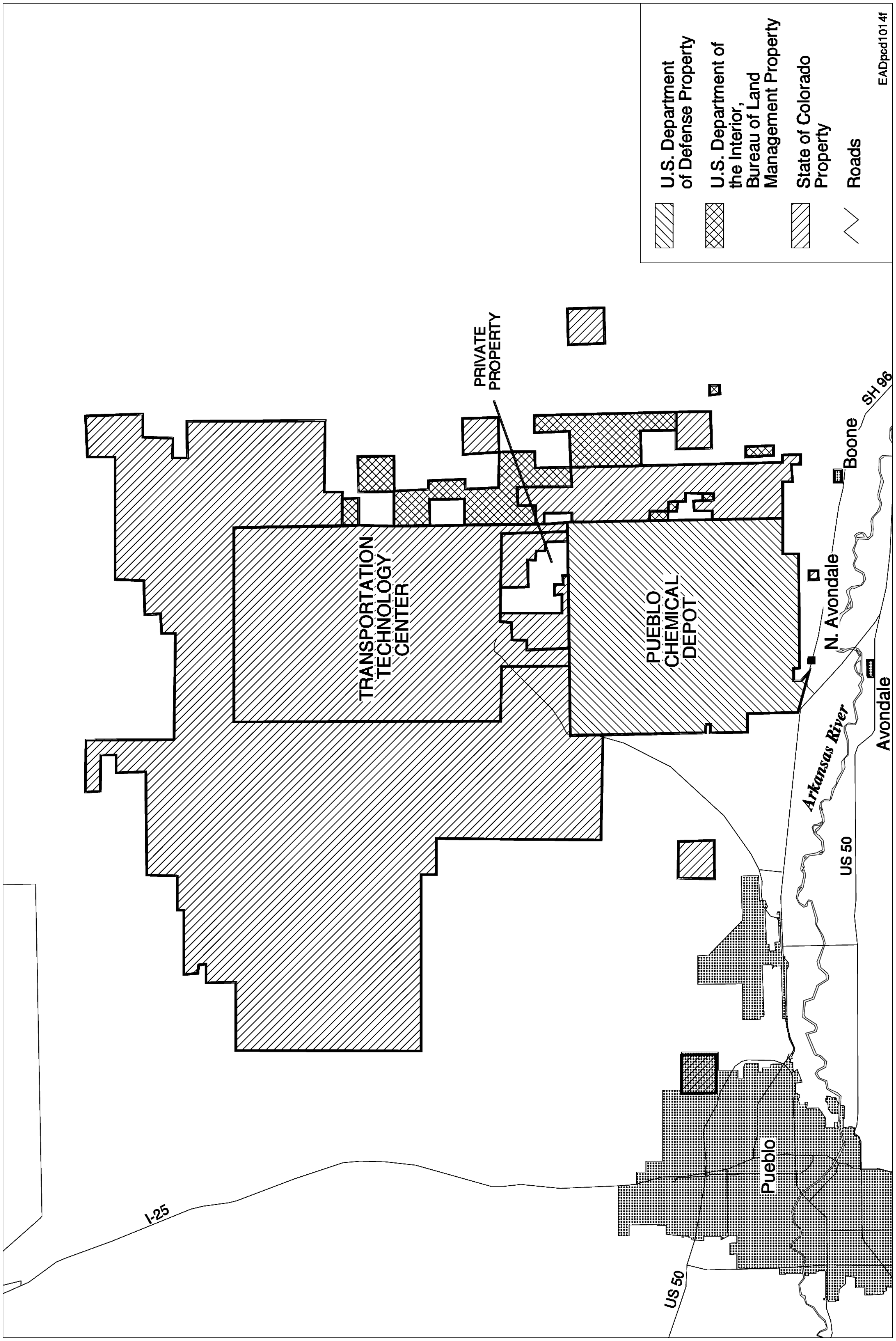

FIGURE 6.2-2 Land Ownership near PCD

Land use near PCD is mainly agricultural and zoned Agricultural One (A-1) by the Pueblo Board of County Commissioners (U.S. Army 1984). With the exception of the TTC, the state lands depicted in Figure 6.2-2 are leased for grazing (EDAW et al. 1994). The State Board of Land Commissioners maintains a multiple-use policy for land owned by the state, and the state land near PCD could be managed for wildlife and recreational purposes. However, these uses remain unexplored. The federal land managed by the BLM is leased for grazing. Because these tracts are small and noncontiguous, they are difficult to manage, and BLM is studying their future disposition. Most of the private land near the installation is also used for grazing. Land lying along the Arkansas River, roughly 2 mi (3 km) south of PCD, is used for irrigated agriculture.

Pueblo (population 102,121), located east of PCD, is the only city in Pueblo County (population 141,472) as well as the only city within a 30-mi (50-km) radius of the installation. Some areas to the south of PCD are zoned light commercial and residential, and several small communities are present there, including Boone, Avondale, and North Avondale.

During the 1990s, the population grew slowly in both Pueblo County and the city of Pueblo (U.S. Bureau of the Census 1999a,b). Land use until 2010 is likely to remain largely rural, focused on grazing and agriculture, with a concentration of trade and service activities and residential uses in the city of Pueblo.

6.2.4 Impacts on Land Use

6.2.4.1 Impacts of the Proposed Action

No impacts to land use would be expected from construction or operation of ACWA facilities. The proposed locations for the ACWA facilities are within the Chem Demil area, and any impacts from construction and normal operations would be localized in this area. Impacts from normal operations at the proposed ACWA pilot testing facilities would be consistent with proposed installation reuse and would not significantly adversely affect those proposed operations (U.S. Army 1997a). Although wildlife would be adversely affected by the construction and operation of an ACWA facility, the impacts would be consistent with the reuse areas at PCD.

Impacts resulting from the construction and normal operation of ACWA facilities would be very localized and would not adversely affect areas outside PCD. Potential small discharges that could occur during operations would have no impacts on land use off the installation. Impacts on more distant land use patterns in the city of Pueblo would be further reduced because of the increased distance.

6.2.4.2 Impacts of No Action

Under the no action alternative, storage of chemical stockpile components at PCD would continue. Land use in the immediate storage area, already identified for activities associated with chemical weapons in the current reuse plan, would also continue. This would be consistent with existing on-post and off-post plans.

6.3 INFRASTRUCTURE

Table 6.3-1 lists the annual utility requirements for an ACWA facility. Table 6.3-2 lists the approximate acreage needed for construction of an ACWA facility and associated utilities infrastructure. The following sections describe the requirements for an ACWA pilot test facility, current installation utility and infrastructure demands, and the impacts that the construction and operation of an ACWA pilot test facility would have on utilities and infrastructure.

TABLE 6.3-1 Approximate Annual Utility Demands for Operation of an ACWA Pilot Test Facility at PCD[a]

	Annual Demand	
Utility	Neut/Bio	Neut/SCWO
Electric power (GWh)	36	60
Natural gas (scf)	94,000,000	149,000,000
Fuel oil (gal)	48,000	48,000
Process water (gal)	13,000,000[b]	18,000,000[b]
Potable water (gal)	6,400,000	6,400,000
Sewage (gal)	7,500,000	7,500,000

[a] Based on 365 d of facility operation during which system operation would occur 12 h/d, 6 d/wk, and 46 wk/yr. Unit conversions: 1 scf (standard cubic foot) = 0.028 Nm^3. 1 gal = 3.8 L.

[b] The numbers used for process water for Neut/Bio and Neut/SCWO at PCD were from demonstration testing. Subsequent design studies now indicate Neut/Bio would use 5.7 million gal/yr and Neut/SCWO would use 1.3 million gal/yr.

Source: Kimmell et al. (2001).

TABLE 6.3-2 Estimated Land Area Disturbed for Construction of an ACWA Pilot Test Facility and Associated Infrastructure at PCD[a]

	Area Disturbed (acres)		
Construction Activity	Area A	Area B	Area C
Pilot facility, including sewage evaporation lagoon and electrical substation	25	25	25
Transmission lines (115-kV)			
Option 1 or 3			
Towers	1	1	1
Conductor stringing	<1	<1	<1
Option 2			
Towers	<1	<1	<1
Conductor stringing	<1	<1	<1
Construction access road[b]	9	9–10	10–11
Gas pipeline[c]	37–43	37–43	37–43
Water pipeline[c]	5–6	5	4
Maximum possible area disturbed	85	84	85

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

[b] A new 35-ft-wide (11-m-wide) access road would be required from the east boundary of PCD to the construction area.

[c] The maximum width of corridor disturbed would be 60 ft (18 m).

6.3.1 Electric Power

6.3.1.1 Current Supply and Use

Currently, the Western Area Power Administration (Western) is the primary provider of electric power to PCD. Existing PCD activities consume the full Western allotment of 1,600 MWh/yr, and additional electric power is purchased each year through a supplemental contract with West Plains Energy Corporation. Southern Colorado Power Company delivers power to PCD through an existing 69-kV transmission line.

6.3.1.2 ACWA Pilot Test Facility Requirements

The electrical demands of an ACWA facility would require the purchase of additional power. Table 6.3-1 lists the amounts of electricity required by the proposed ACWA pilot test facilities. The quantity of electricity required for construction (18 GWh) would be the same for either facility. During operations, annual electricity use by Neut/Bio (36 GWh) would be 60% of the use by Neut/SCWO (60 GWh).

Neither the current power supply nor infrastructure is adequate to meet ACWA Program needs. Either additional power could be purchased to meet the needs of proposed ACWA facilities via the existing supplemental contract with West Plains Energy Corporation, or a contract with a new provider could be established. In either case, new transmission lines would need to be constructed because those currently leading to Munitions Storage Area A are old and unreliable and require frequent maintenance.

Three options exist for the transmission line (see Figure 6.3-1).

- Under Option 1, the new 115-kV line would be extended from the existing substation in the PCD office complex to the ACWA facilities along either Corridor 1 or Corridor 2, a distance of approximately 6 mi (10 km). These corridors, which would be a maximum of 60 ft (18 m), would use existing roads for access and would follow previously disturbed areas along the road rights-of-way.

- Under Option 2, electric power would be extended from an existing power line that runs parallel to the eastern boundary of PCD. Under this option, the new 115-kV transmission line would run along Corridor 3, a distance of about 3 mi (5 km), and a 35-ft-wide (11-m-wide) access road would be constructed.

- Under Option 3, electric power would be delivered from power lines along the eastern boundary (similar to Option 2, but from a point further south along an existing road way).

Because Corridors 1 and 2 are longer, implementation of Option 1 or 3 would cause more ground disturbance than would Option 2.

6.3.1.3 Impacts of the Proposed Action

Although an ACWA facility would demand substantially more electric power than is currently used at the site, the increased demand could be accommodated by existing suppliers

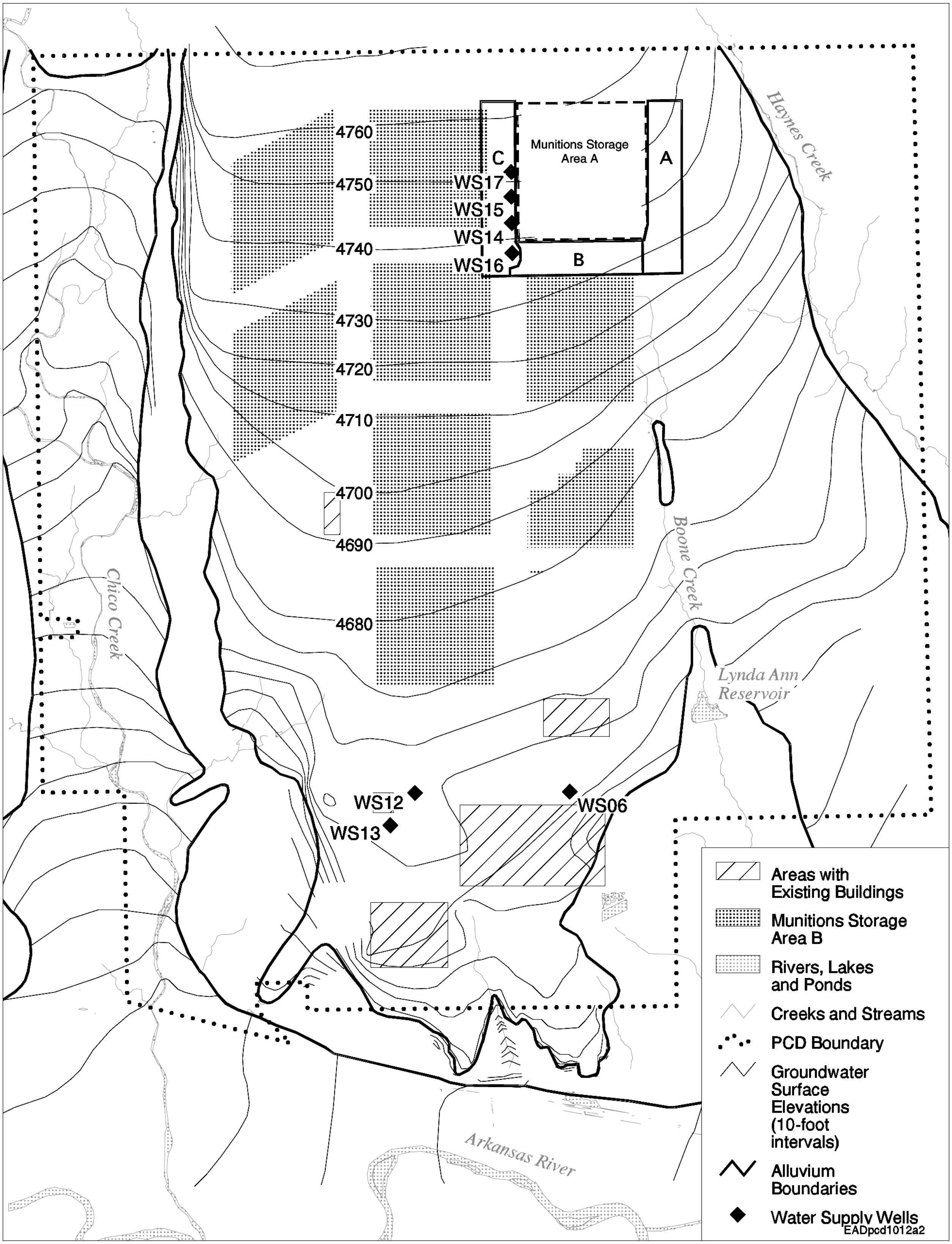

FIGURE 6.3-1 Locations of Water Supply Wells at PCD

and would not significantly affect the regional power supply. Moreover, the use of electric power by the ACWA facility would be temporary; it would cease after three years.

The provision of an additional, reliable electrical infrastructure to support ACWA facilities could have a positive effect on redevelopment initiatives, which could access the new infrastructure.

Ground disturbance impacts that would result from the construction of power facilities are discussed in this EIS under specific environmental resource areas. The only potential for significant impacts would be associated with destruction of sensitive plant habitat, as discussed in Section 6.13.3. Depending on the options chosen, these impacts could be largely avoided or mitigated.

6.3.1.4 Impacts of No Action

Under the no action alternative, the electrical upgrades required by the ACWA Program would not be undertaken. New power lines would not be installed, power usage would continue at current levels, and no ground disturbance would occur.

6.3.2 Natural Gas

6.3.2.1 Current Supply and Use

Excel Energy supplies natural gas to PCD. Currently, natural gas is used in buildings located in the administration area and in some of the warehouse buildings. The main gas line at PCD was installed in 1998 and sized to meet the requirements of Chem Demil activities. Gas pipelines do not extend to Munitions Storage Area A.

6.3.2.2 ACWA Pilot Test Facility Requirements

Table 6.3-1 lists the amount of natural gas that would be used by the proposed ACWA facilities. The quantity of natural gas used during construction would be the same for either facility. Annual natural gas use for operating a Neut/Bio system (94,000,000 scf) would be about 50% less than use for operating a Neut/SCWO system (149,000,000 scf).

The provision of natural gas to an ACWA facility would require the construction of new pipelines to the Munitions Storage Area A area. In this assessment, it was assumed that these pipelines would be installed along either Corridor 1 or 2, as shown on Figure 6.1-3. Since no gas line exists along the east PCD boundary, Corridors 3 and 4 would not be viable for running a gas supply line. For the purpose of this assessment, it was assumed that a 60-ft-wide (18-m-wide) corridor might be affected during installation of these pipelines, and that the pipelines would run along existing roadways. Construction in any of the areas A, B, or C would create a maximum of 43 acres (17 ha) of disturbance.

6.3.2.3 Impacts of the Proposed Action

The ACWA pilot test facilities would require between 94,000,000 and 149,000,000 scf of natural gas annually for approximately three years of operation. The Neut/SCWO technology would require about 50% more natural gas than the Neut/Bio technology. Excel Energy could supply this quantity to PCD without affecting regional gas supplies. Further, the use of natural gas would be temporary; it would cease after three years. Since pipelines would be laid in previously disturbed areas, no significant impacts would be expected from the installation of new pipelines.

6.3.2.4 Impacts of No Action

Under the no action alternative, a natural gas pipeline required by the ACWA Program would not be constructed. New pipelines would not be installed, no ground disturbance would occur, and natural gas consumption would remain at baseline levels.

6.3.3 Water

6.3.3.1 Current Supply and Use

Current water use is approximately 4.3 acre-ft/yr (1,400,000 gal or 5,300 m^3/yr) and is supplied from seven active water supply wells (Ebasco Environmental 1990). Figure 6.3-1 shows the location of these wells. Historically, water usage was much greater; in 1981, water usage was 290 acre-ft/yr.

Water supply wells at PCD provide water on the basis of a delivery contract with more senior water rights holders, because in most years, there is not enough water in the Arkansas River tributary aquifers to fulfill PCD's junior water rights to extract 1,000 acre-ft/yr (1,200,000 m^3/yr) from the terrace alluvium aquifer. As a result, in order to use water on post, PCD must purchase water from more senior water rights holders. All water used at PCD has been diverted from other water rights holders and potential uses.

PCD has the capacity to treat 7,800,000 gal (29,500 m^3) of wastewater annually. Wastewater is treated on post in lagoon systems. One system is located near the administrative area, and one is near Munitions Storage Area A (Figure 6.3-2).

6.3.3.2 ACWA Pilot Test Facility Requirements

Existing water supply wells have adequate extraction capacity to meet the water use requirements for both construction and normal operations of either of the ACWA technologies. However, it is anticipated that the ACWA Program may need to establish a new contract with current water right holders in order to obtain rights to extract additional water. In addition, new water distribution pipelines would need to be installed to convey the water from the water supply wells to the Munitions Storage Area A area (see Figure 6.3-1). For this EIS, it is assumed that these pipes would be installed along Corridor 1, as shown in Figure 6.1-3.

6.3.3.3 Impacts of the Proposed Action

Estimated annual water use during construction of ACWA facilities would be 2,800,000 gal (10,600 m^3 or 8.6 acre-ft) (Kimmell et al. 2001). Existing wells have adequate capacity to meet water use requirements, although new water pipelines would need to be laid.

During operation, total annual water use (potable and process water) would be 19,400,000 gal (73,400 m^3 or 59 acre-ft) for Neut/Bio and 24,400,000 gal (92,400 m^3 or 75 acre-ft) for Neut/SCWO. Existing water supply wells have the capacity (more than 290 acre-ft/yr) to meet this additional need, and no new construction would be required. The existing sewage lagoons (see Figure 6.3-2) might need to be expanded to handle sanitary wastes.

PCD's need to purchase the right to extract additional water from more senior water rights holders could conceivably affect water use prices and other water uses in the Arkansas River drainage. However, because of the relatively small volumes of water involved, it is expected that additional water use by the ACWA pilot test facilities would have a negligible impact on these prices and other water uses.

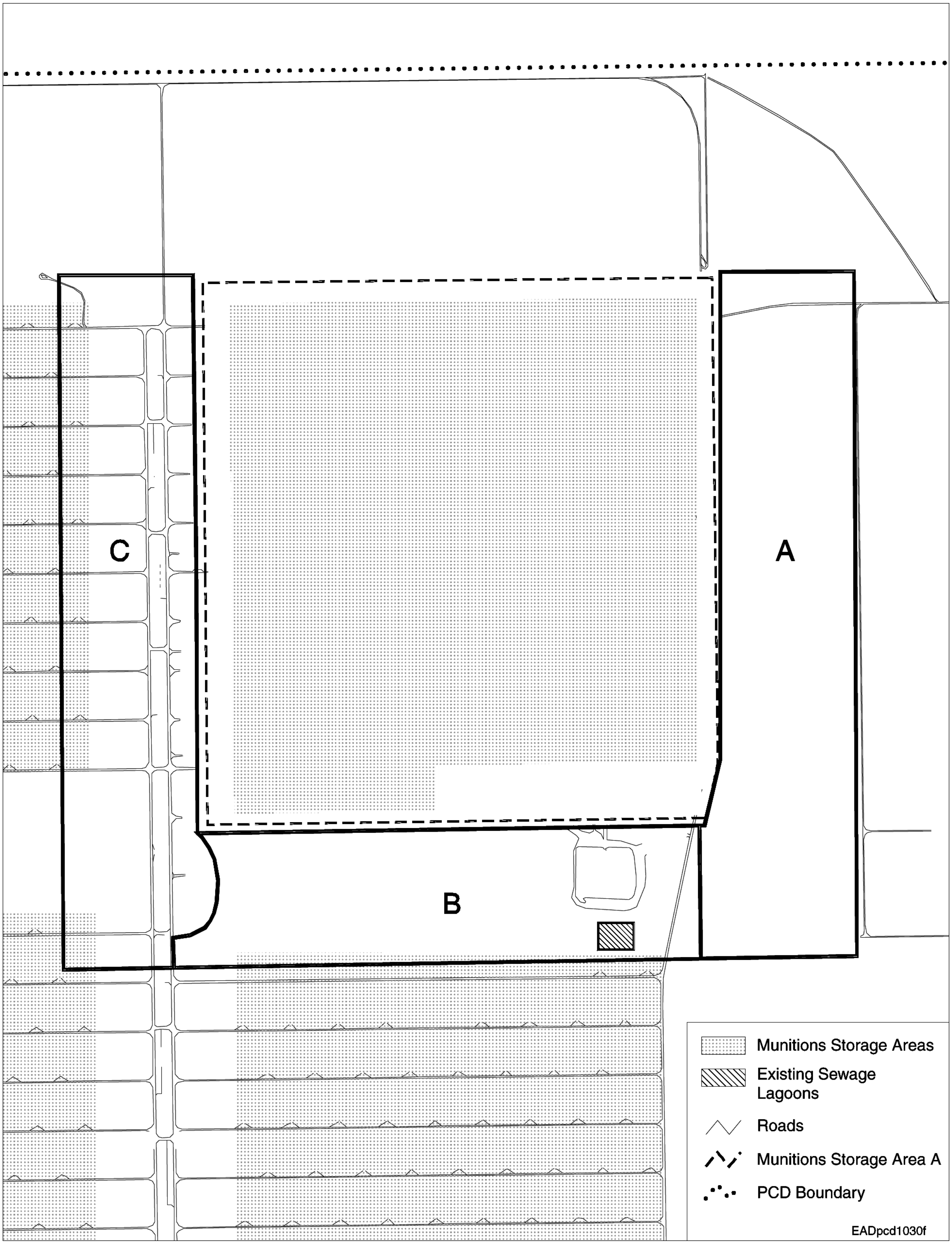

FIGURE 6.3-2 Locations of Sewage Lagoons at Munitions Storage Area A in PCD

6.3.3.4 Impacts of No Action

Under the no action alternative, water use at PCD would remain at current levels; however, water pipes would need replacement because of their age.

6.3.4 Communications

6.3.4.1 Current System

Phone and data lines are present in the main base administrative area. Analog phone lines to the other occupied buildings on post are also present. However, the phone lines to the Munitions Storage Area A area are at capacity. New phone and data lines would need to be run to the site of the proposed ACWA facilities.

6.3.4.2 ACWA Pilot Test Facility Requirements

Operation of the proposed ACWA pilot test facilities would require an upgrade of the current communication system. The upgrade would involve the installation of buried single-mode fiber-optic cable and the installation of new cables (25-pair and 100-pair) at existing interface points.

6.3.4.3 Impacts of the Proposed Action

Impacts of Construction. Construction of new communication lines would not affect existing service. Because the communication lines would follow existing, already disturbed rights-of-way, environmental impacts from ground disturbance would be minimal.

Impacts of Operation. Use of upgraded communication lines would have little if any effect on existing service. Use of these lines would also not affect redevelopment because the lines would serve only the Chem Demil area.

6.3.5.4 Impacts of No Action

Under the no action alternative, the installation of communication lines required by the ACWA Program would likely occur because of the current lines being at capacity.

6.4 WASTE MANAGEMENT

PCD currently generates a variety of solid and liquid hazardous and nonhazardous wastes, as described in Section 6.4.1. It also stores a large quantity of ACWs. While in storage, the ACWs are not considered wastes, but the residuals from processing and destruction become wastes. Wastes associated with operation of an ACWA facility would primarily be those from the residuals of ACW destruction.

6.4.1 Current Waste Management and Generation

6.4.1.1 Hazardous Wastes

PCD currently generates a variety of hazardous wastes associated with two of its missions: (1) storage of chemical munitions and (2) environmental restoration of the installation for future property transfer. Most hazardous wastes generated at PCD are packaged and transported off post to appropriately permitted treatment and disposal facilities. Activities that produce regulated wastes at PCD include:

- Facility maintenance (paints, solvents, water conditioners, etc.);
- Vehicle maintenance (used oil, batteries, coolant, etc.);
- Environmental restoration (contaminated soils, drill cuttings, personal protective equipment [PPE], etc.); and
- Chemical agent decontamination (field test materials, toxic chemical analysis reagents, personal protective equipment, etc.).

Hazardous wastes are stored at a number of locations around PCD (PCD 1999) (Figure 6.4-1). These storage sites include a permitted hazardous waste storage building with

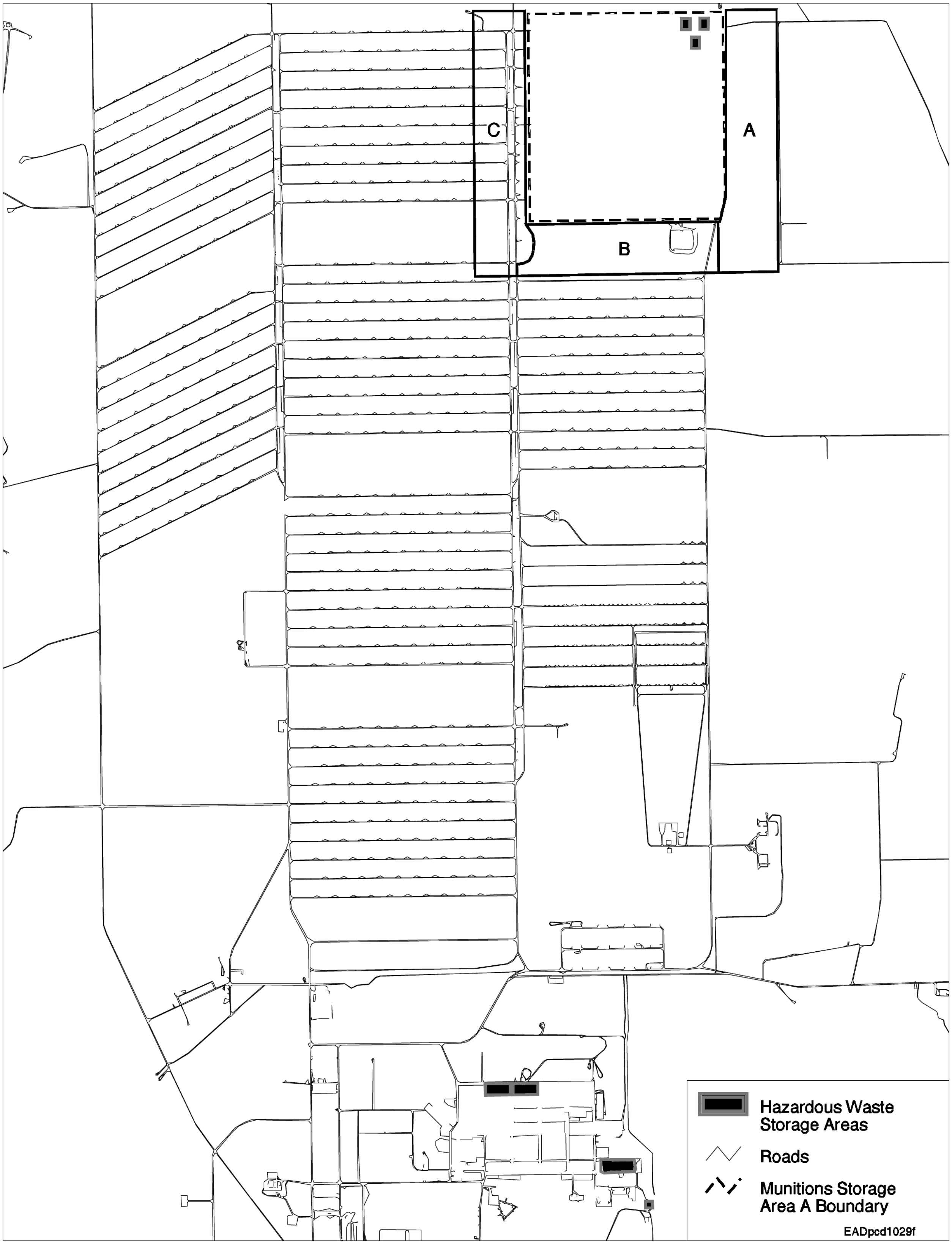

FIGURE 6.4-1 Locations of Hazardous Waste Storage Areas at PCD

secondary containment (Building 540), various temporary storage satellite accumulation points, investigation-derived waste storage areas for remediation wastes, and a temporary (90-day) drum storage area located outside and to the south of Building 529. Igloos G1009, G1109, and G1110 are permitted storage areas for liquid and solid chemical munitions wastes. Igloos G1107, G1109, and G1009 have secondary containment features because of their liquid waste storage capabilities. Building 591 and 592 are permitted for storage of contaminated soil containing explosive residues obtained from environmental restoration activities associated with the former TNT washout facility.

The amounts and types of waste generated at PCD during 1999 (U.S. Army 2000) are summarized in Table 6.4-1. Wastes that might be generated by lessees or tenants are not included in Table 6.4-1. The Master Lease prohibits lessees' generation of wastes without prior approval and stipulates the conditions of approved waste generation (PDADA 1996). (Currently, no lessees have approval to generate waste.) Tenants manage their own wastes, as outlined in various memorandums of understanding between PCD and its tenant organizations. None of the tenants generate significant quantities of hazardous wastes.

PCD has a hazardous waste management plan that outlines treatment of hazardous waste (PCD 1999). The PCD Environmental Management Division is responsible for implementing this plan. This division accepts and stores hazardous waste generated at PCD. U.S. Department of Defense (DOD) policy dictates that the Defense Reutilization and Marketing Office (DRMO) take physical custody of hazardous waste whenever its storage capabilities are greater than or equal to the generator's capabilities. The DRMO is also responsible for the ultimate disposal of hazardous waste stored at PCD and oversight of the transportation of hazardous waste off post to appropriately permitted disposal facilities.

6.4.1.2 Nonhazardous Wastes

PCD generates a variety of nonhazardous solid wastes, such as office trash, debris, used equipment and tools, and uncontaminated PPE. These wastes are collected and disposed off post by a licensed solid waste hauler, currently Waste Management of Pueblo. The site has a recycling plan that outlines procedures for recycling office paper and newspapers (PCD 2000a). Nonhazardous liquid effluent is discussed in Section 6.3.3 on water.

6.4.2 ACWA Pilot Test Facility Waste Generation and Treatment Requirements

The construction and operation of an ACWA pilot test facility would generate an array of solid and liquid wastes, both hazardous and nonhazardous. Estimates of waste generated during construction are based on waste generation from construction of comparable buildings, scaled by building size and number of construction workers (full-time equivalents or FTEs). The types and

TABLE 6.4-1 Hazardous Wastes Generated at PCD in 1999[a]

Type of Waste	Amount Generated	Shipped Off Post?
Hazardous liquids	33,870 lb[b]	Yes
Hazardous solids	12,200 lb[b]	Yes
Hazardous contaminated soils	83,000 lb	Yes
Hazardous contaminated soils[c]	~7,500 tons	No
Contaminated groundwater[d]	205,000,000 gal	No

[a] Unit conversions: 1 lb = 0.45 kg. 1 gal = 3.8 L.

[b] 1999 numbers for hazardous solids and hazardous liquids include one-time disposals of accumulated wastes (10,200 solid wastes) and expired decontamination fluid (2,100 liquid wastes). In 1997, annual accruals of hazardous solids and liquids were 8,300 lb and 21,000 lb, respectively.

[c] Contaminated soil is being composted at Building 591 (at a rate of approximately 7,500 tons/yr). The project that has been generating the contaminated soil (which is approved by the Colorado Department of Public Health and Environment [CDPHE]) is almost complete. Current plans call for the complete treatment of soil stored at Building 591 in 2001.

[d] Contaminated groundwater is generated by the on-post pump and treat system, ICAGRS (Interim Corrective Action Groundwater Remediation System).

Source: U.S. Army (2000).

amounts of waste generation expected from the operation of an ACWA test facility have been estimated by using the techniques of stoichiometric mass balance[1] for each unit process coupled with the analytical results obtained from initial demonstration tests for each technology. This technique relies on a number of assumptions that have not yet been fully verified (Kimmell et al. 2001). How sensitive these estimated results are to the various assumptions used in this procedure has not been determined.

The Neut/Bio facility is anticipated to be larger than the Neut/SCWO facility and thus projected to generate larger quantities of construction wastes (see Table 6.4-2). Current waste management facilities would be adequate to handle construction waste from either facility;

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

however, the wastewater lagoon might need to be expanded to handle an increased amount of sanitary waste.

Wastes resulting from normal operations of an ACWA facility would include components from the treatment of metal parts and dunnage as well as process residues, such as contaminated salts generated from treating chemical agents and energetics (see Section 6.4.3.2). Current operating plans include recycling all process liquids obtained during the operations phase of both technologies back through the reaction vessel. Such recycling would eliminate these liquids from the waste streams. Either of the proposed ACWA technologies would produce significant quantities of potentially hazardous solid wastes. The Neut/SCWO technology would produce approximately 1,900 tons of brine salt waste annually, which would be 5% more than the total amount of brine salt waste generated by the Neut/Bio technology. The Neut/Bio technology would produce 1,000 tons of biomass; the Neut/SCWO technology would not produce this waste stream.

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

6.4.3 Impacts of the Proposed Action

6.4.3.1 Impacts of Construction

Estimates of waste generated during construction are based on waste generation from construction of comparable buildings, scaled by building size and number of construction workers (FTEs). The methodology and assumptions used to make waste generation estimates are described in Kimmell et al. (2001).

Hazardous Wastes. Construction activities would generate small amounts of both solid and liquid hazardous wastes such as solvents, paints, cleaning solutions, waste oils, contaminated rags, and pesticides (Table 6.4-2). The Neut/Bio facility is expected to be larger than the Neut/SCWO facility; thus, it is projected to generate larger quantities of construction wastes.

Current waste management facilities would be adequate to handle construction waste from either facility.

No important impacts would be expected from the generation of hazardous wastes during construction of the ACWA facilities. It is assumed that most wastes generated during construction would be collected and disposed of off post in accordance with U.S. Army, state, and federal regulations. Any wastes defined as hazardous in the RCRA regulations would be stored and disposed of off post as prescribed by the EPA and applicable state and local regulations. Existing on-post and off-post facilities would be adequate to handle the increased wastes generated by construction of the ACWA facilities, and no significant impacts would be expected to the internal, temporary storage facilities or to the off-post treatment facilities.

Nonhazardous Wastes. Construction activities would generate both solid and liquid nonhazardous wastes. Nonhazardous solid wastes would be primarily in the form of building material debris and excavation spoils (Table 6.4-2). The Neut/SCWO facility would be smaller than the Neut/Bio facility and consequently would generate less nonhazardous solid wastes. No significant impacts would be expected from the generation of nonhazardous solid wastes during construction of an ACWA facility. Nonhazardous solid wastes would be collected and disposed of by a licensed waste hauler.

Construction activities would generate liquid nonhazardous wastes as wastewater from washdowns and as sanitary wastes (Table 6.4-2). Construction of the Neut/SCWO facility would

TABLE 6.4-2 Wastes Generated during Construction of an ACWA Pilot Test Facility at PCD

Waste	Neut/Bio	Neut/SWCO
Hazardous wastes		
Solid (yd^3)	80	90
Liquid (gal)	31,000	35,000
Nonhazardous wastes		
Solid		
Concrete (yd^3)	200	200
Steel (tons)	32	36
Other (yd^3)	1,600	1,600
Liquid		
Wastewater (gal)	2,000,000	2,300,000l
Sanitary (gal)	4,500,000	5,100,000

Source: Kimmell et al. (2001).

be expected to generate as much as 5,100,000 gal (19,000 m^3) of sanitary waste (Kimmell et al. 2001). Construction of the Neut/SCWO facility would require a larger work force and therefore would generate slightly more sanitary waste than construction of the Neut/Bio facility (which would generate 4,500,000 gal or 17,000 m^3).

Sanitary sewage generated during construction would be disposed of on post in a lined evaporative lagoon facility. No important impacts would be expected from the generation of wastewater during construction of an ACWA facility. The existing evaporative lagoon might need to be expanded to handle the wastewater generated by the ACWA facility construction.

6.4.3.2 Impacts of Operations

Munitions are not generally considered wastes while they are in storage. Typically, munitions are considered wastes upon their removal from storage for treatment and disposal or if they are no longer usable. However, the Army has declared M55 rockets in storage as hazardous waste because of their obsolescence. Upon the destruction and processing of a munition, the residues do become wastes. Wastes resulting from the normal operations of an ACWA pilot facility would include components from the treatment of metal parts and dunnage as well as process residues (e.g., contaminated salts generated from treating chemical agents and energetics). An ACWA pilot test facility would also generate a number of nonprocess wastes (e.g., office trash, PPE, decontamination solution, spent carbon filters). The ACWA pilot test facility would recycle all process liquids obtained in the operation phase back through the reaction vessel. Such recycling would eliminate these liquids from the waste streams.

Hazardous Wastes. Wastes that would be generated from the operation of an ACWA pilot test facility are summarized in Table 6.4-3. The numbers in Table 6.4-3 account only for waste streams that would be produced by the two technologies and do not account for wastes that would be generated by storage, which would include primarily contaminated solids, such as PPE and pallets, and also a small quantity of contaminated liquids in the form of decontamination water. PCD would continue to generate wastes associated with storage at decreasing rates during ACWA facility operation until the stockpile was destroyed. Generally, these quantities of wastes would be small (see Section 6.4.4).

The brine salts produced by either of the proposed ACWA pilot test facilities could contain significant amounts of toxic heavy metals (e.g., lead). Such solid waste would probably fail the RCRA TCLP tests. If so, the hazardous salt waste would need to be stabilized by a procedure that would reduce leaching of the heavy metal to a level that would allow it to be approved for land disposal as a hazardous solid waste. Salt wastes have proven somewhat difficult to stabilize, so additional studies might be required to identify an effective stabilization technology. If stabilization of the solid salt waste would be required, either a waste management facility for stabilizing the waste would need to be constructed at PCD, or, alternatively, the waste

TABLE 6.4-3 Hazardous Wastes Generated Annually from the Operation of an ACWA Pilot Test Facility at PCD

	Amount of Waste Generated (tons/yr unless noted) per Technology	
Hazardous Waste	Neut/Bio[a]	Neut/SWCO[a]
Brine salts	1,800	1,900
Sodium sulfate	550	900
Sodium chloride	700	700
Sodium phosphate	-[b]	50
Sodium bisulfate	140	-
Ammonium phosphate	40	-
Water in salt cake	280	250
Other salts	50	-
Lead oxide	280 lb/yr	-
Biomass	1,000	-
Biomass solids	650	-
Water in biomass	350	-

[a] There are 276 d/yr of operation for both technologies.

[b] A hyphen means that the waste stream is not generated by the specific technology.

Sources: Mitretek (2001a,b); Kimmell et al. (2001).

would need to be shipped off post to an appropriately permitted waste facility (*Code of Colorado Regulations*, Title 6, Section 1007-3 [6 CCR 1007-3] Parts 262, 264, and 268). Commercial facilities exist for managing this type of waste.

If a generator produces waste streams that are listed as hazardous under federal or state law, that generator may choose to conduct a demonstration to show that the waste is nonhazardous (referred to as an exclusion; see 40 CFR 260.22). If the exclusion is granted, the waste is delisted and can then be disposed of as a nonhazardous solid waste, resulting in an important cost savings. Delisting a waste depends on the types and amounts of minor constituents in the waste and their variation with fluctuations in the operating parameters. The destructive efficiency of the ACWA process and the amounts of hazardous intermediates produced could vary significantly with operating conditions. In the case of PCD, it is known that the residuals from treating chemical agent would be defined and listed as hazardous waste by the Colorado hazardous waste regulations. However, information on the waste streams that could result from the ACWA technologies is not sufficient to determine if a delisting could be obtained.

The potential impacts of the ACWA technologies on waste management facilities would depend on the outcomes of the RCRA TCLP tests or potential delisting of the wastes. Treating all salt and/or biomass wastes as hazardous wastes would impact waste management procedures and facilities.

Neutralization/Biotreatment. A number of process-related waste streams would be generated from the Neut/Bio technology (Table 6.4-3). Salts and biomass would be extracted from the bioreactor effluents, treated further, and dried to be disposed of as solid hazardous waste. The liquids obtained from the further treatment of the bioreactor effluents would be recycled back through the bioreactor, thus eliminating the release of any process liquid wastes.

Various types of nonprocess wastes would be generated from the operation of this technology, including dunnage, PPE, spent carbon filters, pallets, and decontamination solution. These wastes could potentially be contaminated by an agent; such contamination would require treatment. The liquid wastes would be recycled back through the system. Nonprocess solid wastes would be treated by metal parts treatment, which would result in approximately 200 tons of residual brine waste; these wastes are included in the overall brine waste numbers shown in Table 6.4-3.

If the brine salt and biomass wastes would fail the RCRA TCLP tests, some type of stabilization of these wastes would be necessary. Depending on the technology chosen and the amount of loading of the wastes in the stabilization matrix, the amount of stabilized waste could easily exceed the hazardous waste estimates given in Table 6.4-3 by a factor of approximately 2.5. If stabilization of the solid salt waste would be required, either a waste management process for stabilizing the waste would be needed, or, alternatively, the waste would need to be shipped off post to an appropriately permitted treatment facility. Depending on the treatment chosen, a new facility might need to be constructed or an existing off-post commercial facility might need to handle the solid salt waste.

Neutralization/SCWO. Sources of operational wastes from the SCWO units would include various process wastes (see Table 6.4-3). These process effluents from the SCWO units would be combined, and brine salts (mostly sodium sulfate, sodium chloride, and sodium phosphate) would be extracted and dried for disposal as solid hazardous waste. No liquid wastes would be released from the process, since process liquids would be recycled back into the SCWO units.

The Neut/SCWO technology would also generate nonprocess operational wastes, including primarily dunnage, PPE, spent carbon filters, pallets, and decontamination solution. These wastes could potentially be contaminated by an agent; such contamination would require treatment. Current operating plans include recycling all nonprocess liquids obtained in the operation phase back through the reaction vessel. Such recycling would eliminate these liquids from the waste streams. Recycling of contaminated nonprocess solid wastes, which would also be recycled back into the system, would result in approximately 250 tons of brine waste; these wastes are included in the overall brine waste numbers shown in Table 6.4-3.

If the brine salts generated by the Neut/SCWO process would fail the RCRA TCLP tests, some type of stabilization of the salt would be necessary. Depending on the technology chosen and the amount of loading of the salt wastes, the amount of stabilized salt waste could easily exceed the salt waste estimate given in Table 6.4-3 by a factor of approximately 2.5. If stabilization of the solid salt waste would be required, either a waste management process for stabilizing the waste would be needed, or, alternatively, the waste would need to be shipped off post to an appropriately permitted treatment facility. Depending on the treatment chosen, a new facility might need to be constructed or an existing off-post commercial facility might need to handle the solid salt waste.

Nonhazardous Wastes. The operation of an ACWA pilot test facility would generate both solid and liquid nonhazardous wastes. Estimates of nonhazardous solid wastes associated with facility operations were made by scaling data on comparable buildings for the size of the operating work force (Kimmell et al. 2001) (Table 6.4-4). These numbers would be expected to be the nearly same for the two technologies, since the facilities would have similar work force numbers. No significant impacts would be expected from the generation of nonhazardous solid wastes during operation of an ACWA facility. Nonhazardous solid wastes would be collected and disposed of by a licensed waste hauler. In each technology, recyclable metals would be generated from decontamination of various munition parts. These are listed in Table 6.4-4.

TABLE 6.4-4 Nonhazardous Solid Wastes Generated Annually from the Operation of an ACWA Pilot Test Facility at PCD

	Amount of Waste Generated per Technology	
Nonhazardous Solid Waste	Neut/Bio	Neut/SWCO
Recyclable wastes (yd^3)[a]	640	640
Metal waste (tons)	7,200	7,200
Other solid wastes (yd^3)[b]	1,600	1,600

[a] Recyclable wastes include paper and aluminum.

[b] Domestic trash and office waste.

Sources: Mitretek (2001a,b); Kimmell et al. (2001).

Nonprocess waste would also generate small quantities of metal waste, which are included in Table 6.4-4.

Liquid nonhazardous wastes (i.e., wastewater) would be similar for both of the ACWA technologies being considered. During normal operations, both the Neut/Bio facility and the Neut/SCWO facility would generate an estimated 7,500,000 gal/yr (28,000 m^3/yr) of sanitary sewage (Kimmell et al. 2001).

No impacts would be expected from the generation of wastewater during operation of an ACWA facility. Nonhazardous liquid wastes generated during operation would be disposed of on post in a lined evaporative lagoon facility. The existing evaporative lagoon might need to be expanded to handle the wastewater generated by the ACWA facilities, but there is land available for this purpose.

6.4.4 Impacts of No Action

6.4.4.1 Hazardous Wastes

Construction activities related to ACWA pilot facility testing would not occur under the continued storage alternative. Continued storage of munitions at PCD would generate relatively small quantities of hazardous wastes and contaminated solids associated with the cleanup of leaks and spills, such as PPE, pallets, and dunnage.[2] Storage generates an estimated 500 lb (230 kg) of liquid wastes (decontamination water) and less than 100 lb (45 kg) of hazardous solid waste from PPE and pallets (Smith 2000a). The continued degradation of agent containers over time would probably slowly generate increasing amounts of waste from leaks, but, again, these quantities would be relatively small.

Continued storage of chemical weapons at PCD would not adversely affect waste management. Hazardous wastes are collected and disposed of off post in accordance with U.S. Army, state, and federal regulations. Any wastes determined to be hazardous in the RCRA regulations are stored and disposed of off post as prescribed by the EPA and applicable state and local regulations.

6.4.4.2 Nonhazardous Wastes

Construction activities associated with pilot testing would not occur under the continued storage alternative. A small amount of nonhazardous solid waste and nonhazardous sanitary

---

[2] In 1999, PCD generated approximately 10,000 lb (4,536 kg) of solid wastes and 5,200 lb (2,359 kg) of uncontaminated decontamination liquid associated with munitions storage. These numbers are higher than average on the basis of one-time disposals of excess and stockpiled materials.

waste would be generated during activities associated with the storage of chemical weapons. These wastes would be handled by the existing systems. Continued storage of chemical weapons at PCD would not adversely affect waste management. Facilities exist to handle sanitary waste, and solid wastes would be hauled off post by a licensed contractor.

6.5 AIR QUALITY — CRITERIA POLLUTANTS

This section describes existing the meteorology and air quality at PCD and the air emissions and consequences on air quality that might result from constructing and operating a pilot test facility for ACW destruction at PCD. Potential air emissions and consequences on air quality under the no action alternative are also described. Potential impacts on human health as a result of air emissions during construction and normal operations are described in Sections 6.6 and 6.7. Potential impacts on air quality and human health as a result of air emissions from accidents involving explosives and chemical agents are described in Section 6.21.

The analysis of impacts on air quality from both construction and operation was conducted for Area A (see Figure 6.1-2), which is the area closest to the PCD installation boundary in the direction of the nearest off-post residence. The three potential locations for pilot test facilities are adjacent to one another and would require similar infrastructure. Therefore, the analysis of one location provided an adequate representation of the potential impacts from construction on air quality near PCD for any of the three facility locations.

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

The analyses presented in the following sections conclude that the concentrations of particulates in the air that would result from fugitive dust emissions during construction would be below applicable standards. Concentration increments of air pollutants due to emissions from operations would also be within applicable standards, although because of the Neut/Bio system's lower process heat requirements, the emission levels from fossil fuel combustion would be less for the Neut/Bio technology than for the Neut/SCWO technology. However, operation of either technology, by itself or added to background, would be within applicable standards.

6.5.1 Current Meteorology, Emissions, and Air Quality

6.5.1.1 Meteorology

The climate of the area surrounding PCD is semiarid and marked by large daily temperature variations. The following description of climate is based on data recorded at Pueblo Municipal Airport located about 10 mi (16 km) west-southwest of PCD (National Oceanic and Atmospheric Administration [NOAA] 1999), except for wind data that were measured at the height of 33 ft (10 m) at the on-post meteorological tower.

The wind rose, which is based on the Chem Demil tower[3] data recorded on post at PCD for the two-year period 1998 through 1999, is shown in Figure 6.5-1 (Rhodes 2000). For the 1998–1999 period, average annual wind speed was about 8.5 mi/h (mph) (3.8 m/s), and the seasonal average wind speed of 9.8 mph (4.4 m/s) was highest in spring. The wind rose indicates that the prevailing wind at PCD is from the north-northwest, with a secondary peak from the southeast. Irrespective of the season, prevailing wind is from the southeast during the day and from the north-northwest during the night. In general, wind speeds at night tend to be lower than those during the day. During the 1998–1999 period, the highest wind speed measured at PCD was about 44 mph (20 m/s).

The average annual temperature at Pueblo Municipal Airport is 52°F (11°C). January is the coldest month, averaging 29°F (–2°C), and July is the warmest month, averaging 77°F (25°C). Extreme temperatures ranged from –31°F (–35°C) in February 1951 to 108°F (42°C) in June 1990. The number of freeze-free days per year (i.e., days when the daily-minimum temperature is greater than 32°F [0°C]) is about 209, and there are no freeze days in June through August. Temperatures of 90°F (32°C) or higher occur on an average of 65 days per year, with 55 of those days occurring during June, July, and August. Winter cold spells are sometimes broken after a few days by warm, dry winds from the west.

Average annual precipitation at Pueblo Municipal Airport is about 11 in. (28 cm). About 75% of the annual precipitation falls during April through September. July and August have the most precipitation, averaging about 2.1 in. (5.3 cm) and 2.0 in. (5.1 cm), respectively. The greatest amount of precipitation in a single month was 6.2 in. (15.7 cm) in April 1942, and the greatest amount in a 24-hour period was 3.8 in. (9.6 cm) in October 1957. Winter snowfall averages about 31.8 in. (80.8 cm). The greatest amount of snow reported in a single month was 29.3 in. (74.4 cm), which occurred in November 1946, and the greatest amount during a 24-hour period was 16.8 in. (42.7 cm) in April 1990.

---

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

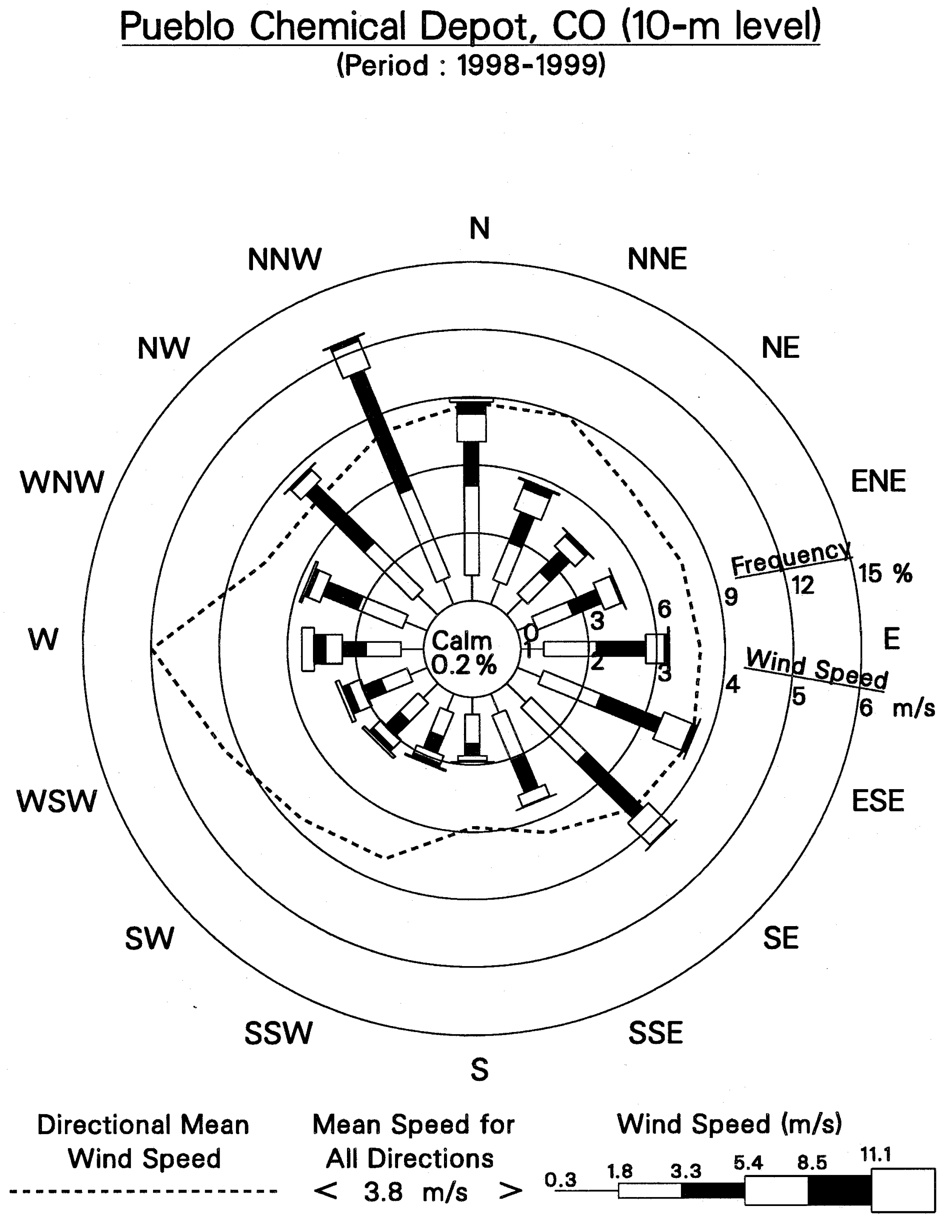

FIGURE 6.5-1 Annual Wind Rose for PCD in 1998–1999 (Source: Rhodes 2000)

Average annual relative humidity at the Pueblo Municipal Airport ranges from 36 to 41% for the daytime hours and from 58 to 68% for nighttime hours. Low humidity in the region limits the occurrence of heavy fog (when visibility is 0.25 mi [0.4 km] or less) to about 10 days per year. Fog in summer is very rare. Thunderstorms occur on an average of 41 days per year. More than 85% of the thunderstorms occur during the four-month period of May through August. Dust storms are frequent during the spring months of abnormally dry years, especially in areas where dry farming (farming without irrigation) is practiced.

Tornadoes are rare in the area surrounding PCD. For the 46-year period of 1950 through 1995, 1,161 tornadoes were reported in Colorado (tornado event frequency of $2.4 \times 10^{-4}/mi^2$ per year and an average of 25 tornadoes per year) (Storm Prediction Center 2000). For the same period, only 9 tornadoes were reported in Pueblo County (tornado event frequency of $8.2 \times 10^{-5}/mi^2$ per year). The mountain ranges west of the county provide a barrier to much of the westward flow of moist air that produces the thunderstorms that often lead to tornadoes.

6.5.1.2 Emissions

On the basis of its current emissions, PCD is classified as a "synthetic minor source" and operates under a synthetic minor permit from CDPHE (Pueblo Depot Activity 1995). This type of source is defined as an emission source with potential emissions of less than 250 tons/yr for all criteria pollutants or less than 100 tons/yr for each individual criteria pollutant. The synthetic minor permit is being updated to reflect fewer emission sources. Permitted emission sources at PCD include building heaters, emergency generators, and five boilers operating in the Chem Demil area (Whorton 2000a). There are also a number of small emission sources classified as insignificant activities within the PCD air permit. Other emissions include vehicle exhaust emissions and fugitive particulate emissions including road dusts. Emission estimates for these sources are presented in Table 6.5-1.

In 1994, the annual total emissions from all categories of PCD sources, including those with permits from the CDPHE, were about 1.91 tons of sulfur dioxide (SO_2), 1.98 tons of nitrogen oxides (NO_x), 5.04 tons of carbon monoxide (CO), 15.9 tons of volatile organic compounds (VOCs), 13.1 tons of coarse particulate matter (PM_{10}),[4] and less than 0.01 ton of lead (Pb). Annual estimates of air pollutants emissions in 1996 from Pueblo County and PCD are listed in Table 6.5-2. The significance of PCD emissions is expressed as a percentage of the total Pueblo County emissions. As the table indicates, PCD emissions account for very small fractions of the emissions released from the Pueblo County, that is, about 0.19%, 0.15%, 0.12%, 0.01%, and 0.01% of the total Pueblo County emissions for VOCs, PM_{10}, NO_x, SO_2, and CO, respectively.

6.5.1.3 Air Quality

PCD is located in Colorado State Air Quality Control Region (AQCR) 7, which covers the south central part of Colorado (Figure 6.5-2). The Colorado State Ambient Air Quality Standards (SAAQSs) reflect the pre-1997 federal standards for concentrations of six criteria pollutants — sulfur oxides (as SO_2), PM_{10}, CO, ozone (O_3), nitrogen dioxide (NO_2), and Pb.

---

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

TABLE 6.5-1 Estimated Emissions of Air Pollutants from Existing PCD Sources in 1994

	Emissions (tons/yr)					
Source Category	SO_2	NO_x	CO	VOC	PM_{10}	Pb
Stationary sources						
Boilers/heaters	0.6	1.1	0.5	0.1	0.2	< 0.01
Generators	0.05	0.78	0.18	0.06	0.06	-[a]
Fuel storage and dispensing	-	-	-	2.44	-	-
Degreasing and abrasive blasting	-	-	-	0.17	-	-
Woodworking	-	-	-	-	1.3	-
Miscellaneous[b]	-	-	-	0.12	< 0.01	-
Subtotal	0.65	1.88	0.68	2.89	1.56	< 0.01
Fugitive sources						
Open detonation	1.26	0.04	2.21	-	1.5	-
Firefighting	-	0.06	1.94	0.26	0.23	-
Landfills	-	-	0.21	12.7	-	-
Road dust	-	-	-	-	9.47	-
Miscellaneous[c]	-	-	< 0.01	0.02	0.34	-
Subtotal	1.26	0.1	4.36	12.98	11.54	-
Total	1.91	1.98	5.04	15.87	13.1	< 0.01

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

[b] Includes emissions from the medical clinic, welding, vapor containment chamber, and other sources.

[c] Includes emissions from storage piles, the firing range, applications of pesticides and herbicides, and other sources.

Source: PDA (1995).

The Colorado SAAQS are identical to the National Ambient Air Quality Standards (NAAQS), except Colorado has stricter standards for 3-hour SO_2 and Pb (CDPHE 1999, 2001). In 1997, the EPA revised the NAAQS for O_3 and PM. The standards were challenged, and the lower court decision was appealed to the U.S. Supreme Court. On February 27, 2001, the U.S. Supreme Court unanimously upheld the constitutionality of the CAA as the EPA had interpreted it in setting the $PM_{2.5}$ and O_3 standards. However, the case was remanded back to the D.C. Circuit Court of Appeals to resolve the remaining issues, which include EPA's justification for the numerical levels. While the case is pending, the O_3 and fine particle standards remain in effect as a legal matter, because the D.C. Circuit Court decision did not vacate the standards. The EPA has not, however, started implementing the revised $PM_{2.5}$ and O_3 standards.

TABLE 6.5-2 Estimated Emissions of Air Pollutants from Pueblo County and PCD Sources in 1996

	Emissions (tons/yr)	
Air Pollutant	Pueblo County	PCD[a]
SO_2	13,898	1.9 (0.01)
NO_x	14,440	16.9 (0.12)
CO	52,302	4.1 (0.01)
VOCs	8,484	16.3 (0.19)
PM_{10}	10,674	16.5 (0.15)

[a] Actual emissions.

Source: EPA (2001a).

Colorado is currently designated as being in attainment for all criteria pollutants, except for CO in Colorado Springs, Denver, Fort Collins, and Longmont and except for PM_{10} in Aspen, Canon City, Denver, Lamar, Pagosa Springs, Steamboat Springs, and Telluride (40 CFR 81.306). The ambient air quality in the state is good and continues to improve. According to CDPHE (1999), there were no violations of the NAAQSs in Colorado for the last four years.

In Pueblo County, a major modification at a steel mill (shutdown of four blast furnaces and two basic oxygen furnaces) has resulted in significant improvement in air quality since the early 1980s. In fact, the measurement of CO was discontinued in Pueblo County in 1986 because the data that had been gathered were close to background levels or low with respect to applicable ambient standards. Only PM_{10} was monitored in the 1990s, and recently $PM_{2.5}$ measurements were initiated (Rink 2000). Particulates are primarily emitted from vehicular traffic on unpaved roads, agricultural activities, and mining. Pueblo has no record of exceeding the PM_{10} or $PM_{2.5}$ standards.

Table 6.5-3 presents the NAAQS, Colorado SAAQS, allowable PSD increments, and highest ambient concentrations measured at the monitoring stations nearest to PCD. Prevention of significant deterioration (PSD) regulations (40 CFR 52.21) limit the maximum allowable incremental increases in ambient concentrations above established baseline levels for SO_2, NO_2, and PM_{10}. The PSD regulations, which are designed to protect ambient air quality in attainment

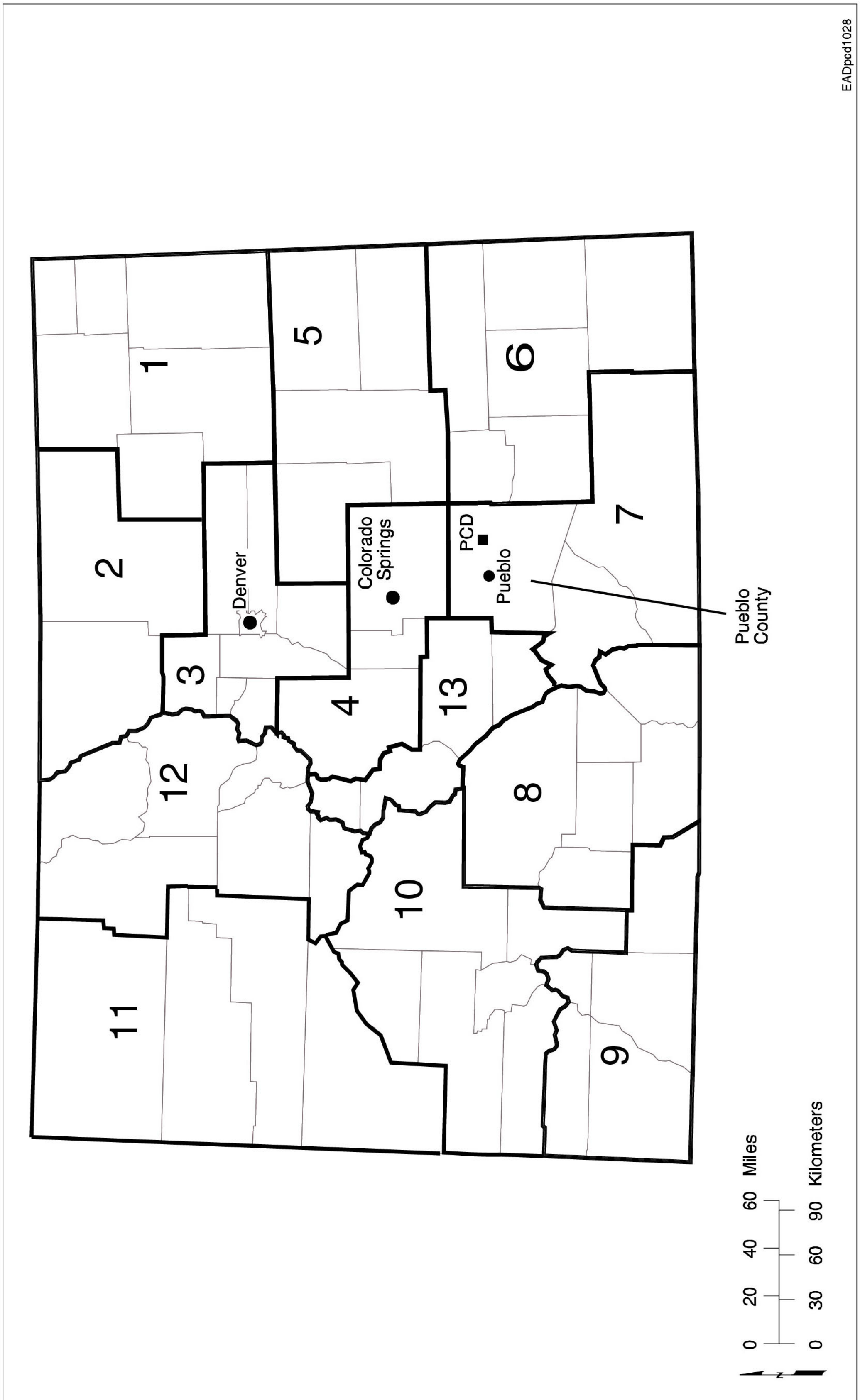

FIGURE 6.5-2 PCD and Air Quality Control Regions in Colorado

TABLE 6.5-3 National Ambient Air Quality Standards (NAAQSs), Colorado State Ambient Air Quality Standards (SAAQSs), Maximum Allowable Increments for Prevention of Significant Deterioration (PSD), and Highest Background Levels in the Urban Area near PCD[a]

		NAAQS (µg/m^3)[b]			PSD Increment (µg/m^3)		Highest Background Level		
Pollutant	Averaging Time	Primary	Secondary	SAAQS[c] (µg/m^3)	Class I	Class II	Concentration (µg/m^3)	Location	Year
SO_2	3 hours	-	1,300	700[d]	25	300[d]	190	Colorado Springs	1998
	24 hours	365	-	365	5	50[d]	65	Colorado Springs	1996
	Annual	80	-	80	2	10[d]	11	Colorado Springs	1999
NO_2	Annual	100	100	100	2.5	25	45	Colorado Springs	1996
CO	1 hour	40,000	-	40,000	-	-	14,971	Colorado Springs	1997
	8 hours	10,000	-	10,000	-	-	8,444	Colorado Springs	1996
O_3	1 hour	235	235	235	-	-	174	Colorado Springs	1999
	8 hours	157	157	157	-	-	137	Colorado Springs	2000
PM_{10}	24 hours	150	150	150	8	30	100	Pueblo	1995
	Annual	50	50	50	4	17	26.8	Pueblo	1997
$PM_{2.5}$	24 hours	65	65	65	-	-	15.7	Pueblo	2000
	Annual	15	15	15	-	-	7.8	Pueblo	2000
Pb	Calendar quarter	1.5	1.5	1.5[d,e]	-	-	0.01	Colorado Springs	1999

[a] A hyphen indicates that no standards exist.

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

[c] The procedures for determining attainment of state standards are the same as those for determining attainment of NAAQS.

[d] Colorado has stricter standards than the federal standards for SO_2 and lead, and it has no adopted the revised $PM_{2.5}$ and O_3 standards.

[e] Averaging time is a one-month period.

Sources: 40 CFR 50; CDPHE (1999, 2001); 40 CFR 52.21; EPA (2001b).

areas, apply to major new sources and major modifications to existing sources. The State of Colorado contains 12 Class I[5] PSD areas consisting of national parks and national wilderness areas. The PSD Class I area that is nearest to PCD is the Great Sand Dunes National Monument, located 75 mi (121 km) west-southwest of PCD. The monument is not located downwind of prevailing winds at PCD, and the Sangre de Cristo Mountains just east of this Class I area provide a partial barrier to the transport of pollutants from the area surrounding PCD under most meteorological conditions.

6.5.2 ACWA Facility Emissions

6.5.2.1 Emissions from Construction

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

6.5.2.2 Emissions from Operations

PCD is currently operating under a synthetic minor permit from CDPHE (PDA 1995). A synthetic minor source is one whose potential emissions are less than 250 tons/yr for all criteria pollutants or less than 100 tons/yr of each individual criteria air pollutant (See Section 6.5.1.2).

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

---

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

Neutralization/SCWO. In a Neut/SCWO pilot test facility, air pollutants would be emitted from four types of stacks: (1) three stacks for natural-gas-burning boilers (two operating, one on standby), (2) two stacks for diesel-powered generators used as a backup system, (3) a filter farm stack for building exhaust air, and (4) a stack for exhaust from the SCWO process. The boilers would be used to generate process steam and building heat, and the diesel generators would be used to provide emergency electricity. The filter farm stack would release emissions from filtered building circulating air, while the SCWO stack would release emissions from SCWO processing equipment. The principal sources of criteria pollutant and VOC emissions would be boilers and emergency generators. The primary sources of hazardous air pollutant (HAP) emissions would be the filter farm stack and the SCWO stack (HAPs are discussed in Sections 6.6 and 6.7).

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

Emission factors and other assumptions used in estimating emission rates of criteria pollutants and VOCs during the operational period are described in Appendix B. Maximum short-term and annual total emission rates, along with stack parameters used in the dispersion modeling (i.e., heights, inside diameter, gas exit temperature, and gas exit velocity), are listed in Table 6.5-4 for the Neut/Bio system and in Table 6.5-5 for the Neut/SCWO system.

6.5.3 Impacts of the Proposed Action

Potential impacts from air pollutant emissions during pilot facility construction and operation were evaluated by estimating the maximum ground-level concentration increments of criteria air pollutants that would result from construction and operational activities, adding these estimates to background concentrations, and comparing the results with applicable ambient air quality standards. As indicated in Table 6.5-3, the Colorado SAAQS for criteria air pollutants are identical to the NAAQS, except the state standards for 3-hour SO_2 and Pb are stricter (CDPHE 1999, 2001).

To evaluate air quality impacts from PCD operations with respect to PSD requirements, estimated maximum increments in ground-level concentrations that would result from the operation of the proposed facility were compared with allowable PSD increments above the baseline, which are also summarized in Table 6.5-3.

TABLE 6.5-4 Emission Rates of Criteria Pollutants and Volatile Organic Compounds and Stack Parameters Associated with Normal Operations of the Neutralization/Biotreatment Technology at PCD

Stack Parameters and Estimated Peak Emission Rates	Steam Boilers	Emergency Diesel Generators
Stack parameters[a]		
Height	70 ft (21.3 m)	47 ft (14.3 m)
Inside diameter	1.1 ft (0.33 m)	0.67 ft (0.20 m)
Gas exit temperature	325°F (436 K)	925°F (769 K)
Gas exit velocity	60 ft/s (18.3 m/s)	323 ft/s (98.5 m/s)
Estimated peak emission rates[b]		
SO_2	0.02 lb/h (0.03 ton/yr)	3.2 lb/h (0.95 ton/yr)
NO_x	4.0 lb/h (6.6 tons/yr)	48.4 lb/h (14.5 ton/yr)
CO	2.4 lb/h (4.0 tons/yr)	10.4 lb/h (3.1 ton/yr)
PM_{10}	0.22 lb/h (0.36 ton/yr)	3.4 lb/h (1.0 ton/yr)
$PM_{2.5}$[c]	0.22 lb/h (0.36 ton/yr)	3.4 lb/h (1.0 ton/yr)
VOCs	0.16 lb/h (0.26 ton/yr)	4.0 lb/h (1.2 ton/yr)

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

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

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

Source: Kimmell et al. (2001).

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

6.5.3.1 Impacts of Construction

The modeling results for both PM_{10} and $PM_{2.5}$ concentration increments that would result from construction-related fugitive emissions are summarized in Table 6.5-6. At the installation boundaries, the maximum 24-hour and annual average concentration increments above background for both PM_{10} and $PM_{2.5}$ would occur about 0.9 mi (1.5 km) north of the

TABLE 6.5-5 Emission Rates of Criteria Pollutants and Volatile Organic Compounds and Stack Parameters Associated with Normal Operations of the Neutralization/SCWO Technology at PCD

Stack Parameters and Estimated Peak Emission Rates	Steam Boilers	Emergency Diesel Generators
Stack parameters[a]		
Height	70 ft (21.3 m)	47 ft (14.3 m)
Inside diameter	1.4 ft (0.42 m)	0.67 ft (0.20 m)
Gas exit temperature	325°F (436 K)	925°F (769 K)
Gas exit velocity	60 ft/s (18.3 m/s)	323 ft/s (98.5 m/s)
Estimated peak emission rates[b]		
SO_2	0.03 lb/h (0.04 ton/yr)	3.2 lb/h (0.95 ton/yr)
NO_x	6.3 lb/h (10.4 tons/yr)	48.4 lb/h (14.5 tons/yr)
CO	3.8 lb/h (6.3 tons/yr)	10.4 lb/h (3.1 tons/yr)
PM_{10}	0.34 lb/h (0.57 ton/yr)	3.4 lb/h (1.0 ton/yr)
$PM_{2.5}$[c]	0.34 lb/h (0.57 ton/yr)	3.4 lb/h (1.0 ton/yr)
VOCs	0.25 lb/h (0.41 ton/yr)	4.0 lb/h (1.2 tons/yr)

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

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

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

Source: Kimmell et al. (2001).

proposed facility and 1.2 mi (2 km) northwest of the proposed facility, respectively. At these locations, for PM_{10}, the maximum 24-hour and annual average concentration increments above background would be about 14% and 1.4% of the NAAQS, respectively. For $PM_{2.5}$, the maximum 24-hour and annual average $PM_{2.5}$ concentration increments above background would be about 17% and 2.0% of the NAAQS, respectively.

To obtain the overall concentrations for comparison with applicable NAAQS, the maximum 24-hour PM_{10} and $PM_{2.5}$ concentration increments (Table 6.5-6) were added to background values. For PM_{10}, the estimated maximum 24-hour and annual average concentrations would be about 41% and 35% of the NAAQS, respectively. For $PM_{2.5}$, the estimated maximum 24-hour and annual average concentrations would be about 55% and 49% of the NAAQS, respectively.

TABLE 6.5-6 Maximum Predicted Off-Post Concentration Increments and Total Concentrations of PM_{10} and $PM_{2.5}$ during Construction at PCD

		Concentration (μg/m³)				
Pollutant	Averaging Time	Maximum Increment[a,b]	Background[c]	Total[d]	NAAQS	Percent of NAAQS[e]
PM_{10}	24 hours	21	40	61	150	41 (14)
	Annual	0.7	17	17.7	50	35 (1.4)
$PM_{2.5}$	24 hours	11	25	36	65	55 (17)
	Annual	0.3	7	7.3	15	49 (2.0)

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

[b] The maximum modeled 24-hour and annual average concentrations occur at receptors about 0.9 mi (1.5 km) and 1.2 mi (2.0 km) to the north and northwest of the proposed facility, respectively.

[c] Background concentrations recommended by the State of Colorado near PCD (Chick 2001).

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

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

In summary, the estimated maximum 24-hour and annual average concentration increments of PM_{10} and $PM_{2.5}$ that would result from construction-related fugitive emissions would be relatively small fractions of the applicable NAAQS. The total (maximum increments plus background) estimated maximum 24-hour and annual average concentrations of PM_{10} would be equal to or less than 41% of the applicable NAAQS. The total estimated maximum 24-hour and annual average concentrations of $PM_{2.5}$ would be less than 55% the applicable NAAQS.

6.5.3.2 Impacts of Operations

In the air quality analysis for the operational period, air quality impacts were modeled for each of the two technologies. The results are presented in tabular format for both cases. The modeling results for concentration increments of SO_2, NO_2, CO, PM_{10}, and $PM_{2.5}$ due to emissions from the proposed facility operations are summarized in Table 6.5-7 for the Neut/Bio system and in Table 6.5-8 for the Neut/SCWO system. The receptor locations where maximum concentration increments would occur are also listed in these tables.

TABLE 6.5-7 Maximum Predicted Off-Post Concentration Increments and Total Concentrations of Criteria Pollutants during Normal Operations of the Neutralization/ Biotreatment Technology at PCD

		Concentration (μg/m³)					Receptor Location[e]	
Pollutant	Averaging Time	Maximum Increment[a]	Background[b]	Total[c]	NAAQS/ SAAQS	Percent of NAAQS/ SAAQS[d]	Distance [mi (km)]	Direction
SO_2	3 hours	5.8	101	107	700	15 (0.8)	1.0 (1.6)	NNW
	24 hours	1.5	39	41	365	11 (0.4)	1.5 (2.4)	NW
	Annual	0.009	8	8	80	10 (<0.1)	1.5 (2.4)	NW
NO_2	Annual	0.17	19	19	100	19 (0.2)	1.5 (2.4)	NW
CO	1 hour	59	3,429	3,488	40,000	9 (0.1)	1.8 (3.0)	NW
	8 hours	13	2,222	2,235	10,000	22 (0.1)	1.5 (2.4)	NW
PM_{10}	24 hours	1.7	40	42	150	28 (1.1)	1.5 (2.4)	NW
	Annual	0.011	17	17	50	34 (<0.1)	1.5 (2.4)	NW
$PM_{2.5}$	24 hours	1.7	25	27	65	41 (2.6)	1.5 (2.4)	NW
	Annual	0.011	7	7	15	47 (<0.1)	1.5 (2.4)	NW

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

[b] Background concentrations recommended by the State of Colorado near the PCD (Chick 2001).

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

[d] The values are total concentration as percent of NAAQS/SAAQS. The values in parentheses are maximum concentration increments attributable to the ACWA facilities as percent of NAAQS/SAAQS.

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

The estimated maximum concentration increments due to operation of the proposed facility would contribute approximately 3% of applicable NAAQS and SAAQS for all pollutants (Tables 6.5-7 and 6.5-8). It is also expected that potential impacts from proposed facility operations on the air quality of nearby communities would be negligible. Short-term concentration increments for both the Neut/Bio and Neut/SCWO systems would be almost the same. Irrespective of the ACW destruction technology used, maximum concentration increments would primarily occur along the northern boundaries.

The maximum 3-hour, 24-hour, and annual SO_2 concentration increments predicted to result from the proposed facility operations (Tables 6.5-7 and 6.5-8) would be less than 2% of the applicable PSD increments (Table 6.5-3). The maximum predicted increments in annual average NO_2 concentrations due to the proposed facility operations would be about 1% of the applicable PSD increments. The 24-hour and annual PM_{10} concentration increases predicted to result from the proposed operations would be less than about 1% of the applicable PSD increments. The predicted concentration increment at a receptor located 30 mi (50 km) away

TABLE 6.5-8 Maximum Predicted Off-Post Concentration Increments and Total Concentrations of Criteria Pollutants during Normal Operations of the Neutralization/SCWO Technology at PCD

		Concentration (µg/m³)					Receptor Location[e]	
Pollutant	Averaging Time	Maximum Increment[a]	Background[b]	Total[c]	NAAQS/ SAAQS	Percent of NAAQS/ SAAQS[d]	Distance [mi (km)]	Direction
SO_2	3 hours	5.9	101	107	700	15 (0.8)	1.0 (1.6)	NNW
	24 hours	1.6	39	41	365	11 (0.4)	1.5 (2.4)	NW
	Annual	0.009	8	8	80	10 (<0.1)	1.5 (2.4)	NW
NO_2	Annual	0.19	19	19	100	19 (0.2)	1.5 (2.4)	NW
CO	1 hour	64	3,429	3,493	40,000	9 (0.2)	1.8 (3.0)	WNW
	8 hours	14	2,222	2,236	10,000	22 (0.1)	1.5 (2.4)	NW
PM_{10}	24 hours	1.8	40	42	150	28 (1.2)	1.5 (2.4)	NW
	Annual	0.012	17	17	50	34 (<0.1)	1.5 (2.4)	NW
$PM_{2.5}$	24 hours	1.8	25	27	65	41 (2.8)	1.5 (2.4)	NW
	Annual	0.012	7	7	15	47 (<0.1)	1.5 (2.4)	NW

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

[b] Background concentrations recommended by the State of Colorado near the PCD (Chick 2001).

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

[d] The values are total concentration as percent of NAAQS/SAAQS. The values in parentheses are maximum concentration increments attributable to the ACWA facilities as percent of NAAQS/SAAQS.

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

from the proposed facility (the maximum distance the Industrial Source Complex [ISCST3] model [Version 00101; EPA 1995] could reliably estimate concentrations) in the direction of the nearest Class I PSD area (Great Sand Dunes National Monument) would be less than 0.2% of the applicable PSD increments. Concentration increments at the Great Sand Dunes National Monument, which is located about 75 mi (121 km) west-southwest of PCD, would be much lower.

Concentration increments for the two remaining criteria pollutants, lead and ozone, were not modeled. As a direct result of the phase-out of leaded gasoline for automobiles, average lead concentrations in urban areas throughout the country have decreased dramatically. It is expected that emissions of lead from the proposed facility operations would be negligible and therefore would have no adverse impacts on lead concentrations in surrounding areas. Contributions to the production of ozone, a secondary pollutant formed from complex photochemical reactions involving ozone precursors (including NO_X and VOCs), cannot be accurately quantified. As discussed in Section 6.5.1, Pueblo County, including PCD, is currently in attainment for ozone (40 CFR 81.306). As shown in Tables 6.5-4 and 6.5-5, ozone precursor emissions from the proposed facility operations would be small, accounting for about 0.17% and 0.02% of the actual emissions of NO_x and VOCs, respectively, from Pueblo County in 1996. As a consequence, the cumulative impacts of potential releases from PCD facility operations on regional ozone concentrations would not be of any concern.

Potential impacts of air pollutant emissions during pilot facility operations were evaluated by estimating maximum ground-level concentration increments of criteria air pollutants resulting from operations, adding these estimates to background concentrations, and comparing the results with applicable ambient air quality standards. Maximum concentrations of SO_2, PM_{10}, and $PM_{2.5}$ were estimated to be less than or equal to 47% of the NAAQS (Tables 6.5-7 and 6.5-8). However, concentration increments due to operation of the proposed facility would contribute ≤ 3% of the NAAQS. Maximum estimated concentrations of NO_2 and CO would approach 19% and 22% of the NAAQS, respectively. However, background concentrations of NO_2 and CO would account for most of total concentrations. It is estimated that concentration increases due to the operation of the proposed facility would be less than 0.2% of the NAAQS.

6.5.3.3 Impacts of Fluctuating Operations

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

Over long time periods, such conditions would be assumed to increase organic emissions to 145% of their normal values and metal emissions to 280% of their normal values (National Research Council 1997a). VOCs contribute to the formation of ozone, a criteria pollutant; multiplying VOC emissions from the proposed facility by 1.45 would result in about 2 tons per year, or less than 0.03% of the 1996 VOC emissions in Pueblo County (EPA 2001a). Therefore, the potential increase in ozone concentration that could result from VOC emissions from the proposed facility operations under fluctuating operational conditions would be almost the same as that under normal operating conditions. Lead (Pb) is the only metal among criteria pollutants. Expected emissions of lead from the proposed facility are currently too small to quantify; therefore, increasing these emissions to 280% of their normal value would probably not cause any appreciable increase in atmospheric lead concentrations. Therefore, under fluctuating operational conditions, the impacts of the criteria pollutants involved on air quality are expected to be insignificant.

6.5.4 Impacts of No Action

The principal sources of air emissions associated with stockpile maintenance activities are exhaust and road dust generated by vehicles. These emissions contribute to the background air quality at the installation, which would remain at baseline levels as described in Section 6.5.1. Air pollutant emissions from these sources are small both in absolute terms and in comparison with emissions from other natural and anthropogenic sources on and off PCD. Therefore, impacts on air quality that would occur as a result of the continued storage of the stockpile are expected to be minimal.

6.6 AIR QUALITY — TOXIC AIR POLLUTANTS

6.6.1 Current Emissions and Air Quality

PCD is classified as a synthetic minor source. With respect to hazardous air pollutant (HAP) emissions, as defined in Section 112 of Title III of the *Clean Air Act* (CAA), this means that PCD does not emit more than 10 tons of any single HAP or 25 tons of total HAPs in any given year. As a part of Pueblo's synthetic minor permit application, HAP emissions for 1994 were tabulated (Pueblo Depot Activity 1995); these emissions are summarized in Table 6.6-1. Total HAP emissions for 1994 were 2.66 tons. Sources of these emissions included mainly fuel storage, degreasing activities, and landfills. Because of its synthetic minor source status, PCD is not required to report HAP emissions annually. However, HAP emissions have decreased since 1994 (Ross 2001).

6.6.2 ACWA Facility Emissions

A summary of estimated emissions of toxic air pollutants[6] from operation of an ACWA pilot facility at PCD is provided in Kimmell et al. (2001). Estimated emission levels from diesel generators, boilers, a Neut/Bio facility, and a Neut/SCWO facility are provided. Emission levels from destruction facility stacks (e.g., SCWO vent, biotreatment vent, filter farm stacks) were based on demonstration test data and site-specific munitions inventories compiled by Mitretek Corp. (2001a,b). Estimated emission levels from diesel generators and boilers were based on standard algorithms that used fuel consumption estimates as input (Kimmell et al. 2001). The estimated emission levels from a Neut/Bio pilot test facility at PCD are provided in Table 6.6-2; estimated emission levels from a Neut/ SCWO pilot test facility are provided in Table 6.6-3. For

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

TABLE 6.6-1 Hazardous Air Pollutant Emissions from PCD in 1994[a]

Substance	Quantity (tons)	Source
Hydroquinone	0.05	Medical clinic
Methyl ethyl ketone	0.01	Landfills
Hexane	0.12	Fuel storage, landfills
Chlorine	0.54	Water treatment
Benzene	0.15	Fuel storage, landfills
Naphthalene	0.02	Fuel storage
Toluene	0.69	Degreasing, landfills
Xylenes	0.57	Fuel storage, landfills
Hydrogen chloride	0.02	Boilers/heaters
Chromium compounds	0.01	Boilers/heaters
Ethyl benzene	0.12	Fuel storage, landfills
Carbonyl sulfide	0.05	Landfills
Dichloromethane	0.04	Landfills
Perchloroethylene	0.02	Landfills
Trichloroethylene	0.01	Landfills
Vinyl chloride	0.02	Landfills
Bromodichloromethane	0.01	Landfills
Dichlorodifluoromethane	0.05	Landfills
Dichlorofluoromethane	0.02	Landfills
Hydrogen sulfide	0.11	Open detonation, landfills
Methyl mercaptan	0.02	Landfills
Total	2.66	

[a] Only emissions of greater than 0.01 ton/yr for any individual HAP are included.

Source: Pueblo Depot Activity (1995).

many substances (e.g., acetaldehyde, formaldehyde), the estimated emission levels from boilers and diesel generators would exceed the after-treatment emissions from destruction facility processes by many orders of magnitude (Tables 6.6-2 and 6.6-3).

The estimates of air emissions from operating the pilot facilities are based on the assumption that organic substances in all Neut/SCWO effluents would be filtered from stack emissions by a series of six carbon filters, each having a removal efficiency of 95%. For PM (e.g., dioxins and furans on PM and metals), it was assumed that two high-efficiency particulate air (HEPA) filters, each with a removal efficiency of 99.97%, would be used for treatment. For the Neut/Bio facility, it is not known whether the emissions from the biotreatment vent would require further treatment. The provider of the equipment used during the ACWA technology demonstrations has stated that further treatment would not be necessary. In this assessment, both treatment and no treatment of biovent stack emissions are assessed (see Table 6.6-2).

TABLE 6.6-2 Estimated Toxic Air Pollutant Emissions from Neutralization/Biotreatment Technology at PCD

	Emissions (µg/s)[b]				
Compound[a]	Diesel Generator	Boiler	Biotreatment Vent, Treated[c]	Biotreatment Vent, Untreated[c]	Filter Farm Stack[d]
1,1,1-Trichloroethane	-	-	-	-	1.1×10^{-10}
1,2,3,4,6,7,8,9-OCDD	-	-	1.6×10^{-9}	1.6×10^{-2}	3.2×10^{-13}
1,2,3,4,6,7,8,9-OCDF	-	-	3.2×10^{-10}	3.7×10^{-3}	7.4×10^{-13}
1,2,3,4,6,7,8-HpCDD	-	-	3.2×10^{-10}	3.7×10^{-3}	6.3×10^{-13}
1,2,3,4,6,7,8-HpCDF	-	-	3.7×10^{-10}	4.2×10^{-3}	6.3×10^{-13}
1,2,3,4,7,8,9-HpCDF	-	-	1.1×10^{-10}	1.1×10^{-3}	6.3×10^{-14}
1,2,3,4,7,8-HxCDD	-	-	1.6×10^{-11}	1.6×10^{-4}	6.3×10^{-14}
1,2,3,4,7,8-HxCDF	-	-	1.1×10^{-10}	1.1×10^{-3}	6.3×10^{-13}
1,2,3,6,7,8-HxCDD	-	-	3.2×10^{-11}	3.7×10^{-4}	2.1×10^{-13}
1,2,3,6,7,8-HxCDF	-	-	4.7×10^{-11}	5.3×10^{-4}	3.2×10^{-13}
1,2,3,7,8,9-HxCDD	-	-	5.3×10^{-11}	5.3×10^{-4}	2.1×10^{-13}
1,2,3,7,8,9-HxCDF	-	-	-	-	3.2×10^{-14}
1,2,3,7,8-PeCDD	-	-	1.6×10^{-12}	2.1×10^{-5}	6.3×10^{-14}
1,2,3,7,8-PeCDF	-	-	4.7×10^{-11}	5.3×10^{-4}	1.1×10^{-13}
1,2-Dichloroethane*	-	-	5.3×10^{-7}	3.7×10^{1}	2.1×10^{-5}
1,2-Dichloropropane*	-	-	-	-	3.2×10^{-10}
1,3-Butadiene*	1.1	-	-	-	-
1,4-Dichlorobenzene*	-	-	-	-	3.2×10^{-9}
2,3,4,6,7,8-HxCDF	-	-	4.7×10^{-11}	5.3×10^{-4}	3.2×10^{-13}
2,3,4,7,8-PeCDF	-	-	5.3×10^{-11}	1.1×10^{-3}	4.2×10^{-13}
2,3,7,8-TCDD*	-	-	2.6×10^{-12}	2.6×10^{-5}	-
2,3,7,8-TCDF	-	-	5.3×10^{-11}	1.1×10^{-3}	1.1×10^{-12}
2-Methylnaphthalene	-	8.6×10^{-2}	-	-	-
3/4-Methyl phenol*	-	-	-	-	1.1×10^{-9}
3-Methylchloranthrene	-	6.4×10^{-3}	-	-	-
Acenaphthene	3.9×10^{-2}	6.4×10^{-3}	-	-	-
Acenaphthylene	1.4×10^{-1}	6.4×10^{-3}	-	-	-
Acetaldehyde*	2.1×10^{1}	-	1.6×10^{-6}	1.1×10^{2}	-
Acrolein*	2.6	-	-	-	-
Aldehydes	1.9×10^{3}	-	-	-	-
Anthracene	5.2×10^{-2}	8.6×10^{-3}	-	-	-
Arsenic*	-	7.2×10^{-1}	-	-	-
Barium	-	1.6×10^{1}	-	-	-
Benz(a)anthracene	4.7×10^{-2}	6.4×10^{-3}	-	-	-
Benzene*	2.6×10^{1}	7.5	-	-	8.4×10^{-9}
Benzo(a)pyrene	5.2×10^{-3}	4.3×10^{-3}	-	-	-
Benzo(b)fluoranthene	2.8×10^{-3}	6.4×10^{-3}	-	-	-
Benzo(g,h,i)perylene	1.4×10^{-2}	4.3×10^{-3}	-	-	-
Benzo(k)fluoranthene	4.3×10^{-3}	6.4×10^{-3}	-	-	-
Beryllium*	-	4.3×10^{-2}	-	-	-
bis (2-Chloroethyl) ether*	-	-	4.2×10^{-7}	2.6×10^{1}	-

TABLE 6.6-2 (Cont.)

	Emissions (µg/s)[b]				
Compound[a]	Diesel Generator	Boiler	Biotreatment Vent, Treated[c]	Biotreatment Vent, Untreated[c]	Filter Farm Stack[d]
bis (2-Ethylhexyl) phthalate*	-	-	5.3×10^{-7}	3.7×10^{1}	8.4×10^{-9}
Bromomethane*	-	-	1.6×10^{-6}	1.1×10^{2}	2.1×10^{-7}
Butane	-	7.5×10^{3}	-	-	-
Cadmium*	-	3.9	-	-	-
Carbon disulfide*	-	-	-	-	2.1×10^{-7}
Carbon tetrachloride*	-	-	-	-	3.2×10^{-9}
Chlorobenzene*	-	-	-	-	3.2×10^{-7}
Chloroethane*	-	-	-	-	4.2×10^{-9}
Chloroform*	-	-	-	-	5.3×10^{-7}
Chloromethane*	-	-	1.6×10^{-6}	1.1×10^{2}	3.2×10^{-6}
Chromium*	-	5.0	-	-	2.1×10^{-7}
Chrysene	9.8×10^{-3}	6.4×10^{-3}	-	-	-
Cobalt*	-	3.0×10^{-1}	-	-	2.1×10^{-7}
Copper	-	3.0	-	-	-
Dibenzo(a,h)anthracene	-	4.3×10^{-3}	-	-	-
Dibenzofuran*	-	-	-	-	3.2×10^{-9}
Dichlorobenzene*	-	4.3	-	-	-
Diethylphthalate	-	-	5.3×10^{-7}	4.2×10^{1}	-
Dimethylbenz(a)anthracene	1.6×10^{-2}	5.7×10^{-2}	-	-	-
Dimethylphthalate*	-	-	-	-	2.1×10^{-8}
Ethane	-	1.1×10^{4}	-	-	-
Ethyl benzene*	-	-	4.7×10^{-6}	3.2×10^{2}	8.4×10^{-10}
Fluoranthene	2.1×10^{-1}	1.1×10^{-2}	-	-	-
Fluorene	8.1×10^{-1}	1.0×10^{-2}	-	-	-
Formaldehyde*	3.3×10^{1}	2.7×10^{2}	1.1×10^{-5}	1.1×10^{3}	-
Glycol ethers (2-butoxy ethanol)	-	-	4.2×10^{-6}	2.6×10^{2}	-
H (mustard)[e]	-	-	-	-	2.8×10^{2}
Hexane(n)*	-	6.4×10^{3}	-	-	-
Indeno(1,2,3-cd)pyrene	1.0×10^{-2}	6.4×10^{-3}	-	-	-
Lead*	-	1.8	-	-	7.4×10^{-9}
m,p-Xylene*	7.9	-	4.2×10^{-5}	2.6×10^{3}	3.2×10^{-8}
Manganese*	-	1.4	-	-	6.3×10^{-8}
Mercury*	8.4×10^{-3}	9.3×10^{-1}	1.6×10^{-4}	2.1×10^{1}	2.1×10^{-8}
Methyl ethyl ketone*	-	-	-	-	1.1×10^{-5}
Methyl ethyl ketone/butyraldehydes*	-	-	5.3×10^{-7}	3.2×10^{1}	-
Methylene chloride*	-	-	1.1×10^{-5}	1.1×10^{3}	2.1×10^{-8}
Molybdenum	-	3.9	-	-	-
Naphthalene*	2.4	2.2	3.7×10^{-7}	2.6×10^{1}	4.2×10^{-8}
Nickel*	-	7.5	-	-	1.1×10^{-7}
OCDD	-	-	3.2×10^{-10}	3.2×10^{-3}	-
OCDF	-	-	1.1×10^{-10}	1.6×10^{-3}	-
o-Xylene*	-	-	-	-	2.1×10^{-9}

TABLE 6.6-2 (Cont.)

	Emissions (µg/s)[b]				
Compound[a]	Diesel Generator	Boiler	Biotreatment Vent, Treated[c]	Biotreatment Vent, Untreated[c]	Filter Farm Stack[d]
Particulates	-	-	-	-	5.3×10^{-4}
Pentane(n)	-	9.3×10^{3}	-	-	-
Phenanthrene	8.1×10^{-1}	6.1×10^{-2}	-	-	-
Phenol*	-	-	1.6×10^{-7}	1.1×10^{1}	5.3×10^{-9}
Phosphorus*	-	-	-	-	2.1×10^{-8}
PAHs	4.7	-	-	-	-
POM (fluorene)*	-	-	-	-	3.2×10^{-8}
Propanal (propionaldehyde)*	-	-	5.3×10^{-7}	4.2×10^{1}	-
Propane	-	5.7×10^{3}	-	-	-
Propylene	7.2×10^{1}	-	-	-	-
Pyrene	1.3×10^{-1}	1.8×10^{-2}	-	-	-
Selenium*	-	8.6×10^{-2}	-	-	2.1×10^{-9}
Styrene*	-	-	-	-	8.4×10^{-13}
Tetrachloroethene*	-	-	-	-	2.1×10^{-10}
Toluene*	1.1×10^{1}	1.2×10^{1}	1.1×10^{-6}	5.3×10^{1}	4.2×10^{-8}
Total HpCDD	-	-	5.3×10^{-10}	5.3×10^{-3}	1.1×10^{-12}
Total HpCDF	-	-	5.3×10^{-10}	5.3×10^{-3}	8.4×10^{-13}
Total HxCDD	-	-	4.2×10^{-10}	4.7×10^{-3}	2.1×10^{-12}
Total HxCDF	-	-	3.7×10^{-10}	4.2×10^{-3}	2.1×10^{-12}
Total PeCDD	-	-	-	-	2.1×10^{-12}
Total PeCDF	-	-	5.3×10^{-10}	5.3×10^{-3}	4.2×10^{-12}
Total TCDD	-	-	1.6×10^{-11}	1.6×10^{-4}	1.1×10^{-12}
Total TCDF	-	-	2.6×10^{-10}	2.6×10^{-3}	2.1×10^{-8}
Vanadium	-	8.2	-	-	-

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

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

[c] For untreated values, it is assumed that compounds are released directly to the stack after being processed through the catalytic oxidation unit (CatOx). For treated values, it is assumed that after organics pass through the CatOx, they pass through six carbon filters in series, each at 95% efficiency. For treated values, it is assumed that PM passes through two HEPA filters in series, each at 99.97% efficiency.

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

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

TABLE 6.6-3 Estimated Toxic Air Pollutant Emissions from Neutralization/SCWO Technology at PCD

	Emissions (µg/s)[b]			
Compound[a]	Diesel Generator	Boiler	SCWO Vent[c]	Filter Farm Stack[d]
1,3-Butadiene*	1.1	-	-	-
2-Methylnaphthalene	-	1.4×10^{-1}	-	-
3-Methylchloranthrene	-	1.0×10^{-2}	-	-
Acenaphthene	3.9×10^{-2}	1.0×10^{-2}	-	-
Acenaphthylene	1.4×10^{-1}	1.0×10^{-2}	-	-
Acetaldehyde*	2.1×10^{1}	-	1.3×10^{-7}	-
Acrolein*	2.6	-	-	-
Aldehydes	1.9×10^{3}	-	-	-
Anthracene	5.2×10^{-2}	1.4×10^{-2}	-	-
Antimony*	-	-	2.5×10^{-7}	-
Arsenic*	-	1.1	8.8×10^{-8}	-
Barium	-	2.5×10^{1}	-	-
Benz(a)anthracene	4.7×10^{-2}	1.0×10^{-2}	-	-
Benzene*	2.6×10^{1}	1.2×10^{1}	-	-
Benzo(a)pyrene	5.2×10^{-3}	6.8×10^{-3}	-	-
Benzo(b)fluoranthene	2.7×10^{-3}	1.0×10^{-2}	-	-
Benzo(g,h,I)perylene	1.4×10^{-2}	6.8×10^{-3}	-	-
Benzo(k)fluoranthene	4.3×10^{-3}	1.0×10^{-2}	-	
Beryllium*	-	6.8×10^{-2}	1.3×10^{-8}	-
Butane	-	1.2×10^{4}	-	-
Cadmium*	-	6.2	1.3×10^{-8}	-
Chromium*	-	7.9	5.0×10^{-7}	-
Chrysene*	9.8×10^{-3}	1.0×10^{-2}	-	-
Cobalt*	-	4.8×10^{-1}	1.3×10^{-7}	-
Copper	-	4.8	-	-
Dibenzo(a,h)anthracene	1.6×10^{-2}	6.8×10^{-3}	-	-
Dichlorobenzene*	-	6.8	-	-
Dimethylbenz(a)anthracene	-	9.1×10^{-2}	-	-
Ethane	-	1.8×10^{4}	-	-
Ethyl benzene*	-	-	1.3×10^{-6}	-
Fluoranthene	2.1×10^{-1}	1.7×10^{-2}	-	-
Fluorene	8.1×10^{-1}	1.6×10^{-2}	-	-
Formaldehyde*	3.3×10^{1}	4.3×10^{2}	2.5×10^{-7}	-
H (mustard)[d]	-	-	-	2.8×10^{2}
Hexane(n)*	-	1.0×10^{4}	-	-
Indeno(1,2,3-cd)pyrene*	1.0×10^{-2}	1.0×10^{-2}	-	-

TABLE 6.6-3 (Cont.)

	Emissions (µg/s)[b]			
Compound[a]	Diesel Generator	Boiler	SCWO Vent[c]	Filter Farm Stack[d]
Lead*	-	2.8	2.5×10^{-7}	-
m,p-Xylene*	7.9	-	-	-
Manganese*	-	2.2	5.0×10^{-7}	-
Mercury*	8.3×10^{-3}	1.5	-	-
Methyl ethyl ketone/butyraldehydes*	-	-	6.3×10^{-8}	-
Molybdenum	-	6.2	-	-
m-Xylene*	-	-	1.5×10^{-6}	-
Naphthalene*	2.3	3.5	-	-
Nickel*	-	1.2×10^{1}	1.3×10^{-6}	-
Particulates	-	-	8.8×10^{-5}	-
p-Cresol (4-methylphenol)*	-	-	1.3×10^{-7}	-
Pentane(n)	-	1.5×10^{4}	-	-
Phenanthrene	8.1×10^{-1}	9.6×10^{-2}	-	-
Phosphorus	-	-	2.5×10^{-5}	-
PAHs	4.7	-	-	-
Propane	-	9.1×10^{3}	-	-
Propylene	7.1×10^{1}	-	-	-
Pyrene*	1.3×10^{-1}	2.8×10^{-2}	-	-
Selenium*	-	1.4×10^{-1}	8.8×10^{-8}	-
Toluene*	1.1×10^{1}	1.9×10^{1}	-	-
Total HpCDF	-	-	2.5×10^{-16}	-
Total TCDD	-	-	1.3×10^{-12}	-
Vanadium	-	1.3×10^{1}	-	-
Zinc	-	-	-	-

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

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

[c] For SCWO vent stack emissions, organics are assumed to pass through six carbon filters in series, each at 95% efficiency. PM is assumed to pass through two HEPA filters in series, each at 99.97% efficiency.

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

6.6.3 Impacts of the Proposed Action

6.6.3.1 Impacts of Construction

During construction, low-level emissions of potentially toxic air pollutants would result from the use of chemicals in items such as paints, thinners, and aerosols. These emissions would be expected to be minor and were not quantitatively estimated for this EIS. The main emissions from construction-related heavy equipment and from the commuter vehicles used by construction workers would consist of criteria pollutants and HAPs (Kimmell et al. 2001). HAPs emissions were not quantified for this assessment because of insufficient data (e.g., whether the engine type is two-stroke, four-stroke, or diesel) (EPA 2000b). Although not quantified, the emission levels would be expected to be less than reportable quantities and similar across the technology systems evaluated.

6.6.3.2 Impacts of Operations

Estimates of emissions of toxic air pollutants that would result from the operation of an ACWA pilot facility are provided in Tables 6.6-2 and 6.6-3. Many of the toxic air pollutants that would be emitted from the pilot test facility stacks would be HAPs as defined in Title III, Section 112 of the CAA. However, a pilot test facility would not be a major source of HAP emissions and would not fall into any of the source categories regulated by EPA National Emission Standards for Hazardous Air Pollutants (NESHAP), as adopted by the CDPHE (see Chapter 8). Therefore, no regulatory action under NESHAP would be necessary for the HAP emissions from a pilot test facility.

In order to assess health risks associated with toxic air pollutant emissions (Section 6.7), the locations of maximum on-post and off-post concentrations of the emitted compounds listed in Tables 6.6-2 and 6.6-3 were identified through air modeling. The ISCST3 model (EPA 1995) was used in the same way as it was used for criteria air pollutant emissions assessed in Section 6.5. Details on the modeling conducted are presented in Appendix C.

The main emissions from commuter vehicles and delivery trucks would be criteria pollutants (as summarized in Section 6.5); toxic air pollutant emissions were not quantified.

6.6.3.3 Impacts of Fluctuating Operations

To account for possible fluctuations in operations that could occur during pilot testing, it was assumed that levels of organic compounds would be 10 times higher than the estimated annual average for 5% of the time and that levels of inorganic compounds would be 10 times higher than the estimated annual average for 20% of the time. These assumptions were based on EPA guidance (EPA 1994, as cited in National Research Council 1997a) and were used to generate ambient annual air concentrations for exposure estimates, as detailed in Appendix C.

During fluctuating operations, agent could be released from the filter farm stack, which is the ventilation stack for the Munitions Demilitarization Building (MDB) process area. Regardless of the ACWA technology selected for implementation at PCD, the filter farm stack would be equipped with multiple carbon filter banks and with agent monitoring devices between banks. These devices would ensure that, in the unlikely event that some agent had not been destroyed in the neutralization process and subsequent treatment, the agent would be detected and the causes would be mitigated immediately.

For the purpose of estimating the maximum potential emissions of chemical agent, only the MDB process area was assumed to be a potential source. The filter systems would be designed to remove mustard agent from the ventilation air stream to a level below the detectable level (Kimmell et al. 2001). Therefore, if any agent were detected in the exhaust stream, alarms would sound, the cause would be identified and mitigated, and the emission of agent (if any) would be short-term and at low levels. Since no potential chemical agent emission levels were estimated on the basis of demonstration test results, it was conservatively assumed for this assessment that a chemical agent could hypothetically be emitted from a stack continuously at the detection limit level for that agent. Modeling dispersion from the source at these levels results in the maximum hypothetical on-post and off-post agent concentrations presented in Table 6.6-4. All these values are less than 1% of the allowable concentration of 0.1 μg/m^3 HD/HT for general public exposures established by the Centers for Disease Control and Prevention (CDC 1988). In practice, the facility stacks would have continuous agent monitoring devices that would sound if any agent was detected in the stacks, so that the reasons for the agent's presence could be identified and the agent could be eliminated.

TABLE 6.6-4 Maximum Annual Average Estimated On-Post and Off-Post Concentrations of Mustard Agent during ACWA Pilot Facility Operations at PCD[a]

Agent	Maximum Annual Average Off-Post Concentration (μg/m^3)	Maximum Annual Average On-Post Concentration (μg/m^3)	General Population Exposure Limit[b] (μg/m^3)	Percent of Limit off Post	Percent of Limit on Post
Mustard	5.6×10^{-5}	2.0×10^{-4}	1.0×10^{-1}	0.06	0.2

[a] Estimated concentrations account for fluctuating operations and are applicable to both the Neut/Bio and Neut/SCWO technologies.

[b] The general population exposure limits are for 72-hour time-weighted average exposures, as estimated by the CDC (1988).

6.6.4 Impacts of No Action

Activities associated with continued storage at PCD would include inspecting, monitoring, and conducting an annual inventory of all munitions; overpacking any leaking munitions discovered during inspections; and transporting any overpacked leakers to a separate RCRA-permitted storage igloo. All chemical munition storage igloos would continue to be routinely inspected and monitored in accordance with strict Army regulations. Inspection and monitoring of all of the permitted igloos containing the overpacked leakers would be done in accordance with applicable State of Colorado-issued RCRA permit conditions. Upon discovery of a leaker, a filter would be installed, and the entry door would be sealed. The amount of mustard agent that might spill from a leaking munition would probably be small, and any vapor that might form as a result of the spill would be likely to be contained within the igloo. These conditions would occur because mustard agent is less volatile and has a higher melting point than nerve agents. Air temperatures inside the earth-covered concrete igloos tend to be below 14.5°C (58°F) for most of the year. The mustard agent would therefore be likely to be in solid form most of the time, except during periods when the igloo temperature would rise above the agent's melting point. Any liquid that might leak from a munition would therefore tend to spill slowly over the munition(s) and then onto the igloo floor. Evaporation of the liquid would be at a slow rate because the air inside the igloo would be still and because the agent is not very volatile.

6.7 HUMAN HEALTH AND SAFETY — ROUTINE OPERATIONS

Impacts on human health from routine operations are generally assessed by estimating exposures to the toxic substances that are emitted from a facility on a routine basis and by estimating the potential for those exposures to cause adverse health effects. Because the degree of exposure is partially determined by where the human population is located with respect to the emission points, this section gives data on the locations of workers and the general public around the proposed facilities. Guidance for the estimation of exposure and risk from routine low-level exposures is available from the EPA. The assessment for this EIS generally followed the principles of the EPA's Risk Assessment Guidance for Superfund, which includes the estimation of risk for a reasonably maximally exposed individual (MEI) (EPA 1989, 1997). For example, the risk for the off-site public would be assessed by assuming that the MEI resided in the area of off-site maximum contaminant concentrations (generally but not always the fence line). Other assumptions on intake levels and susceptibility are made to ensure that, whenever possible, exposures and risks will be overestimated rather than underestimated. The reasoning is that if the MEI risk is found to be within acceptable limits, then the risk to the general public will be lower and also generally acceptable.

In addition to risks from exposures to facility emissions, occupational hazard risks of injury and fatality are presented for the facility workers. Some risk of on-the-job injury or fatality is associated with any industry, and a screening estimation of this risk is presented. The main determination of this type of risk is the type of work (construction or facility operation) being done and the number of employees who are doing it.

6.7.1 Current Environment

6.7.1.1 Existing Environmental Contamination and Remediation Efforts

Under RCRA, CDPHE and the EPA regulate environmental activities at PCD. The Base Realignment and Closure (BRAC) Environmental Restoration Program monitors them. Media that have been or are being monitored include soils, groundwater, surface water, and air. Ecological resources, such as vegetation, habitats, fish, and wildlife, are also monitored. Fifty-eight (58) solid waste management units (SWMUs) have been identified for cleanup at PCD; none are located in or near the areas proposed for construction of an ACWA facility. Environmental cleanup of contamination from past operations at PCD is being addressed in other environmental compliance documentation and is beyond the scope of this EIS.

6.7.1.2 On-Post Workers and Residents

PCD employs approximately 185 people, of whom 78 are associated with chemical stockpile maintenance (Marrero 2000). There are also approximately 30 employees working for on-post commercial and industrial tenants (Oburn 2000). In addition, 60 people currently reside on PCD in the housing area in the southwest section of the depot (see Figure 6.1-3) (Holland 2000).

The types of workers currently employed at PCD include environmental protection specialists, fire and emergency services specialists, facility management and maintenance workers, and administrative and office workers. The hazards associated with these jobs vary; workers receive training to address their specific job hazards. Although occupational hazards exist for all types of work (rates for various industry classifications are published; for example, see National Safety Council [1999]), these hazards can be minimized when workers adhere to safety standards and use protective equipment as necessary.

On-post workers and residents at the PCD site could be exposed to chemicals released to air, water, or soil. PCD does not currently emit any reportable quantities of HAPs as defined in Title III, Section 112 of the CAA. Contaminant levels in PCD releases to water are subject to applicable National Pollutant Discharge Elimination System (NPDES) regulations. Most nonhazardous solid wastes and hazardous liquids and wastes that are generated at PCD are sent off post for treatment (see Section 6.4). Sanitary waste is sent to holding ponds and is not discharged to nearby waterways. Therefore, any existing emissions or contamination at PCD should not result in increased health risks to workers or on-post residents.

6.7.1.3 Off-Post Public

Demographic information on the off-post public is contained in Section 6.19.1. No increased health risks to the off-post public are associated with normal PCD operations. Procedures are in place to minimize risks associated with accidents (see Section 6.7.1.4)

6.7.1.4 Emergency Response

Procedures for on-post emergency response actions involving toxic chemical munitions are contained in PCD's *Chemical Accident/Incident Response and Assistance Plan* (PCD 2001). This plan establishes policies and procedures that ensure adequately trained personnel and appropriate equipment are present on post at all times to respond to emergency situations.

The Chemical Stockpile Emergency Preparedness Program (CSEPP) has further enhanced the depot's ability to respond to a chemical accident by providing facilities and equipment and by supporting a framework for exchanging information and coordinating assistance with the state and county. As part of CSEPP, PCD operates an emergency operations center (EOC) in Building 2 for 24 hours a day, seven days a week. This facility enables the depot to respond expeditiously to any accident that might occur. In the unlikely event of a chemical accident or incident, EOC staff can readily run plume projections by using the Emergency Management Information System, determine the protective action recommendation (PAR), alert the off-post response community, signal depot staff to respond, and activate the outdoor warning system (made up of six on-post devices capable of emitting several tones and voice messages). Many of these activities can occur simultaneously.

CSEPP has also encouraged PCD, the county, and the state to cooperate with regard to communications, event classification and notification, exercises, public affairs, and planning. Joint communication links include telephones, radios, e-mail, and microwave transmissions. A memorandum of agreement (MOA) for notification allows for the rapid exchange of information and sounding of outdoor warning devices. The county has installed tone alert radios on post and off post, and it will provide emergency information to employees, tenants, contractors, and on-post residents. Joint exercises have been held annually since 1992. Public affairs efforts are coordinated and include a joint information center (formalized by a MOA), annual calendars, and quarterly newsletters. Finally, emergency response plans have been synchronized.

PCD also has plans for responding to other potential spill hazards. Procedures for responding to spills of oil or a hazardous substance are contained in PCD's *Installation Spill Contingency Plan* (PCD 2000b). Controls designed to prevent spills of oil or hazardous substances and to minimize the impact of spills on the environment are described in PCD's *Oil and Hazardous Substance Spill Prevention, Control, and Countermeasures Plan* (PCD 2000c). Emergency response plans establish policies and procedures to ensure that adequately trained personnel and appropriate equipment are present on post at all times to respond to emergency situations.

The PCD Fire Prevention/Protection Department is staffed at all times with five firefighters. Equipment present on post for use in emergency situations includes fire-fighting equipment and vehicles, an emergency response vehicle, heavy equipment, and spill kits.

PCD has mutual aid agreements with local fire departments and medical facilities to augment its emergency preparedness (PCD 2001). The agreements are with the Boone Volunteer Fire Department, TTC Fire Department, and Pueblo Rural Fire Department. These local fire departments have agreed to provide emergency response assistance to PCD, upon request, when it is possible to do so. In return, the PCD Fire Department has agreed to do the same for these local entities. In addition, MOAs have been established by the U.S. Army Medical Department Activity located at Fort Carson, Colorado, and PCD with two hospitals located in the city of Pueblo: Parkview Episcopal Medical Center and St. Mary Corwin Hospital. These MOAs address the treatment of casualties, illnesses, and injuries requiring off-post assistance.

6.7.2 Impacts of the Proposed Action

This section discusses the potential environmental consequences on human health and safety that could result from constructing and operating a pilot test facility for ACW destruction at PCD. Factors that would affect human health and safety include occupational hazards to workers during continued storage, construction, and operations and the potential release of chemical agent or other hazardous materials during routine operations.

6.7.2.1 Impacts of Construction

Facility Workers. Impacts from construction would include occupational hazards to workers. Although occupational hazards to workers can be minimized when workers adhere to safety standards and use protective equipment as necessary, accidents associated with construction work might still occur.

The expected number of worker fatalities and injuries that would be associated with the construction of an ACWA facility was calculated on the basis of rate data from the Bureau of Labor Statistics, as reported by the National Safety Council (1999), and on the basis of estimates of total worker hours required for construction activities for each option, as given in Kimmell et al. (2001). This analysis uses annual fatality and injury rates for the construction sector because that sector was assumed the most representative for the construction of an ACWA facility. Construction of the Neut/Bio facility would require approximately 480 FTEs per year. Construction of the Neut/SCWO facility would require approximately 390 FTEs per year.

Construction of either facility could require up to 34 months. The annual construction fatality and injury rates used were as follows: 13.9 fatalities per 100,000 full-time workers, and 4.4 injuries per 100 full-time workers. Annual fatality and injury risks were calculated as the product of the appropriate incidence rate (given above), and the number of full-time-equivalent (FTE) employees.

The annual fatality and injury rates for construction of ACWA facilities are shown in Table 6.7-1. No distinctions among categories of workers (e.g., supervisors, laborers) were made, because the available fatality and injury statistics by industry are not refined enough to warrant analysis of worker rates in separate categories. The estimated number of fatalities for both of the ACWA technology systems assessed is less than 1. The estimated annual number of injuries for construction of a Neut/Bio facility is 17 and for construction of a Neut/SCWO facility is 21.

TABLE 6.7-1 Annual Occupational Hazard Rates Associated with Continued Munitions Maintenance (No Action) and ACWA Facility Construction and Operations at PCD

Impact to Workers[a]	Neut/Bio	Neut/SWCO	No Action
Fatalities			
Construction	0.05	0.07	NA[b]
Systemization	0.01	0.01	NA
Operations	0.02	0.02	0.002
Injuries			
Construction	17	21	NA
Systemization	15	15	NA
Operations	30	30	4

[a] Impacts are based on the projected work force over the lifetime of the project. Fatality estimates of less than one should be interpreted as “no expected fatalities.” For the ACWA technologies, construction is estimated to require up to 34 months, and operations are conservatively estimated to require a maximum of about 3 years. Under the terms of the CWC, the no action alternative could not extend beyond 2012, or about 11 years.

[b] NA = not applicable; i.e., no construction and systemization phases are associated with the no action alternative.

The calculation of fatality and injury rates from industrial accidents was based solely on historical industrywide statistics and therefore did not consider a threshold (i.e., it was assumed that any activity would result in some estimated risk of fatality and injury). Whatever technology is implemented will be accompanied by best management practices, which should reduce fatality and injury rates.

Other On-Post Workers and Residents. The main pollutant emission associated with construction of the ACWA facilities would be PM (see Section 6.4). The levels of PM at the administrative and residential areas on post would be about 4% or less of the health-based NAAQS levels. Therefore, no adverse health impacts on on-post workers and residents would be expected from construction activities.

Off-Post Public. The main pollutant emission associated with construction of the ACWA facilities would be PM (see Section 6.4). The levels of PM at the nearest off-post residence (located about 1.7 mi [2.7 km] north of the proposed construction area) would be about 14% or less of the health-based NAAQS levels. Levels at residential areas located farther away would be lower. Therefore, no adverse health impacts on the off-post public would be expected from construction activities.

6.7.2.2 Impacts of Operations

Facility Workers

Occupational Hazards. Occupational hazards associated with systemization (i.e., preoperational testing) and operation of an ACWA pilot facility at PCD were estimated by using the same approach as that discussed above for construction (Section 6.7.2.1). Operation of both the Neut/Bio and the Neut/SCWO facilities would require approximately 635 FTEs/yr. This number includes a mix of contractor and government employees. Systemization would require 12 months with a peak work force of 315 FTEs (Kimmell et al. 2001). Annual fatality and injury rates for the manufacturing sector were used because this sector was assumed to be the most representative for systemization and operations work at an ACWA facility. The annual fatality and injury rates used were as follows: 3.2 fatalities per 100,000 full-time workers, and 4.8 injuries per 100 full-time workers.

The annual fatality and injury rates for systemization and operation of ACWA facilities are shown in Table 6.7-1. The estimated number of fatalities for all the technologies assessed is less than 1. The estimated annual number of injuries is the same for each technology: 15 per year for systematization and 30 per year for operations.

Inhalation Risks. For routine operations, inhalation exposures and risks to facility workers would depend in part on detailed facility designs that are not yet available. In this EIS, facility workers are generally excluded from health risk evaluation for occupational exposures because such exposures are covered by other guidance and regulations (EPA 1998b). Quantitative estimates of risks to ACWA facility workers from inhalation of substances emitted during facility operations were not generated for this EIS. However, the workplace environment would be monitored to ensure that airborne chemical concentrations were below applicable occupational exposure limits. Health risks from occupational exposure through all pathways would be minimized because operations would be enclosed insofar as possible and because protective equipment would be used if remote handling of munitions was not possible during processing.

Other On-Post Workers and Residents

Inhalation of Toxic Air Pollutants. Estimated maximum on-post concentrations of toxic air pollutants from ACWA facility pilot testing are discussed in Appendix C. The maximum on-post concentrations would occur close to Munitions Storage Area A at PCD; therefore, people most likely to be exposed would be on-post workers. (The residential area at the PCD site is removed from the location of maximum modeled air concentrations; it is approximately 5 mi (8 km) from the Munitions Storage Area A area on the south side of the site.) On-post exposures were modeled by using exposure assumptions typical for the maximum exposed individual (MEI) in the worker population. This person would be a worker present at the location of maximum on-post air concentration for 8 hours per day and 250 days per year, for the duration of the pilot test operations for each technology. Exposure estimates generated on the basis of these assumptions were compared with cancer and noncancer toxicity values to generate estimates of increased cancer risk and of the potential for noncancer health impacts. A summary of the results of this assessment is shown in Table 6.7-2. Details of the assessment are provided in Appendix C.

As shown in Table 6.7-2, estimated hazard indexes and carcinogenic risks from exposure to toxic air pollutants estimated for the on-post MEI were well below the benchmarks considered to be representative of negligible risk levels. The typical benchmark indicator for significant noncarcinogenic hazards is a hazard index of greater than 1, and for carcinogenic hazards, it is an increased lifetime carcinogenic risk level of greater than 10^{-6}. Although many more chemicals were detected in gas samples from Neut/Bio than from Neut/SCWO during the demonstration, the estimated risk levels for routine emissions from the two technologies were very comparable, generally on the same order of magnitude. Almost all of the estimated noncarcinogenic and carcinogenic risks were associated with the boiler emissions and not with the destruction facility processes (see Appendix C). Note that exposures and risks are slightly higher for the off-post MEI than for the on-post MEI because the annual exposure duration for the off-post MEI is assumed to be longer (see next subsection on off-post public).

TABLE 6.7-2 Toxic Air Pollutant Emissions and Impact on Human Health and Safety during Normal Operations at PCD[a]

Emissions and Impacts	Neut/Bio[b]	Neut/SCWO
Hazardous air emissions		
Number of chemicals	107	60
Number of chemicals with quantitative data on toxic, noncarcinogenic effects[c]	78	35
Number of chemicals with quantitative data on carcinogenic effects[d]	57	22
Impacts[e]		
Hazard index (*hazard index of <1 means adverse health impacts are unlikely*)		
For MEI in off-post general public	5×10^{-4} (1×10^{-3})	7×10^{-4}
For MEI in on-post population	1×10^{-4} (3×10^{-4})	1×10^{-4}
Increased lifetime carcinogenic risk *(risk of 10^{-6} is generally considered negligible)*		
For MEI in off-post general public	2×10^{-9} (5×10^{-9})	3×10^{-9}
For MEI in on-post population	2×10^{-9} (3×10^{-9})	6×10^{-10}
Increased lifetime carcinogenic risk to population due to worst-case mustard emissions *(risk of 10^{-6} is generally considered negligible)*[f]		
On post	7×10^{-9}	1×10^{-8}
Off post	2×10^{-7}	2×10^{-7}

[a] Based on emission estimates from demonstration testing (Kimmell et al. 2001) and model estimates of maximum on-post and off-post concentrations and adjusted to account for fluctuating operations. ISCST3 model was used. Estimates for general public assumed 24-h/d exposures for the duration of operations. Estimates for the on-post population assumed 8-h/d exposures and a 250-d/yr for the duration of operations. See Appendix C for details.

[b] For Neut/Bio, the value in parentheses assumes no further treatment of emissions from the biotreatment vent after processing in the immobilized cell bioreactor (ICB) unit.

[c] Potential noncarcinogenic impacts from some detected chemicals could not be evaluated quantitatively because toxicity data were not available. However, only 17 chemicals for Neut/Bio and 14 chemicals for Neut/SCWO could not be quantitatively evaluated for either noncarcinogenic or carcinogenic effects (see text discussion).

[d] All known carcinogens were evaluated for carcinogenic risk.

[e] Carcinogenic risks are less than 10^{-6} and hazard indexes are less than 0.01 for all technologies; thus, they are in the negligible range. Although calculated cancer risks range from approximately 10^{-10} to 10^{-7}, and calculated hazard indexes range from 10^{-4} to 10^{-3}, there is no significant difference in risk among the technologies. Thus, for all the technologies, increased cancer and noncancer risks from inhalation of emissions are in a range considered to be negligible.

[f] Although the facility would be designed to operate without mustard releases, these values were estimated as a worst case by assuming continuous emissions at the detection limit (Kimmell et al. 2001). The estimated concentrations are all less than 1% of the allowable concentration for general population exposures.

Some uncertainties in the demonstration test data used to estimate emissions of toxic air pollutants should be considered in interpreting the results. Some unit operations were not characterized in demonstration testing, so trace effluents were not estimated for all unit operations that make up the complete systems. Generally, data were available for unit operations that would be expected to generate the most gaseous emissions during actual operations (Mitretek 2001a,b). However, the emission levels and health risk estimates provided here should be considered only indicative of likely levels. They may need to be revised as the technology designs near completion and as estimates of process efficiencies become more reliable (Kimmell et al. 2001). Nevertheless, the values used for the risks from operations presented in this EIS were designed to be very conservative (i.e., potentially resulting in overestimates of risk) and to bound minor variations in the way that the ACWA destruction systems would be engineered.

In general, toxicity benchmark levels were available to allow quantitative risk estimates for the majority of toxic air pollutants detected. For Neut/Bio operations, 17 chemicals did not have established toxicity benchmark levels. For Neut/SCWO operations, 14 chemicals did not have established (i.e., peer-reviewed) noncarcinogenic or carcinogenic toxicity benchmark levels (see Appendix C). For most of the substances for which toxicity could not be quantitatively evaluated, emission levels were very low (e.g., less than 10 g/d). Although not quantitatively assessed, toxic effects would be highly unlikely in association with these very low emission levels. For several substances emitted from boilers and diesel generators (aldehydes, propane, butane, pentane, and ethane), emission levels were somewhat higher (up to about 1 kg/d). Although potential health effects from inhalation of these substances could not be quantitatively evaluated because of the lack of toxicity benchmark levels, such data would not distinguish among risks associated with the two alternative technologies, because both of them would use boilers and diesel generators.

Per Executive Order 13045 (1997), it is also necessary to consider whether sensitive subpopulations, such as children or the elderly, could be more affected than the general population by the estimated exposures to toxic air pollutants. The reference concentrations used to evaluate the noncarcinogenic toxicity of the emitted substances already include factors to account for the possible added sensitivity of certain subpopulations. Chemical-specific potency estimates for carcinogens also include conservative uncertainty factors and so can be used to assess risks for sensitive subpopulations. However, the exposure parameters used to estimate intake (i.e., 154 lb [70 kg] body weight; 20 m^3/d inhalation rate) are typical for adults. To consider intake for young children (less than 1 year old), an inhalation rate of 4.5 m^3/d and a body weight of 20 lb (9 kg) (EPA 1997) could be assumed. Use of these assumptions would result in an estimate of inhalation dose (in milligrams per kilogram of body weight per day) for a young child that is 1.7 times greater than the dose assumed for an adult, and overall hazard indices and cancer risks would also increase by a factor of 1.7. Since the hazard indices and cancer risks estimated for toxic air pollutant emissions during normal operations were low (Table 6.7-2), risk levels for sensitive subpopulations, such as children, would still be less than benchmark levels.

Inhalation of Chemical Agent. Maximum potential concentrations from emissions of mustard agent under fluctuating operations were discussed in Section 6.6.3.3. Modeling dispersion from the estimated maximum emissions resulted in a maximum estimated on-post concentration of 0.0002 $\mu g/m^3$ for the technologies evaluated. This value is less than 1% of the allowable concentration of 0.1 $\mu g/m^3$ HD/HT for general public exposures (CDC 1988). In practice, the facility stacks would have continuous agent monitoring devices that would sound if any agent was detected in the stacks, so that the source could be identified and eliminated quickly. Emissions would not be allowed to continue at the detection limit level, as was assumed in the modeling exercise.

Mustard has been classified as a known carcinogen (Agency for Toxic Substances and Disease Registry [ATSDR] 1992; also see Appendix C). The maximum incremental cancer risk for the on-post MEI due to hypothetical mustard emissions was estimated to be 1×10^{-8} (Table 6.7-2). This risk level is about 100 times lower than the benchmark risk value of 10^{-6}, and, as stated above, emission levels would not be allowed to continue at the emission limit level for more than a short time, so the exposure assumption of longer than two years is a large overestimate. Therefore, even under hypothetical worst-case emission levels, carcinogenic risks from mustard emissions associated with the destruction facilities would be very small.

Exposures from Other Pathways. Other potential exposure pathways to be considered are water (if effluent from the pilot facilities would be released to nearby waterways) and soil and food (if soil would become contaminated by releases to air and subsequent deposition). In order to use the ACW destruction systems for pilot testing, plans have been made to recycle all process water through the system. The facilities are not expected to generate any aqueous effluent except for the sanitary wastewater generated by employees. Also, exposure through soil and food chain pathways from deposition onto soil and/or water is expected to be very low, since the level of air emissions that would result from routine operations is expected to be very low and since the duration of operations would be short. All facility releases would be in conformance with applicable local and state permit requirements. Therefore, exposures through water, soil, or foodchain pathways would result in minimal, if any, additional risk to on-post workers and residents.

Off-Post Public

Inhalation of Toxic Air Pollutants. Maximum off-post concentrations of toxic air pollutants that would result from the destruction technologies are discussed in Appendix C. Off-post exposures were modeled by using exposure assumptions typical for the MEI in the off-post residential population. (This person is a hypothetical individual present at the location of maximum off-post air concentration for 24 hours per day and 365 days per year, for the duration of the pilot test operations for each technology.) Exposure estimates generated on the basis of these assumptions were compared with cancer and noncancer toxicity values to generate estimates of increased cancer risk and of the potential for noncancer health impacts. A summary of the results of this assessment is shown in Table 6.7-2. Details of the assessment are provided in Appendix C.

This assessment was limited to the estimation of risks associated with inhalation of emitted substances. For some of the emitted substances (e.g., dioxins and furans), exposure to the off-post public through the food-chain pathways could be as large or larger than exposure through inhalation, because these substances are bioaccumulative. Estimates of exposure through these alternate pathways can be highly uncertain and are beyond the scope of this EIS. However, for both technologies, the emission rates for these substances are quite low (less than 0.00001 lb/yr for all forms of dioxins and furans). For the purpose of this assessment (i.e., to compare the risks associated with pilot testing the alternate ACWA technology systems), estimation of the risk associated with inhalation should be indicative of the risk from all pathways.

As shown in Table 6.7-2, estimated hazard indexes and carcinogenic risks from exposure to toxic air pollutants estimated for the off-post MEI were well below levels considered to be hazardous. The typical benchmark indicator for significant noncarcinogenic hazards is a hazard index of greater than one, and for carcinogenic hazards, it is an increased lifetime carcinogenic risk level of greater than 1×10^{-6}. Although many more chemicals were detected in gas samples from Neut/Bio than from Neut/SCWO during the demonstration, the estimated risk levels for routine emissions from the two technologies were very comparable, generally on the same order of magnitude. Almost all the estimated noncarcinogenic and carcinogenic risks were associated with the boiler emissions and not with the destruction facility processes (see Appendix C). Note that exposures and risks were slightly higher for the off-post MEI than for the on-post MEI because the annual exposure duration was assumed to be longer for the off-post MEI (see previous subsection regarding on-post workers and residents). Even if it is assumed that children have up to 1.7 times greater exposure than adults (see Section 6.7.2.2), risks would still remain below levels of concern. A more detailed discussion of assumptions and data limitations for this assessment is provided in Appendix C.

Inhalation of Chemical Agent. Maximum potential concentrations from emissions of mustard agent under fluctuating operations were discussed in Section 6.6.3.3. Modeling dispersion from the estimated maximum emissions resulted in a maximum estimated off-post concentration of 0.00006 $\mu g/m^3$ for the technologies evaluated. This value is only 0.06% of the allowable concentration of 0.1 $\mu g/m^3$ HD/HT for general public exposures (CDC 1988). In practice, the facility stacks would have continuous agent monitoring devices that would sound if any agent was detected in the stacks, so that the source could be identified and eliminated quickly. Emissions would not be allowed to continue at the detection limit, as was assumed in the modeling exercise.

Mustard has been classified as a known carcinogen (ATSDR 1992; also see Appendix C). The maximum incremental cancer risk for the off-post MEI due to hypothetical mustard emissions was estimated to be 2×10^{-7} (Table 6.7-2). Note that the risk is slightly higher for the off-post MEI than for the on-post MEI because the annual exposure duration is assumed to be longer for the off-post MEI. This risk level is five times lower than the benchmark risk value of 10^{-6}, and, as stated above, emission levels would not be allowed to continue at the emission limit level for more than a short time, so the exposure assumption of more than 2 years is a large overestimate. Therefore, even under hypothetical worst-case emission levels, carcinogenic risks from mustard emissions associated with the destruction facilities would be very small.

Exposures from Other Pathways. Exposures through water, soil, or food-chain pathways would result in minimal, if any, additional risk to off-post residents (see previous discussion of exposure from other pathways for other on-post workers and residents).

6.7.3 Impacts of No Action

Munitions maintenance workers at PCD can be exposed to chemicals when conducting inspections or annual munitions inventories. Before a worker is allowed to enter any igloo, the air inside is monitored for the presence of agent. Workers are required to wear respiratory protection and protective clothing while in the storage igloos. No routine use of chemicals would be required for continued storage operations, so exposures to other chemicals would be limited. Another potential hazard is heat stress associated with the heavy protective clothing and equipment required for work. However, workers are trained to control this hazard. For the other on-post workers and residents and for the general public, no impacts to human health would be expected in association with the no action alternative.

Risk calculations for fatalities or injuries resulting from the no action alternative are shown in Table 6.7-1. The expected number of worker fatalities and injuries associated with continuing maintenance of the munitions stockpile at PCD was calculated on the basis of rate data from the BLS as reported by the National Safety Council (1999) and on an estimate of 78 total annual FTE employees required for munitions maintenance activities. Annual fatality and injury rates for the manufacturing sector were used because this sector was assumed to be the most representative for munitions maintenance work. The specific rates were as follows: fatality rate of 3.2 per 100,000 full-time workers, and injury rate of 4.8 per 100 full-time workers. Annual fatality and injury risks were calculated as the product of the appropriate incidence rate (given above) and the number of FTE employees. No distinctions were made among categories of workers (e.g., supervisors, inspectors, security personnel), because the available fatality and injury statistics by industry are not refined enough to warrant analysis of worker rates in separate categories. The estimated number of fatalities from no action is less than one. The estimated total number of injuries is four.

6.7.4 Impacts from Transportation

Chemical agent would not be transported on or off post for any of the alternative technologies evaluated. However, transportation can have adverse impacts on human health because of the associated emission of toxic air pollutants such as benzene, 1,3-butadiene, and formaldehyde. Emissions consist of engine exhaust from diesel- and gasoline-powered vehicles and fugitive dust raised from the road by transport vehicles. Increased incidence of lung cancer has been associated with prolonged occupational exposure to diesel exhaust (Dawson and Alexeeff 2001); toxic air pollutants are also emitted from gasoline-burning vehicles (EPA 2000e). Also, transportation results in some increased risk of injuries and fatalities from mechanical causes; that is, the transport vehicles may be involved in accidents. This type of risk is termed "vehicle-related." Both the chronic health hazard from inhalation of emissions from transport vehicles and the injury risk are directly proportional to the number of vehicle miles traveled.

For the transportation impacts in this EIS, the annual number of vehicle miles traveled by delivery vehicles (used for delivery of construction materials) and commuter vehicles (used to transport construction and operation workers) was compared for each of the alternative technologies and for the no action alternative. In addition, the annual number of shipments of raw materials and waste required for each alternative was tabulated. It was assumed that the distances for shipping raw materials and waste would be similar for each of the alternatives. This assumption was necessary because actual origination and destination locations had not been determined. Therefore, the data did not support risk calculations using diesel emission factors. The comparison of the number of vehicle miles traveled and the number of shipments by alternative is useful for an overall comparison of the potential transportation impacts to human health from each alternative.

The transportation impacts for PCB are summarized in Table 6.7-3. The number of miles traveled annually by construction and operations worker commuter vehicles is similar for both technologies. The Neut/SCWO technology would require about 30% more shipments annually than the Neut/Bio technology. The amount of transportation required for the no action alternative is very small.

6.8 NOISE

The *Noise Control Act of 1972*, along with its subsequent amendments (*Quiet Communities Act of 1978*, found in *United States Code*, Title 42, Parts 4901-4918 [42 USC 4901-4918]), delegates to the states the authority to regulate environmental noise and directs government agencies to comply with local community noise statues and regulations. The State of Colorado has quantitative noise-limit regulations. The maximum permissible noise limits for the various classes of source areas under the Colorado Noise Abatement Law are listed in Table 6.8-1. Pueblo and Pueblo County use the Colorado limits.

TABLE 6.7-3 Comparison of Annual Transportation Requirements for Construction and Routine Operations for Alternative Technology Systems at PCD[a]

Parameter	Neut/Bio	Neut/SCWO	No Action[b]
Number of vehicle miles traveled[c]			
Construction delivery vehicle	200,000	200,000	NA[d]
Construction worker commuter vehicle	3,700,000	4,600,000	NA
Operations worker commuter vehicle	7,000,000	7,000,000	900,000
Number of shipments[e]			
Mustard agent			
Raw materials	159	883	NA
Waste	1110	809	NA
Total	1,269	1,692	NA

[a] Number of vehicle miles traveled and number of shipments are used as indicators of potential transportation-associated health impacts, since emissions and vehicle-related risks increase with increasing transportation.

[b] No action alternative assumes 78 employees would be required for continued storage maintenance.

[c] Annual miles are calculated as the number of workers × 276 work days per yr × 40 mi per round trip.

[d] NA = not applicable.

[e] Raw material and waste shipments for nerve agent are the maximum annual for either GB or VX processing.

Input data sources: Kimmel et al. (2001).

The EPA guideline recommends an L_{dn} of 55 dBA to protect the public from the effect of broadband environmental noise in typically quiet outdoor and residential areas (EPA 1974).[7,8] For protection against hearing loss in the general population from nonimpulsive noise, the EPA guideline recommends an L_{eq} of 70 dBA or less over a 40-year period.[9]

[7] L_{dn} is the day-night A-weighted equivalent sound level, averaged over a 24-hour period.

[8] dBA is a unit of weighted sound-pressure level, measured by the use of the metering characteristics and the A-weighting specified in ANSI S1.4-1983 (the American National Standards Institute specification for sound level meters) and in ANSI S1.4A-1985, the amendment to S1.4-1983 (Acoustical Society of America 1983, 1985).

[9] L_{eq} is the equivalent steady sound level that, if continuous during a specific time period, would contain the same total energy as the actual time-varying sound. For example, L_{eq}(1-h) is the 1-hour equivalent sound level.

TABLE 6.8-1 State of Colorado Regulations on Maximum Permissible Noise Levels

	Maximum Permissible Noise Level (dBA)[a]	
Zone	7 a.m. to 7 p.m.[b]	7 p.m. to next 7 a.m.
Residential	55	50
Commercial	60	55
Light industrial	70	65
Industrial	80	75

[a] At a distance of 25 ft (8 m) or more from the property line. Periodic, impulsive, or shrill noises are considered a public nuisance when such noises are at a level of 5 dBA less than those listed. Construction activities are subject to the limits listed for industrial zones.

[b] For a period not to exceed 15 minutes in any one hour, the noise level may be exceeded by 10 dBA.

Source: *Colorado Revised Statutes*, Title 25 on Health, Article 12 on Noise Abatement.

6.8.1 Current Environment

An investigation of the noise environment at PCD (U.S. Army Environmental Hygiene Agency [USAEHA] 1990) indicated that noise levels within the potion of PCD encompassing Areas A, B, and C was less than 65 dBA. Measurements made in November 1999 at the TTC, located north of PCD, indicate that minimum background noise levels were around 34 dBA during mid-afternoon, with an average background L_{95} of 38 dBA for a 1½-hour period (White 2000).[10] The average nighttime background noise level was around 25 to 30 dBA, depending on wind conditions. These background levels are comparable to the residual sound levels of typical rural areas, which are approximately 30 to 35 dBA (Liebich and Cristoforo 1988).

Currently, the only residence or sensitive noise receptors (e.g., hospitals, schools, parks) in the immediate vicinity of PCD are the on-post residences located in the Administrative Area and Hi-Pardner Park, next to PCD's main gate (see Figure 6.1-2). The off-post residence closest to an area being considered for a pilot facility is located about 0.5 mi (0.8 km) north of the PCD boundary. The closest population centers with schools or town infrastructure are North Avondale

[10] L_{95} represents a sound level that is exceeded 95% of the stated time period.

and Avondale, which are about 0.4 mi (0.7 km) and 1.6 mi (2.6 km), respectively, from the south boundary of the PCD site.

6.8.2 Noise Sources for the ACWA Pilot Test Systems

Standard commercial and industrial practices for moving earth and erecting concrete and steel structures would be used to construct an ACWA pilot facility. Noise levels generated from these activities would be comparable to those from any construction site of similar size.

Pilot facility operations would involve a variety of equipment that would generate noise. Because of the nature of chemical agent destruction operations, most of the equipment would be housed in buildings designed to prevent the release of chemical agents and to contain potential explosions. These buildings would attenuate the noise generated by the activities within them. However, equipment such as fans and pumps used to convey treatment residues (e.g., pollution abatement systems), heating and air conditioning units, electrical transformers, and in-plant public address systems would generate noise, and these items might be located outside. In addition, vehicular traffic in and around the ACWA facility during both construction and operation would generate noise.

6.8.3 Impacts of the Proposed Action

6.8.3.1 Impacts of Construction

The operation of equipment and vehicles during construction and associated activities would result in noise. Activities such as land clearing, grubbing, excavation, and soil movement at a typical construction site generate noise levels in the 77–90 dBA range at a distance of about 50 ft (15 m) from the source (EPA 1979). Noise levels decrease about 6 dB per doubling of distance from the source because sound spreads over an increasing area. Thus, construction activities at the pilot test facility location would result in estimated noise levels of about 45–50 dBA at the PCD boundary closest to Area A and 40–45 dBA at the residence nearest to the site (i.e., at a distance of about 1.7 mi [2.7 km] north of the center of Area A).

This 45-dBA estimate is likely to be an upper bound because it does not account for other types of attenuation, such as air absorption and ground effects due to terrain and vegetation. The 45-dBA level is below Colorado and EPA standards for residential zones (see Table 6.8-1) and is in the range found within a typical residential community at night (Corbitt 1990). If other attenuation mechanisms were considered, noise levels at the nearest residence would decrease to near background levels of 30–35 dBA (see Section 6.8.1). Thus, potential noise impacts from construction activities at the pilot test facility location are expected to be minor or nonexistent at the nearest residence and well within local and state limits.

6.8.3.2 Impacts of Operations

The pollution abatement system being used at the baseline incinerator facility in Tooele, Utah, is similar in design to the pollution abatement systems being considered for use in the ACWA pilot facility. Sound level measurements taken during operation of this system were less than 73 dBA within 100 ft (30 m) of the abatement equipment (Andersen 2000). When the noise attenuation factors discussed in Section 6.8.3.1 are applied, it is estimated that noise levels from the proposed facility would be less than 35 dBA at the nearest residence, 1.7 mi (2.7 km) from the proposed facility. This noise level at the nearest residence is comparable to the ambient background level discussed in Section 6.8.1; it would be barely distinguishable from the background level. In conclusion, noise levels generated by plant operations should have a negligible impact on the residence that is located nearest to the proposed facility and be well within local and state limits.

6.8.4 Impacts of No Action

The levels of noise generated by current stockpile maintenance activities are part of the current background noise levels that reflect installation operation. These would not be expected to change under the no action alternative. Therefore, the conditions described in the affected environment would continue to exist. Existing noise levels are within legal limits and are not a significant concern.

6.9 VISUAL RESOURCES

Natural and man-made features give a particular landscape its character and aesthetic quality. The character of a landscape is determined by the elements of form, line, color, and texture; each element may influence the landscape's character to a varying degree. The stronger the influence of any one or all of these elements, and the more visual variety that the landscape can successfully incorporate, the more pleasing is the aesthetic quality of the landscape.

6.9.1 Current Environment

The viewshed within the vicinity of PCD consists primarily of rolling, open pasture land used for livestock grazing. Although there are signs of development around PCD, including residential homes, rail test facilities, roads, railways, and transmission lines, the overall visual character of the area is still the open plains typical of eastern Colorado. There are no areas of significant scenic quality (e.g., national or state parks, nearby mountain vistas).

PCD itself is largely industrial. Although there are some large undisturbed areas and a few small water bodies on the post, much of the installation has been disturbed by the construction of buildings, storage igloos, roads, rail lines, utility structures and corridors, and fences. The developed portions of the installation will continue to be used under the PCD Reuse Plan (PDADA 2000).

The industrial and other developed areas on the site, including utility corridors, are generally consistent with a BLM VRM Class IV designation (activities that lead to major modification of the existing character of the landscape). The remainder of the site fits a VRM Class III or IV designation (hosting activities that, at most, only moderately change the existing character of the landscape) (DOI 1986a,b).

The three potential sites for ACWA facilities are adjacent to the Munitions Storage Area A area, which is surrounded by a chain link fence. The igloo structures are low-profile but are visible, since the area is flat and has very little vegetation. A large tower, storage tanks, and several buildings are visible in the Munitions Storage Area A area. Although not presently developed, all of the potential sites for the ACWA facilities are within the Chem Demil area.

The state of Colorado has a visibility standard that limits the maximum permitted light extinction coefficient value to 0.076 per kilometer (equivalent to a minimum visual range of about 30 mi, or 50 km) averaged over a four-hour period between 8 a.m. and 4 p.m. local time. This standard applies when the relative humidity is less than 70% to a program area that includes the Denver metropolitan area but does not include PCD or any other areas in Pueblo County. The location subject to this visibility standard is about 15 mi (24 km) north of PCD, at the El Paso County line.

6.9.2 Site-Specific Factors

The general visual character of PCD could be affected by the

1. Visual character of the ACWA facility and its supporting components (other facilities, transmission lines, roads, parking areas),
2. Placement of the ACWA facility (its elevation, adjacent land use, resulting viewshed, etc.) and
3. Visibility impacts from fugitive dust emissions created by construction or from steam emissions created by the operating stacks.

6.9.3 Impacts of the Proposed Action

6.9.3.1 Impacts of Construction

Construction of an ACWA facility would not be expected to affect visual resources because (1) there are no significant visual resources in the area, (2) surrounding areas are used primarily for grazing, and (3) the effects would be intermittent and temporary.

6.9.3.2 Impacts of Operations

The presence of ACWA facilities is consistent with the surrounding land uses and would not adversely affect the visual resources in the area. Operation of the facilities would not create significant, visible emissions.

6.9.4 Impacts of No Action

Under the no action alternative, there would be no change to the existing visual character of PCD.

6.10 GEOLOGY AND SOILS

6.10.1 Current Environment

6.10.1.1 Geology

PCD is situated on a terrace in the western part of the Colorado Piedmont section of the Great Plains physiographic province. The gently rolling topography at PCD ranges in elevation from about 4,800 ft (1,500 m) above mean sea level (MSL) at the northern boundary to about 4,700 ft (1,500 m) above MSL at the southern boundary (Chafin 1996).

The upland alluvial terrace deposits underlying PCD consist of interlayered sand, gravel, and clay layers that were deposited during the Pleistocene Epoch (Watts and Ortiz 1990). Across the installation, these alluvial deposits range in thickness from 0 to 95 ft (30 m) (Chafin 1996). They unconformably overlie the Pierre Shale, a thinly bedded, dark gray to black shale/sandy shale unit of Upper Cretaceous age. The Pierre Shale, which is approximately 1,200 ft (370 m) thick in this area, is characterized by an irregular surface that was shaped by erosion before deposition of the alluvial terrace deposits (Watts and Ortiz 1990). Irregularities in the surface of the Pierre Shale account for the wide variability in thickness of the alluvial deposits at PCD. Weathered exposures of the Pierre Shale bedrock occur along the courses of Chico and Haynes Creeks (Scott et al. 1978), but these contacts are partially obscured by soils (Watts and Ortiz 1990). Economic geologic resources beneath PCD are limited to sand and gravel deposits. Mineral resources are not known to be present.

6.10.1.2 Seismicity

PCD is located within the Plains Seismotectonic Province as defined by Kirkham and Rogers (1981). Tectonic activity during the past 23 million years has been limited in this province; there is no evidence of major Neogene activity present (Kirkham and Rogers 1981). Only four faults in the Plains Province show evidence of Neogene activity: the Fowler Fault, Cheraw Fault, Valmont Fault, and Rocky Mountain Arsenal Fault.

The closest potentially active tectonic feature to PCD is Fowler Fault, located near the town of Fowler, Colorado. This fault trends northwest-southeast and, at its closest point, is located about 13 mi (20 km) east of the site. It has a length of about 8 mi (12 km). The most recent movement on this fault has been dated to the period of time between the mid-Pleistocene and Holocene Epochs (i.e., between 1 million and 11,000 years ago) (Kirkham and Rogers 1981; U.S. Army et al. 1987). A second potentially active fault, Cheraw Fault, is also located in the lower Arkansas River Valley region near Cheraw, Colorado. This fault trends northeast-southwest and, at its closest point, is located about 43 mi (70 km) east of PCD. It has an estimated length of 27 mi (44 km). Movement on this fault also has been dated to the Quaternary (10,000 years before present) (Kirkham and Rogers 1981; U.S. Army et al. 1987). The Valmont Fault lies about 5 mi (8 km) northeast of Boulder, Colorado. This fault has been described as minor, with a north, 50 degrees east trend (Kirkham and Rogers 1981). The Rocky Mountain Fault is an inferred linear northwest-trending zone in northeast Denver, Colorado. It is widely accepted that a series of earthquakes that begin in 1962 along this fault were triggered by deep fluid injection at the Rocky Mountain Arsenal well (Kirkham and Rogers 1981). Cheraw and Fowler Faults experienced movement during the Quaternary Epoch. They could be responsible for earthquakes up to intensity VI (U.S. Army et al. 1987). A modified Mercali intensity VI earthquake would be felt by all; windows, dishes, and glassware would break; furniture would move or overturn; and weak plaster and masonry would crack (Kirkham and Rogers 1981).

The nearest recorded earthquake to PCD that produced damage occurred on January 6, 1979 (Kirkham and Rogers 1981). This earthquake had a center at Divide, Colorado, approximately 60 mi (100 km) from the site. It had an intensity of V (small objects were displaced, pictures moved).

On the U.S. Army's behalf, Jacobs Engineering Group, Inc., and URS/John A. Blume & Associates jointly prepared a comprehensive assessment of the earthquake hazards at PCD. The results of this assessment and comprehensive discussions of regional geology, tectonics, and earthquake history are presented in a report issued by the U.S. Army (U.S. Army et al. 1987). On the basis of this assessment, it was determined that the maximum earthquake that could affect PCD would most likely occur on Fowler Fault (U.S. Army et al. 1987). The maximum earthquake magnitude for Fowler Fault was estimated to be a local magnitude of M = 6.1 (equivalent to m_b = 5.7).[11] An earthquake of this magnitude would produce a peak ground acceleration of 0.21 G at PCD. The earthquake duration was estimated to be eight seconds. The impacts on buildings that would result from an earthquake of this intensity would be damage to masonry, with a potential for a partial building collapse.

A recent probabilistic analysis was performed for the Army Chemical Disposal Facility at Pueblo, Colorado. This study indicated that the peak ground acceleration associated with the Cheraw and Sangre de Cristo Faults and the Great Plains and Denver Basin Source Zones would be approximately 0.1 G for an earthquake that would have a 100% probability of occurring once in 1,000 years. A peak ground acceleration of approximately 0.23 G was estimated for an earthquake that would have a 100% probability of occurring once in 10,000 years (Benjamin and Geomatrix 1996). This value agrees closely with the 0.21-G value previously estimated by the U.S. Army et al. (1987). However, the Benjamin and Geomatrix (1996) study did not include Fowler Fault in the analyses because recent data did not show any bedrock fault with significant displacement in the location of the postulated feature. The nearest capable fault for this study was Cheraw Fault, described above.

According to Army Technical Memorandum 5-809-10 (U.S. Army et al. 1992), PCD is located in seismic probability zone 1, a zone where minor earthquake damage may be expected to occur at least once in 500 years (or a 10% probability of occurrence in 50 years). This manual contains seismic design criteria that are in accordance with recommendations from the Structural Engineers Association of California, American Concrete Institute, American Institute of Steel Construction, and International Conference of Building Officials. In a report on the seismic fragility of structures and equipment that was done for the U.S. Army Pueblo Chemical Agent Disposal Facility in Pueblo, Colorado, designs were based on an earthquake that had a 100% probability of occurring once in 100,000 years (Shah and Reed 1996). The peak ground acceleration for this event was estimated to be 0.403 G.

6.10.1.3 Soils

Soil types at PCD vary (Table 6.10-1 and Figure 6.10-1) and are grouped into several soil associations on the basis of shared characteristics (USDA 1979). Within the areas at PCD designated for chemical demilitarization activities, the soils belong to the Valent, Olney-Vona, and Arvada-Keyner Associations. The soils along the utility corridors are basically the same as

---

[11] M (moment magnitude) represents the strength of an earthquake based on the concept of seismic moment. m_b (body-wave magnitude) is a measure of the energy released by an earthquake.

TABLE 6.10-1 Soil Associations at PCD

Association	Soil Type	Characteristics
Stoneham-Adena-Manzola	Sandy to clayey loams that form in loess and in loamy and clayey alluvium	Deep, well drained Slow or moderate permeability High available water capacity Medium runoff Moderate potential for erosion
Olney-Vona	Sandy loams and loamy sands that form in eolian sands	Deep, well drained Moderate to rapid permeability High available water capacity Slow runoff High potential for wind erosion
Limon-Razor-Midway	Silty clays, silty clay loams, clay loams, and clays that form in materials weathered from shale	Shallow to deep, well drained Slow permeability High to very low available water capacity Rapid to medium runoff Moderate to severe potential for erosion
Arvada-Keyner	Sandy to clayey loams that form on terraces in alluvium derived from mixed sedimentary rocks	Deep, well-drained Very slow permeability High available water capacity Slow runoff Slight potential for erosion
Valent	Loamy sands and sands that form in eolian sands	Deep, excessively well drained Very rapid permeability Low available water capacity Slow runoff Severe potential for wind erosion
Las Anima-Glenberg-Apishapa	Fine sandy loams and silty clays that form in alluvium on flood plains	Deep, somewhat poorly to well drained Slow to moderately rapid permeability Moderate to high available water capacity Slow runoff High potential for erosion

Source: Adapted from USDA (1979).

the soils encountered at Sites A, B, and C, except that Corridors 2, 3, and 4 also include soils from the Limon-Razor-Midway Association. The engineering properties of these soils are variable and must be accounted for in the design of any facilities built in these areas.

For the most part, the soils at Site A have been largely undisturbed, except along roadways and the Munitions Storage Area A fence line. Soils at Sites B and C have been disturbed by previous activities. Soils along Corridors 1 and 2 and most of 4 have been previously disturbed, whereas soils along Corridor 3 are largely undisturbed.

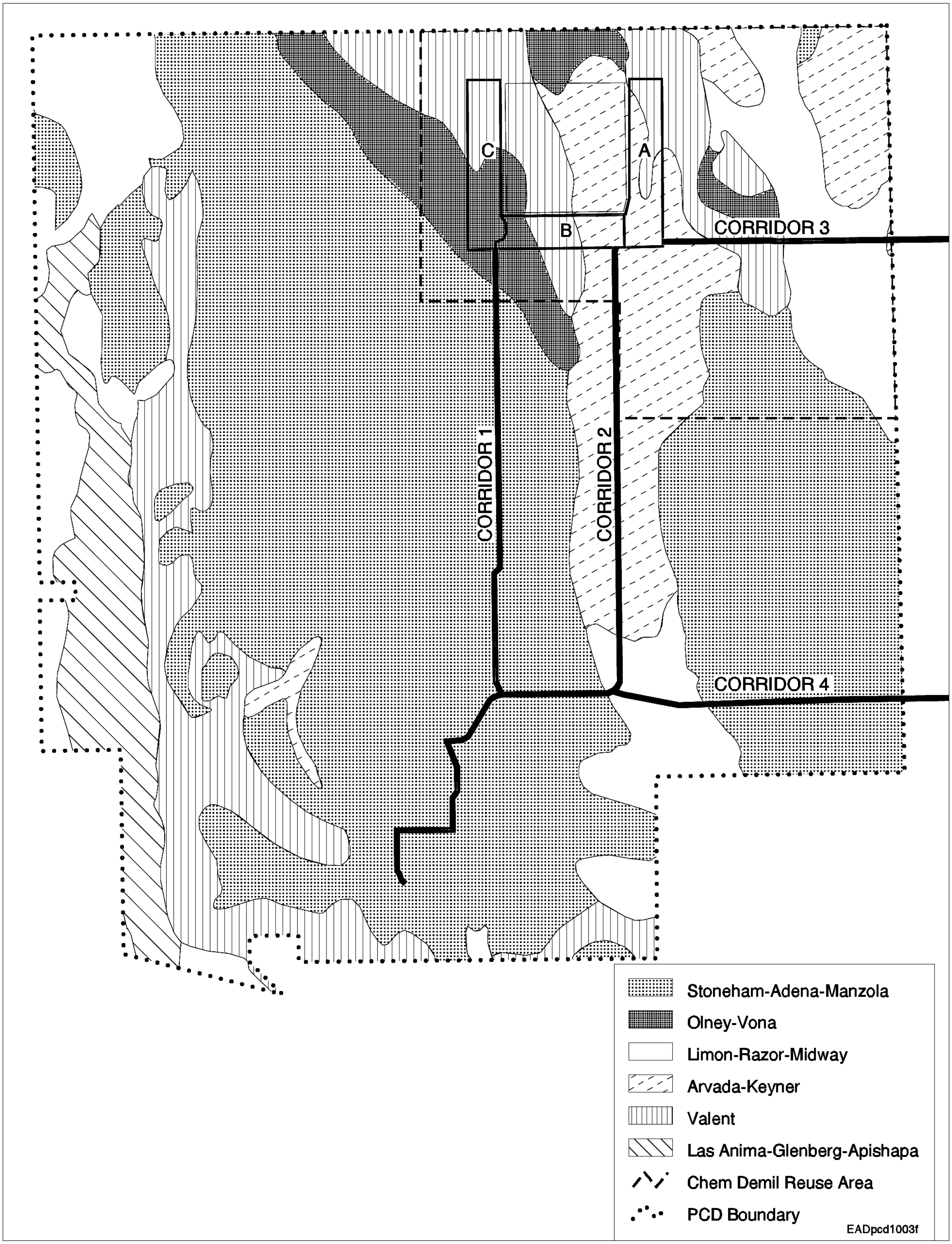

FIGURE 6.10-1 Soil Types at PCD

6.10.2 Site-Specific Factors

Because the proposed action would entail only shallow excavation and require only standard building materials, it would not affect the geologic resources at or in the vicinity of PCD. However, it could affect the soils at PCD, as a result of excavation, erosion, or accidental spills and releases of a variety of hazardous materials, including chemical agents. These potential impacts are discussed in the following sections on impacts of the proposed action and no action. Potential impacts on soils associated with a major accident resulting in catastrophic releases of agent are discussed in Section 6.21.

6.10.3 Impacts of the Proposed Action

6.10.3.1 Impacts of Construction

Approximately 25 acres (10 ha) of ground could be affected to some degree from construction of the pilot facilities, sewage lagoon, and a new substation to support pilot testing in either Site A, B, or C. As much as an additional 60 acres (24 ha) of ground could also be disturbed from development of the site infrastructure (e.g., installation of an electric transmission line, gas pipeline, and water pipeline) (Table 6.3-3). Soil disturbance could result in an increased potential for erosion, which could affect surface water bodies and biological resources. Best management practices (e.g., use of soil fences, berms, and liners; revegetation of disturbed land following construction) would be employed to minimize the potential for soil erosion.

In addition, soils could be affected during construction of the pilot facilities if there was an accidental spill or release of a hazardous material. Primarily, such events would be limited to spills of hazardous materials (e.g., paints, solvents) transported to the site and used during construction of the pilot facilities and to leaks of petroleum-based products (e.g., fuel, hydraulic fluid) from construction vehicles. In such an event, actions would be taken to contain the spill or leak to limit its migration. Any contaminated soils would be excavated and disposed of in accordance with applicable requirements.

6.10.3.2 Impacts of Operations

Impacts on soils could result from the operation of pilot facilities if there were an accidental spill or release of a hazardous material. Such events could include spills of any chemical transported to and used in the ACWA pilot facilities, spills of chemical agent during transport of an ACW from the storage bunker to the pilot facilities, and leaks of petroleum-based products from vehicles. In such an event, actions would be taken to contain the spill or leak to limit its migration. Any contaminated soils would be excavated and disposed of in accordance with applicable requirements.

Although operations would result in air emissions of a variety of contaminants, the concentrations of these contaminants would be so low (see Sections 6.5 and 6.6) that they would not have a significant impact on surface soils.

6.10.4 Impacts of No Action

Under the no action alternative for PCD (which is defined as continued storage of the ACWs), potential impacts on soils would be limited primarily to leaks of petroleum-based products from vehicles. Releases of other hazardous materials, including chemical agent, would be very unlikely, given the contained nature of stockpile maintenance activities.

6.11 GROUNDWATER

6.11.1 Current Environment

6.11.1.1 Geohydrology

This description of the geohydrology of PCD is compiled mainly from the 1996 U.S. Geological Survey (USGS) report (Chafin 1996). The USGS delineates two separate aquifers on PCD: (1) the terrace alluvial aquifer that underlies the majority of the site and (2) the Chico Creek aquifer that is located downgradient and west in Chico Creek Valley. The Chico Creek aquifer will not be affected by the proposed activities because it is separated from the main PCD post area by the incised drainage of Chico Creek. Therefore, this discussion focuses on the terrace alluvial aquifer because it is the only aquifer that can be affected by the proposed action. A third aquifer, the Arkansas River Valley aquifer, is located in the Arkansas River Valley south of PCD. This aquifer is significant and supplies agricultural irrigation wells, many of which are located downgradient of PCD. The terrace alluvial aquifer located under PCD and the Arkansas River Valley aquifer are not hydraulically connected (Ebasco Environmental 1990). However, Rust (1997) found some connection between aquifers in a narrow alluvial channel near Unnamed Creek in the south-central portion of PCD.

Hydraulic conductivity in the terrace alluvial aquifer, measured in a combination of pump and slug tests, covers a wide range, from 0.4 to 400 ft/d (0.12 to 122 m/d) (Chafin 1996). Under the assumption that porosity is 0.2, the estimated groundwater flow velocity ranges from 0.02 to 3 ft/d (0.12 to 122 m/d); the median is 0.8 ft/d (7.9 m/d) (Chafin 1996). In locations near the landfill, velocities as high as 11 ft/d have been estimated (Chafin 1996). The estimated hydraulic gradient ranges from 0.003 to 0.02 (Chafin 1996). Because the potential evaporation of 48 in. (120 cm) exceeds the precipitation of 11 in. (30 cm) by a large margin, potential recharge to the groundwater aquifer from rainfall on PCD is small (Chafin 1996). Rice et al. (1989) argues that under these types of conditions, recharge is approximately 1% of precipitation, or, in this case, 0.1 in. (0.25 cm) per year. Water, and any potential contamination, may migrate through thin, highly permeable layers in the terrace alluvium at velocities near the upper range of the estimates provided. In addition, in areas where eolian sands cover the surface, infiltration rates could be higher.

The terrace alluvial aquifer at PCD consists of interlayered sand, gravel, and clay from a Pleistocene deposit (see Section 6.10). According to Chafin (1996), drillers logs indicate that the alluvium is 1 to 10 ft (0.3 to 3 m) of sandy or silty clay, clayey or sandy silt, or clayey or silty fine- to medium-grained sand underlain by interbedded layers of poorly sorted, often clayey and gravelly, fine- to coarse-grained sand. Chafin (1996) indicated that the seven bores drilled to characterize the terrace alluvial aquifer penetrated 40 to 95 ft (10 to 30 m) of alluvium before reaching bedrock. The terrace alluvial aquifer is underlain by an almost impermeable Pierre Shale (bedrock), which is 1,200 ft (360 m) thick (Watts and Ortiz 1990). The shale effectively isolates the surface terrace alluvial aquifer from other groundwater resources in the area. The shale would also isolate deeper groundwater aquifers from any impacts that would result from the proposed activities. The uppermost significant water-bearing formation below the Pierre Shale is in the Dakota Sandstone, at least 2,200 ft (670 m) below the surface (Chafin 1996).

Below the terrace alluvial aquifer, the bedrock surface, shown in Figure 6.11-1, slopes about 0.5% to the south (Ebasco Environmental 1990) and is regular in the northern portion of PCD. The bedrock surface in the southern portion of PCD is irregular and has a series of hills, troughs, and ridges (Chafin 1996). The bedrock surface is inferred from limited data. The saturated thickness of the aquifer ranges from 0 to 45 ft (0 to 14 m). A bedrock trough starts near the center of the northern boundary and trends in a southern direction through the center of PCD. Four water supply wells are located in this trough because of the increased saturated thickness of the aquifer in this region (Chafin 1996).

The terrace alluvial aquifer is bounded on the west by a steep scarp caused by Chico Creek downcutting into the terrace deposits. On the south, it is bounded by the Arkansas River Valley, which has formed a similar scarp. The Boone Creek drainage, near the center of PCD, effectively separates the terrace alluvial aquifer into two hydrogeologically distinct units. The head of the Boone Creek drainage contains a bedrock alluvium contact spring located just to the southeast of Munitions Storage Area A. The eastern boundary of the terrace alluvial aquifer is formed by a scarp from the downcutting of Haynes Creek. Where the terrace alluvial aquifer does not encounter an exposed bedrock-alluvial boundary, the aquifer is bounded by local bedrock highs that reach above the groundwater table.

Figure 6.11-2 shows the groundwater surface profile. Groundwater flow generally follows the surface slope in a southerly direction. However, in the southwest area of PCD, flow directions are complex and dictated by the irregular bedrock surface and surface drainage features that cut into the terrace alluvial deposit. In addition, there are bedrock outcrops, and a series of seeps and springs discharge at the exposed bedrock-alluvial contact.

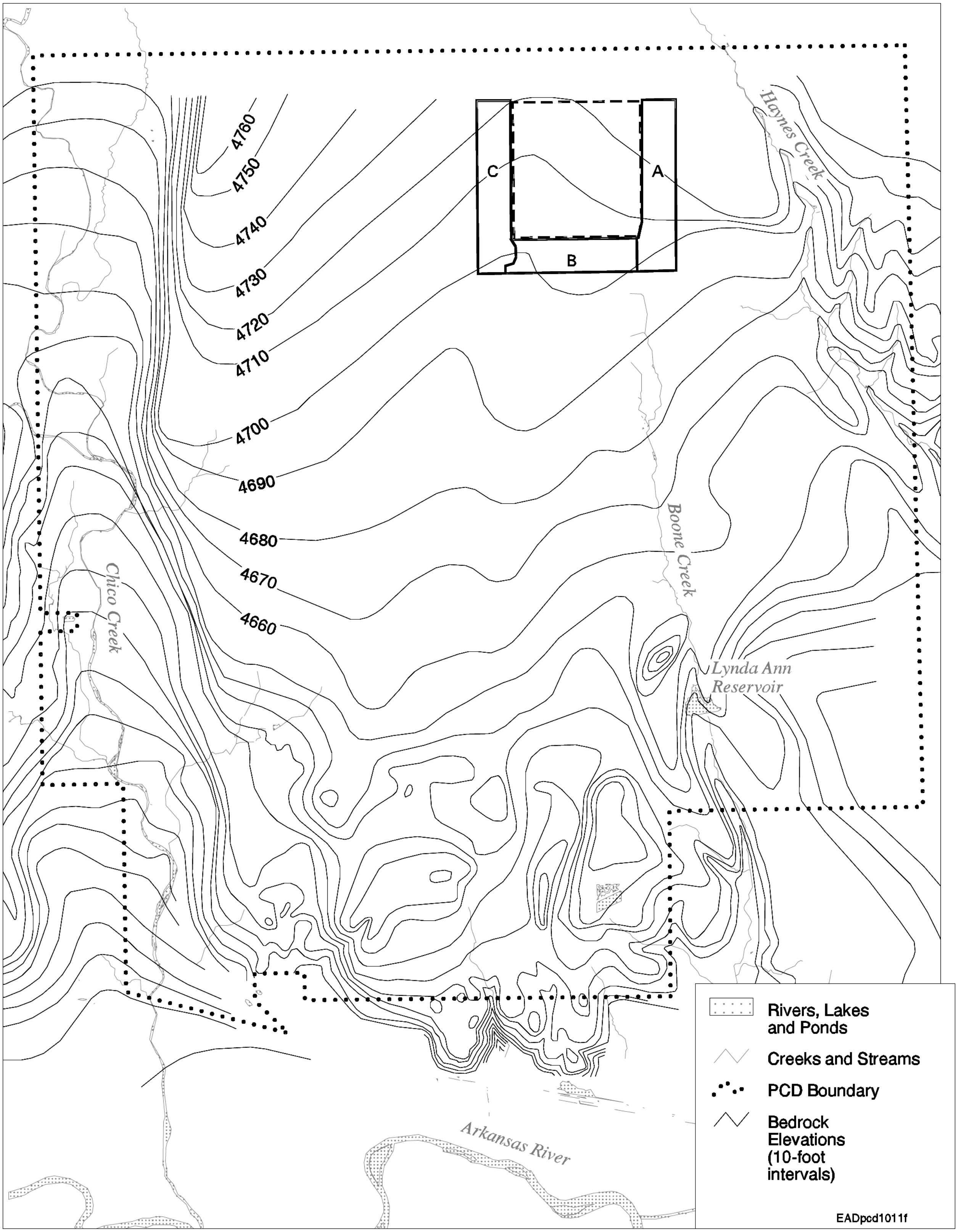

FIGURE 6.11-1 Bedrock Surface Elevations at PCD

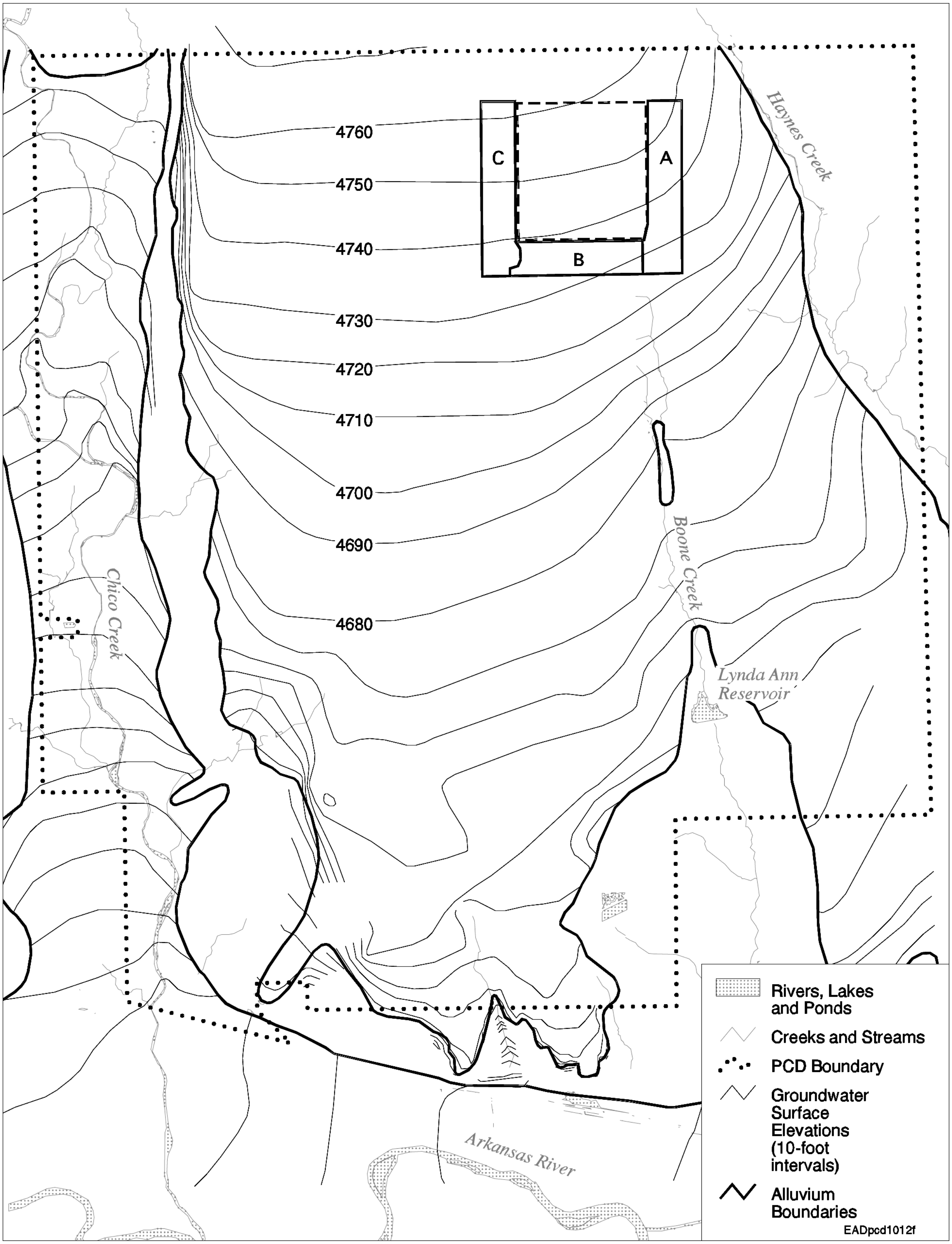

FIGURE 6.11-2 Groundwater Contours at PCD

6.11.1.2 Groundwater Quantity

The source for groundwater under PCD is primarily from underflow from the north (U.S. Army 1982). Estimated flow volumes range from 400 acre-ft/yr (490,000 m^3/yr) (Chafin 1996) to 900 acre-ft/yr (1,100,000 m^3/yr) (U.S. Army 1984). Both of these studies assume that little or no recharge takes place on PCD, even though the surface soil is generally permeable. The studies attribute this lack of infiltration to low precipitation and high evapotranspiration. Because the aquifer ends on the scarps and slopes that surround PCD, these estimates would also be the same for the total discharge of springs, seeps, and groundwater withdrawals on post and immediately off post (Chafin 1996).

Watts and Ortiz (1990) estimated discharge from the terrace alluvial aquifer along the southern edge of the landfill and areas south of the landfill to be 9,600 to 19,200 ft^3/d (80 to 160 acre-ft/yr or 99,000 to 197,000 m^3/yr). Groundwater along the southern boundary discharges in seeps and springs along the terrace edge, flows across the exposed Pierre Shale, and infiltrates into unconsolidated material adjacent to the terraces. Heavy plant growth in this area reduces water flow, and not enough water is discharged to reach the Arkansas River aquifer to the south (Watts and Ortiz 1990). However, there is a possibility that the Arkansas River aquifer may receive surface water flow from the terrace alluvial aquifer that originated as groundwater discharge (Ebasco Environmental 1990).

6.11.1.3 Groundwater Quality

Groundwater in the terrace alluvial aquifer is sodium-bicarbonate type and generally of good quality (U.S. Army 1994) north of the administrative area. Specific conductance is generally less than 800 μS/cm, with the smallest values in the north (Chafin 1996). Values increase to the south and toward seepage faces. Chafin (1996) reported a high value of 3,300 μS/cm near the landfill in the south and suggested that this was a result of contamination. Dissolved solids are generally at levels of less than 500 mg/L, except in water in the southern portion near the landfill (Chafin 1996) and in water in areas of known contamination.

In general, with the noted exception of the contaminated areas in the southern portion of PCD, groundwater below PCD meets the primary state and federal standards for drinking water, except for the selenium standard (U.S. Army 1984). Near the landfill, sulfate and nitrate levels exceed the secondary drinking water standards (Watts and Ortiz 1990). Selenium concentrations range from a low of 0.008 to a high of 0.02 mg/L (U.S. Army 1984). The federal standard for selenium in drinking water is 0.01 mg/L. The high selenium levels are derived from local geological materials that have naturally high selenium concentrations. Sulfate concentrations range from 222 to 720 mg/L near the landfill (Watts and Ortiz 1990), and several wells have exhibited high nitrate concentrations. Nine of fifteen wells sampled by Watts and Ortiz had nitrate levels above 10 mg/L (Watts and Ortiz 1990). The secondary drinking water standard for sulfate is 250 mg/L (40 CFR 143.3), and the primary maximum concentration level (MCL) for nitrate is 10 mg/L (40 CFR Part 141).

Near the landfill in the southern section of PCD, dissolved solids range from 700 to 1,800 mg/L (Watts and Ortiz 1990) and increase downgradient across the landfill. Watts and Ortiz (1990) identified two organic contaminants in the groundwater downgradient of the landfill: trichloroethylene (TCE) and trans-1,2-dichloroethylene (DCE). TCE concentrations ranged from 5.2 to 2,900 μg/L, and concentrations of DCE ranged from nondetectable levels (i.e., the detection limit is 5 μg/L) to 720 μg/L. Watts and Ortiz (1990) suggest that there is more than one source for the organic contamination: the landfill and another location to the north of the landfill. Rust (1997) indicates that the Plating Waste Drainage Ditch and sumps in former Building 547, both to the north of the landfill, are also sources of groundwater contamination. The findings from the Rust report support the CDPHE Compliance Order on Consent. The MCL for TCE is 5 μg/L, and the MCL for DCE is 100 μg/L (40 CFR Part 141).

Rust (1997) reports the presence of an organic contaminant groundwater plume south of the landfill that is being contained by the interim corrective action groundwater remediation system (ICAGRS) along the southern boundary of PCD. Explosive compounds have been identified in groundwater in the southwestern portion of PCD and at low concentrations at an off-post spring just north of Highway 96. While Rust, Inc. (1997) describes a connection between the alluvial aquifer and the Arkansas River Valley aquifer near Chico Creek and Unnamed Creek in the south-central portion of PCD, there is no evidence that water reaches the Arkansas River Valley aquifer from the alluvial aquifer as groundwater. However, surface flows from springs and seeps may reach the Arkansas River Valley aquifer. No organic contaminants were found in the Arkansas River Valley aquifer immediately south of the landfill; a plume of explosives has been identified to the east.

To address groundwater contamination in the southern portion of PCD, the ICAGRS was constructed and placed into operation in March 1995 (Cain 1999). The goals of this system are to stop off-post migration of contaminated groundwater, treat captured groundwater to meet regulatory guidelines, reduce existing off-post contamination levels, and produce a continued decrease in contaminant levels (Cain 1999). The system is located near the south-central section of PCD and includes 54 recovery wells along the southern boundary of PCD. Groundwater is treated by using air-stripping for organic contaminants and, if needed, carbon filters for inorganic contaminants. The majority of the treated water is infiltrated downgradient of the recovery well system through infiltration galleries. The remainder is released by surface discharge to Unnamed Creek (Cain 1999).

6.11.2 Site-Specific Factors

Construction-related impacts on water resources are expected to be essentially the same for each of the ACWA technologies being considered. Although there may be some variation between the technologies with regard to the amount of area disturbed by construction activities, until engineering design studies are completed, the exact acreage will not be known. A maximum of about 85 acres (34 ha) could be disturbed by construction, equal to about 0.4% of the total area of PCD (Table 6.3-3). Approximately half of this area would be disturbed as a result of site preparation, and the other half would be disturbed as a result of the installation of a gas pipeline and other utilities. These utilities might be installed in existing disturbed corridors, such as along roadways. Only 25 acres (0.1% of the total area of PCD) would be disturbed by construction of the pilot facilities.

The foreseeable impacts on groundwater resources from operation of the ACWA technologies would result from the use of water and the generation of sanitary sewage. These numbers are similar for the two technologies. Impacts from increased water usage are discussed in Section 6.3.3.2. Impacts from generation of sanitary sewage are discussed in Sections 6.4.3.1 and 6.4.3.2.

6.11.3 Impacts of the Proposed Action

6.11.3.1 Impacts of Construction

Estimated annual water use during the construction of ACWA facilities would be 2,800,000 gal (10,600 m^3 or 8.6 acre-ft) (Kimmell et al. 2001). This amount would represent almost a twofold increase above the current water usage of 4.3 acre-ft/yr. There is sufficient water in the alluvial terrace aquifer to meet increased demand. The impact of these additional withdrawals would be negligible, because withdrawals would be significantly less than historical withdrawals and be short-lived. Also, if impacts would occur, they would exist for only a short period. During incident-free construction activities, no contamination of groundwater would be expected. Standard precautions during equipment fueling and maintenance and other activities should be followed to prevent spills or leaks (see Section 6.7.1).

6.11.3.2 Impacts of Operations

Estimated annual water (potable and process) use during the operation of ACWA facilities would be 19,000,000 gal (73,000 m^3 or 59 acre-ft) for Neut/Bio and 24,000,000 gal (92,000 m^3 or 75 acre-ft) for Neut/SCWO (Kimmell et al. 2001). These quantities represent a large increase over current water use levels but would be well below historic water usage rates. There is sufficient water in the alluvial terrace aquifer to meet increased demand. The impact of these additional withdrawals would be negligible, because withdrawals would be significantly less than historical withdrawals and be short-lived.

The facilities would be designed to contain small accidental releases, and the entire site is surrounded by a berm. Accidents during routine operations or fluctuating operations would not result in releases to groundwater. The operations of a facility would not release water or other substances to groundwater. Potential impacts from an accidental release of agent are discussed in Section 6.21. Such an accident would be extremely unlikely.

6.11.4 Impacts of No Action

Continued storage of chemical weapons at PCD would not adversely affect groundwater. Procedures are in place to preclude chemical spills and to address them if they do occur (see Section 6.7.1). Accidents that would result in the release of an agent are discussed in Section 6.21. Such an accident would be extremely unlikely.

6.12 SURFACE WATER

6.12.1 Current Environment

PCD is located in the Arkansas River drainage basin, on an alluvial terrace deposit, north of the river and approximately 150 ft (45 m) in elevation above it. The alluvial terrace is underlain by the relatively impermeable Pierre Shale (see Section 6.10). Surface runoff is low because of the low precipitation, at 11 in. (30 cm) per year, and the potentially high rate of evaporation, at 48 in. (120 cm) per year (Chafin 1996). The surface of the alluvial terrace slopes at a grade of approximately 1% (U.S. Army 1984) southward toward the Arkansas River; surface runoff is also generally to the south.

The Arkansas River is a major source of potable, industrial, and agricultural water in the area. In the basin, numerous canals divert water from the river for irrigation and other uses. These diversions significantly affect flow in the river. Pueblo Reservoir, located approximately 5 mi (8 km) upstream from the City of Pueblo, is used for water storage and flood regulation on the Arkansas River. The Arkansas River east of the City of Pueblo has a large number of diversion structures and water withdrawals.

Figure 6.12-1 shows the three surface drainages on PCD. Chico Creek near the western border of PCD controls drainage in the western portion of PCD. Boone Creek, which begins on post near the Munitions Storage Area A igloos, controls drainage from the central portion of PCD. Haynes Creek, which crosses the northeast corner of PCD and continues along the eastern border of the post, controls drainage from the eastern portion of PCD. Chico and Haynes Creeks are ephemeral and generally flow only after rainfall or snowmelt events (Ebasco Environmental 1990). Boone Creek is a spring-fed perennial stream near its head. It was fed with sewage treatment plant effluent in its southern portion (Ebasco Environmental 1990). However, the sewage treatment plant is no longer in use. Also, a small creek (called Unnamed Creek in this document) begins on post near the landfill and exits the post near the ICAGRS on the south central boundary. Water from Boone, Chico, and Haynes Creeks eventually enters the Arkansas River south of PCD, although Unnamed Creek has no channel south of Highway 96 (Ebasco Environmental 1990).

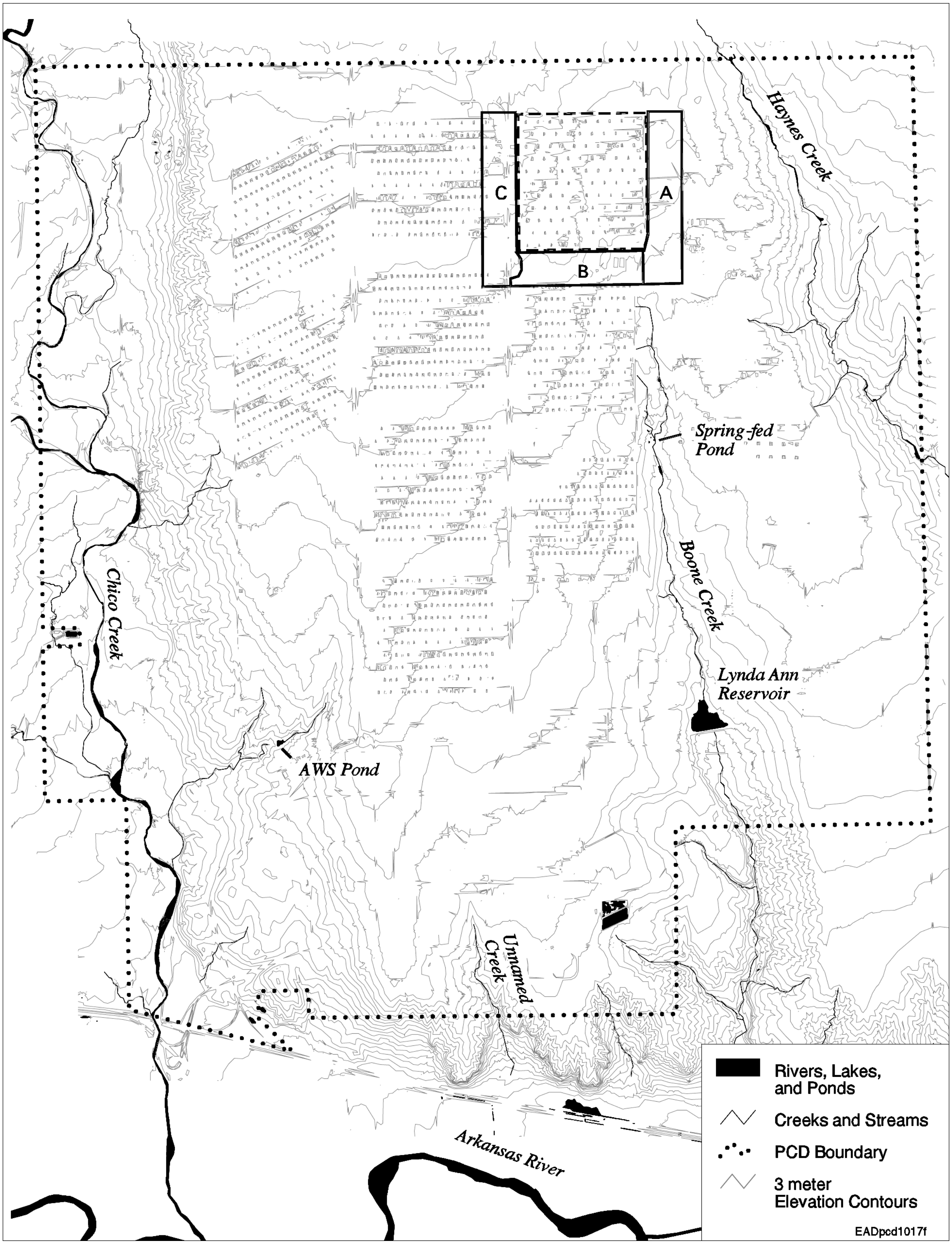

FIGURE 6.12-1 Surface Water Features at PCD

One reservoir and one small pond exist on post (Figure 6.12-1). Two other small ponds exist; one is near Haynes Creek outside the eastern boundary of PCD, and the other is near Chico Creek just outside the western boundary of PCD. Lynda Ann Reservoir is created by a small dam approximately 6 m (20 ft) high on Boone Creek. It is used primarily for runoff control. The reservoir is approximately 17 acres (6.9 ha) in size and is fed by Boone Creek and small seeps and springs that occur at the alluvium-bedrock contacts in the incised stream bed near the reservoir. A second pond is the Ammunition Workshop (AWS) Pond. There is a spring-fed pond in the Boone Creek watershed located about 0.5 mi (0.8 km) from the potential construction Area A.

6.12.2 Site-Specific Factors

Because no routine releases to surface water are anticipated during construction or normal operations, impacts on surface waters would result only from erosion, spills, or leaks.

6.12.3 Impacts of the Proposed Action

6.12.3.1 Impacts of Construction

Construction-related impacts on water resources would be expected to be essentially the same for each ACWA technology being considered. Although there may be some variation between the technologies with regard to the amount of area disturbed by construction activities, until engineering design studies are completed, the exact acreage will not be known. A maximum of about 85 acres (34 ha) could be disturbed by construction, equal to about 0.4% of the total area of PCD (Table 6.3-3). Approximately half of this area would be disturbed as a result of site preparation, and the other half would be disturbed as a result of the installation of a gas pipeline and other utilities. These utilities might be installed in existing disturbed corridors, such as along roadways. Only 25 acres (0.1% of the total area of PCD) would be disturbed by construction of the pilot facilities, evaporative lagoon, and electrical substation.

Construction-related impacts on surface water flow would be none to negligible because water use would be relatively small when compared with historical usage. Also, if impacts would occur, they would exist for only a short period. During incident-free construction activities, no contamination of surface water would be expected. Standard precautions during equipment fueling and maintenance and other activities should be followed to prevent spills or leaks (see Section 6.7.1).

6.12.3.2 Impacts of Operations

There would not be any foreseeable impacts on surface water, since no releases are anticipated. If treated sewage were released rather than being treated in evaporative ponds, flow in Boone Creek or another receiving stream might increase. In general, this increased flow would be beneficial, although there would be a slight chance of increased erosion.

6.12.4 Impacts of No Action

Continued storage of chemical weapons at PCD would not adversely affect surface water. Controls are in place to minimize soil erosion, although some erosion is expected to occur in areas kept clear of vegetation for security purposes and on dirt roadways within the storage block. Procedures are in place to preclude chemical spills and to address them if they do occur. Potential impacts from a highly unlikely accident resulting in releases of an agent during no action are discussed in Section 6.21.

6.13 TERRESTRIAL HABITATS AND VEGETATION

6.13.1 Current Environment

PCD encompasses 22,822 acres (9,240 ha) characterized as gently sloping prairie or shortgrass steppe (Rust and E-E Management 1999). A total of 215 plant species in six major vegetative types have been identified on PCD. The vegetative types are (1) shortgrass prairie (it is the most common vegetation on the basis of total acreage), (2) northern sandhill prairie, (3) greasewood scrub, (4) wetlands, (5) riparian woodland, and (6) disturbed/landscaped areas. Data on their distribution over the entire PCD are included in Rust and E-E Management (1999). Figure 6.13-1 is a map of vegetation, including areas of transitional vegetation in the northern portion of PCD adjacent to Munitions Storage Area A. The areas include northern sandhill prairie, greasewood scrub, and northern sandhill prairie/shortgrass prairie/rabbitbrush transition vegetative types.

Different types of vegetation occur at the alternative locations (Areas A, B, and C) for the proposed pilot plant. Area A is in a transitional area having floral components of both shortgrass prairie and northern sandhill prairie. Area B includes floral components of shortgrass prairie and greasewood scrub. Area C is shortgrass prairie. There are no survey data on vegetation in these three areas; however, the areas are representative of ungrazed areas in northern portions of PCD that were surveyed in 1995 (Rust and E-E Management 1999). Areas B and C have been heavily disturbed by past activities. Area A, which is located in an ungrazed and otherwise undisturbed area transitional between northern sandhill prairie and shortgrass prairie, is characterized by the

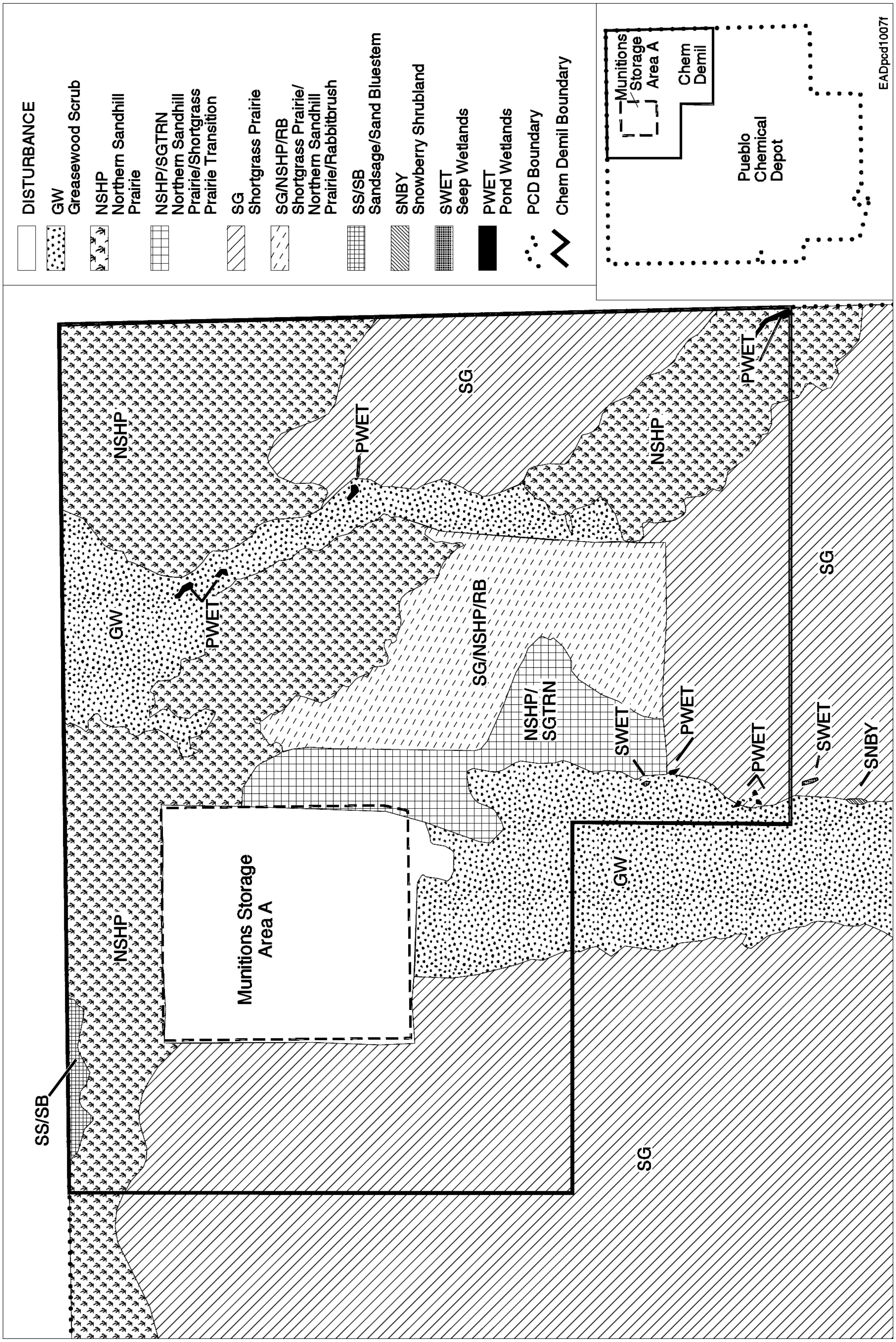

FIGURE 6.13-1 Vegetation at PCD

occurrence of sand sagebrush (*Oligosporus filifolius)*, sand bluestem (*Andropogon hallii)*, sandreed (*Calamovilfa longifolia)*, blue grama (*Chondrosum gracile)*, and cholla cactus (*Cylindropuntia imbricata*). The dominant grasses of ungrazed northern sandhill plant communities at PCD are blue grama, needle-and-thread (*Stipa comata)*, and purple three-awn (*Aristida purpurea)*. Where mechanical disturbance or overgrazing occurred on northern sandhill prairie, forb and shrub species increased in both cover and composition (Rust and E-E Management 1999). Examples of species that are more common in northern sandhill prairie communities at PCD where disturbance has occurred include little rabbitbrush (*Chrysothamnus viscidiflorus)*, broom snakeweed (*Gutierrezia sarothrae)*, and plains prickly pear cactus (*Opuntia polyacantha)*.

Shortgrass prairie and greasewood scrub vegetative types are present along the south boundary of Munitions Storage Area A at Area B. This area is ungrazed and is characterized by several grass species that are short (i.e., generally less than 2 ft or 0.6 m). The dominant grasses in terms of percent cover and composition are blue grama and purple three-awn. Other grasses occurring on shortgrass prairie sites surveyed included squirreltail (*Elymus elymoides)*, needle-and-thread, and sand dropseed (*Sporobolus cryptandrus)*. Forbs and shrubs collectively made up 10 to 20% of the total plant cover on shortgrass prairie sites surveyed during 1995 (Rust and E-E Management 1999).

The greasewood scrub vegetative type on PCD is characterized by the presence of the shrubs, black greasewood (*Sarcobatus vermiculatus)*, and three rabbitbrush species (*Chrysothamnus viscidiflorus, C. nauseosus,* and *C. pulchellus)*. The plant community is more diverse in this type of vegetation than it is in northern sandhill prairie or shortgrass prairie. Surveys in 1995 showed that grasses made up about 65–70% of the total plant cover of ungrazed greasewood scrub areas, although shrubs visually appeared to be more dominant than grasses. The dominant grass species recorded were galletagrass (*Hilaria jamesii)*, blue grama, and alkali sacaton (*Sporobolus airoides)*.

Area C is located in shortgrass prairie vegetation within Munitions Storage Area B and immediately southwest of the current entrance to Munitions Storage Area A. The composition of plant species reflects the effects of revegetation after mechanical disturbance, but it is expected to be similar to that of other shortgrass prairie plant communities in the northern one-third of PCD. Some sand sagebrush has invaded the eastern portion of Area C. The southern third of Area C is entirely shortgrass prairie.

6.13.2 Site-Specific Factors

It is expected that impacts on vegetation resulting from construction would be the same regardless of the technology evaluated, given the similarity in space requirements, construction activities, and time requirements for constructing the pilot test facilities. Routine pilot testing during operations would generate emissions that would be deposited on vegetation downwind of the facility.

ACWA pilot test facility factors that would affect terrestrial habitats and vegetation would include construction activities, releases and spills, and accidents, as discussed in the following sections. These factors would include activities associated with constructing the test facility complex and activities associated with installing utilities, communication cables, and other support areas (such as parking lots and material laydown areas). Transportation of the work force and building materials to the site would also be considered an impacting factor during construction.

6.13.3 Impacts of the Proposed Action

The following sections address the impacts of construction and operations on vegetation and terrestrial habitats. Routine operational impacts consider the impacts of the on-site work force and effects of airborne emissions during operations.

6.13.3.1 Impacts of Construction

Construction of an ACWA pilot facility would disturb about 25 acres (10 ha) for the buildings and landscaped space around the buildings. An additional 60 acres (24 ha) could be disturbed for site infrastructure, temporary offices, holding basins for surface water, parking lots, and construction lay-down areas. The total area disturbed would be approximately the same, about 85 acres (34 ha), regardless of whether the site would be located in Area A, B, or C (Table 6.3-2).

The following discussion of construction impacts identifies the potential impacts from building a facility within the three large regions around Munitions Storage Area A identified as possible sites for the pilot facilities — Areas A, B, and C (Figure 6.1-4) — and the potential impacts from developing the associated infrastructure (e.g., electric power supply, gas and water pipelines, access roads). Mitigation measures that could minimize or prevent impacts on ecologically sensitive communities in these areas are presented in Section 6.24.

Construction impacts would mainly result from clearing vegetation to prepare the site for the pilot facilities; installing a 115-kV transmission line, a new substation, and a sewage lagoon; and building pipelines for water and gas supplies (see Section 6.3.1).

Construction of the pilot facilities in Area A would affect a vegetation transition area that consists of species typical of northern sandhill prairie and shortgrass prairie communities (Figure 6.13-1). The northern sandhill prairie community, which occurs in the northern portion of Area A and immediately north of Munitions Storage Area A, is classified by the Colorado Natural Heritage Program (CNHP) as a sensitive community type that is declining statewide (CNHP 1999). By siting facilities in southern portions of Area A and limiting construction traffic and equipment in northern portions, impacts on northern sandhill prairie could be avoided.

Construction of the pilot facilities in Area B would affect greasewood scrub vegetation. The central and eastern portions of Area B contain the most concentrated areas of shrubs, which consist mainly of sand sagebrush and greasewood.

Construction in Area C would affect low shrub and shortgrass communities west of the paved road that parallels the west boundary of Munitions Storage Area A. Constructing pilot facilities near the center of Area C would avoid losses of the shortgrass prairie habitat that occurs in the southern portion of the area and that supports a colony of black-tailed prairie dogs. The black-tailed prairie dog is a candidate species under consideration for listing as threatened by the U.S. Fish and Wildlife Service (USFWS) (65 FR 24, February 4, 2000) under the *Endangered Species Act*. Also, siting facilities west of the entrance to Munitions Storage Area A would allow construction on vegetated areas previously disturbed by igloo construction.

6.13.3.2 Impacts of Operations

During routine operations, a portion of the material released from the facility stacks would be deposited on the soils surrounding the site. Deposition from atmospheric emissions would result in very low concentrations of trace metals and organic compounds.

A soil screening-level ecological risk assessment was conducted to assess the risk to terresterial biota from air emissions expected from the Neut/Bio and Neut/SCWO technologies. The deposition of emissions from a pilot facility using either of the two ACWA technologies was shown to pose no ecological risks to terrestrial vegetation (Section 6.14.3.2).

6.13.4 Impacts of No Action

Continued storage of chemical agent at PCD would not adversely impact plant communities or wildlife populations in the vicinity of Munitions Storage Area A under normal maintenance and monitoring of the storage bunkers, vegetated areas, and cleared areas. Periodic mowing of vegetation between the bunkers has precluded establishment of shrub species. This type of vegetation control would likely continue into the future. No impacts from continued storage would occur on threatened, endangered, or sensitive species or to wetlands.

6.14 WILDLIFE

6.14.1 Current Environment

Quantitative surveys were conducted at PCD in 1995 for big game, small mammals, and birds. Survey techniques included live trapping, mark and release of small mammals, direct counts of birds along transects made by using the method to estimate density developed by Emlen (1971), and direct counts of big game herds. The following discussion presents data on common wildlife occurring throughout the site and on species that are known to be highly dependent on shortgrass prairie, northern sandhill prairie, and greasewood scrub plant communities.

6.14.1.1 Amphibians and Reptiles

Four amphibian species have been observed at PCD. The great plains toad (*Bufo cognatus)* and western Woodhouse toad (*Bufo woodhousei)* are the most widely distributed species, occurring in all vegetative types. The bullfrog (*Rana catesbeiana)* was abundant at Lynda Ann Reservoir, located about 3 mi (5 km) southeast of Munitions Storage Area A. The northern leopard frog (*Rana pipiens)* was observed in pools along Chico Creek and in effluent from the PCD water treatment plant south of the PCD boundary. Breeding habitat for amphibians exists in Lynda Ann Reservoir, in the Spring Fed Pond about 2 mi (3 km) upstream of Lynda Ann Reservoir, along Chico Creek near the western boundary of PCD, and in the Ammunition Workshop (AWS) Pond located about 4 mi (6 km) southwest of Munitions Storage Area A. The tiger salamander (*Ambystoma tigrinum*) and plains leopard frog (*Rana blairi*) have been observed along Boone Creek drainage since the 1995 surveys were conducted (Canestorp 2000).

Ten reptilian species have been observed at PCD. Species include one turtle, five snakes, and four lizards. Lizards are the most abundant reptile group. The checkered whiptail (*Cnemidophorus tesselatus),* six-lined racerunner (*C. sexlineatus)*, and lesser earless lizard (*Holbrookia maculata)* were observed in all vegetative types except riparian woodland (Rust and E-E Management 1996). The red-lipped plateau lizard (*Sceloporus undulatus)* was observed in all vegetative types. The ornate box turtle (*Terrapene o. ornata)* was documented from northern sandhill prairie at PCD. Hammerson (1999) reports that the ornate box turtle inhabits grasslands and sandhill habitats in Colorado. The prairie rattlesnake (C*rotalus v. viridus)* was observed in all vegetative types, as was the bull snake (*Pituophis catenifer).* The central coachwhip (*Masticophis flagellum testaceus)* and eastern yellow-bellied whipsnake (*Coluber constrictor flaviventris)* were observed in the northern sandhill prairie and shortgrass prairie communities. The wandering garter snake (*Thamnophis elegans vagrans*) was observed in wetland, riparian, and disturbed sites on PCD.

6.14.1.2 Birds

Quantitative surveys of birds were conducted in August 1995 along five 0.5-mi-long (0.8-km-long) transects in shortgrass prairie, northern sandhill prairie, riparian woodlands, and wetland habitats at PCD (Rust and E-E Management 1999). On the basis of the transect data, grassland-shrubland habitats supported a total estimated bird density of 977 (number of birds per 50 acres [20 ha]).

No surveys were conducted at Areas A, B, and C. However, data collected in grassland- and shrub-dominated communities elsewhere on PCD are likely to be representative of the plant communities in the vicinity of Munitions Storage Area A. The most commonly observed bird species in the three major plant community types in the northern portion of PCD were as follows:

- Shortgrass prairie
  Lark sparrow *Chondestes grammacus*
  Lark bunting *Calamospiza melanocorys*
  Horned lark *Eremophila alpestris*
  Mourning dove *Zenaidura macroura*
  Western meadowlark *Sturnella neglecta*

- Northern sandhill prairie
  Sage thrasher *Oreoscoptes montanus*
  Western meadowlark *Sturnella neglecta*
  Lark bunting *Calamospiza melanocorys*
  Vesper sparrow *Prooecetes gramineus*
  Western kingbird *Tyrannus verticalis*

- Greasewood scrub
  Lark sparrow *Chondestes grammacus*
  Western meadowlark *Sturnella neglecta*
  Western kingbird *Tyrannus verticalis*

Species observed only in shortgrass prairie communities during the ecological surveys include the ferruginous hawk (*Buteo regalis*), mountain plover (*Charadrius montanus*), and burrowing owl (*Athene cunicularia*). The burrowing owl uses burrows of the black-tailed prairie dogs for nesting and cover (Robbins et al. 1966). The western meadowlark was frequently observed in shortgrass prairie in the igloo areas. The rock wren (*Salpinctes obsoletus*) nests in rocky areas of berms adjacent to the igloos and also in the munition storage areas.

Raptors observed at PCD include the American kestrel (*Falco saprverius*), northern harrier (*Circus cyaneus*), red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*B. swainsoni*), ferruginous hawk, great-horned owl (*Bubo virginianus*), barn owl (*Tyto alba*), and burrowing owl. The kestrel, red-tailed hawk, and Swainson's hawk were observed throughout PCD during the course of the ecological surveys. These three species nest in plains cottonwood trees at several locations. Northern harriers, barn owls, and great-horned owls nest on PCD. With the exception of Swainson's hawk, these raptors are permanent residents at PCD.

The mourning dove and scaled quail are the only upland game birds at PCD. Scaled quail were observed in flocks of about 5, 10, and 20 individuals in areas dominated by greasewood scrub and rabbitbrush within the igloo areas, around Lynda Ann Reservoir, and along Chico Creek.

Several species of waterfowl and shorebirds use the AWS Pond and Lynda Ann Reservoir during the summer breeding season and migration periods. Nine waterfowl and shorebird species were recorded during surveys conducted in August and September 1995 and from incidental observations made in the spring and fall (Rust and E-E Management 1996). The most common summer residents included the mallard (*Anas platyrhynchos),* blue-winged teal (*A. discors*), American coot (*Fulica americana*), and killdeer (*Charadrius vociferus*). The great blue heron (*Ardea herodias*) frequents the Lynda Ann Reservoir and ponds on PCD during the winter. Large flocks of Canada geese (*Branta canadensis*) have been observed during the fall migration on Lynda Ann Reservoir. Snow geese (*Chen caerulescens*) also use the reservoir during fall migration. One commentor on the draft version of this EIS provided a photograph showing waterfowl use of the Boone Creek Watershed downstream of Lynda Ann Reservoir and noted the importance of the area to migratory, wintering, and breeding ducks and geese.

6.14.1.3 Mammals

Twenty six mammalian species were recorded at PCD during field surveys in 1995 (Rust and E-E Management 1999). As a group, rodents are the most abundant; 19 species were recorded during the surveys. Common rodent species of the shortgrass prairie included the black-tailed prairie dog (*Cynomys ludovicianus)*, thirteen-lined ground squirrel (*Spermophilus tridecemlineatus)*, and spotted ground squirrel (*S. spilosoma)*. Up to 10 prairie dog towns were inhabited in any one season within the shortgrass prairie. Black-tailed prairie dog populations have fluctuated dramatically from year to year because of plague (Canestorp 1999). One active prairie dog town located immediately west of Area B, extending on each side of the north/south access road to the west entrance of Munitions Storage Area A, was observed in February 2000.

Other common rodent species captured during the small mammal live-trapping surveys (Rust and E-E Management 1996) included Ord's kangaroo rat (*Dipodomys ordii)*, plains pocket mouse (*Perognathus flavescens)*, western harvest mouse (*Reithrodontomys megalotis)*, northern grasshopper mouse (*Onychomys leucogaster)*, and deer mouse (*Peromyscus maniculatus)*. The western harvest mouse occurred in greatest numbers in all vegetative types having a dense grass cover. This species probably occurs in the dense, grass-covered areas within the munitions storage complex at PCD, but no trapping was conducted in these areas to confirm this assumption. Northern grasshopper mice were captured frequently in both grazed and undisturbed habitats in all vegetative types except ungrazed greasewood scrub. The Ord's kangaroo rat was captured in shortgrass prairie, northern sandhill prairie, and greasewood scrub communities. Population density was estimated at 15 individuals per acre on the basis of 1995 live-trapping data (Rust and E-E Management 1999).

Both the black-tailed jackrabbit (*Lepus californicus)* and white-tailed jackrabbit (*L. townsendii)* were observed during the field surveys. Jackrabbits were most common in shrub-dominated areas of riparian woodland and greasewood scrub but were not abundant at PCD. The desert cottontail (*Sylvilagus audubonii)* was observed in all habitat types but was not abundant enough to allow density calculations.

No surveys for bats have been conducted at PCD. Individual bats were observed foraging in the vicinity of Lynda Ann Reservoir and along Chico Creek during the evening.

Five carnivores recorded during the surveys were the coyote (*Canis latrans)*, swift fox (*Vuples velox)*, raccoon (*Procyon lotor)*, badger (*Taxidea taxus)*, and striped skunk (*Mephitis mephitis)*. The coyote is the most abundant carnivore; it occurred in all habitats and frequently was seen in the igloo areas of the munitions storage areas. The striped skunk probably occurs in all habitats at PCD, while the raccoon is likely to be more common in riparian woodland and wetland habitats.

The pronghorn (*Antilocapra americana)* is the most abundant big game mammal at PCD. Pronghorns are commonly observed in shortgrass prairie. Herds of up to 35 individuals occur in the eastern and western portions of PCD. Their presence in the munitions storage areas is limited because of their inability to traverse the 8- to 10-ft-high (2- to 3-m-high) security fences that surround these areas. Mule deer (*Odocoileus hemionus)* and whitetail deer (*O. virginianus)* are most common in riparian woodland along Chico Creek. During the early evening, deer move to greasewood scrub and northern sandhill prairie when foraging (Rust and E-E Management 1999).

6.14.2 Site-Specific Factors

It is expected that impacts from construction on wildlife would be the same regardless of the technology evaluated, given the similarity in space requirements, construction activities, and time requirements for constructing the pilot test facilities. During construction, impacts on wildlife might result from clearing vegetation for an ACWA pilot test facility and associated infrastructure. Increased activity from the presence of the on-post work force, noise from facility operations, and increases in vehicular traffic may also affect wildlife. Operations would result in emissions of organic compounds and trace metals and the discharge of sewage effluents, all of which could affect wildlife.

6.14.3 Impacts of the Proposed Action

6.14.3.1 Impacts of Construction

Loss of habitat, increased human activity in the Munitions Storage Area A area, increased traffic on local roads, and noise would be the most important factors from construction of an ACWA facility that would affect wildlife species. The presence of construction crews and increased traffic in the Munitions Storage Area A area would cause some wildlife species to avoid areas next to the construction site during the 30-month construction period. Wildlife inhabiting the area rely on native shrubs and grasses for food, cover, and nesting and therefore would be affected by vegetation clearing. Less mobile and burrowing species (such as amphibians, some reptiles, and small mammals) would be killed during vegetation clearing and other site preparation activities. Amphibian and reptile species likely to be affected by loss of habitat would include the great plains toad, Woodhouse toad, ornate box turtle, checkered whiptail lizard, lesser earless lizard, and six-lined racerunner. Small mammals that would be affected by vegetation clearing include Ord’s kangaroo rat, plains pocket mouse, western harvest mouse, deer mouse, and northern grasshopper mouse. However, because similar habitat is abundant next to cleared areas, no impacts on the continued survival of local populations of these species would be expected.

Construction in the southern portion of Area C could affect an existing black-tailed prairie dog colony located nearby. Increased construction traffic would increase the potential for roadkills to species such as prairie dogs, thirteen-lined ground squirrels, and spotted ground squirrels along the north-south road from the west entrance to Munitions Storage Area A. Scaled quail and mourning doves, important game birds in Colorado, would be adversely affected by loss of shortgrass prairie and shrub/grass transition habitat in Areas A and C. Kingery (1998) reported that scaled quail rely heavily on shortgrass prairie with cholla cactus and are more abundant in these areas than in shrub-dominated communities. Other birds that inhabit shortgrass prairie and northern sandhill prairie communities that would be affected by vegetation clearing include the burrowing owl (often associated with prairie dog colonies), lark sparrow, and western meadowlark.

Birds of prey at PCD would probably not be adversely affected by loss of a prey base associated with up to 85 acres (34 ha) of vegetation clearing, but they might avoid foraging in areas next to construction sites because of increased human activity. Species such as the ferruginous hawk, red-tailed hawk, and kestrel might benefit from the H-frame towers that would be constructed for the transmission line; they could use the towers as perch sites. Suitable raptor perches are generally absent on PCD, except for the trees and shrubs around Lynda Ann Reservoir, along Chico Creek, and in the housing area.

Raptor electrocution from simultaneous wing contact with two conductors or a conductor and ground wire on the 115-kV transmission line would not be expected. The largest raptors expected to visit PCD, the golden eagle and bald eagle, have a maximum wingspan of about

7.5 ft (2.3 m) (Avian Power Line Interaction Committee 1996). A wooden H-frame tower for a 115-kV transmission line is typically designed with a 12.5-ft (3.8-m) space between conductors; thus, an eagle could not contact both conductors simultaneously while in flight. The distance between a conductor and ground wire is normally longer than 9 ft (2.7 m). Plans for supplying power to ACWA facilities do not include electric distribution lines, which account for most raptor electrocutions. Instead, underground cables would be used; they would extend from the substation to the various facilities requiring power. The design of the 115-kV transmission line would follow suggested practices for protecting raptors (Avian Power Line Interaction Committee 1996).

Noise levels generated by construction equipment would be expected to range from 85 to 90 dBA at the proposed ACWA facilities (see Section 6.8.3.1). Levels would diminish to about 55 to 60 dBA at the northeast boundary of PCD. Numerous published studies indicate that small mammals might be adversely affected by the maximum noise levels that could result from the use of construction equipment (Manci et al. 1988; Luz and Smith 1976; Brattstrom and Bondello 1983). The Manci et al. (1988) article, which reviews the effects of noise on wildlife and domestic animals, reports that sudden sonic booms of 80 to 90 dB startled seabirds, causing them to temporarily abandon nest sites. The startle response of the birds to abrupt noise and continuous noise and the birds' ability to acclimate to noise seemed to vary with species (Manci et al. 1988). Pronghorn antelope in New Mexico responded to helicopters that generated noise levels of 60 to 77 dB by running when a helicopter's altitude approached 150 ft (50 m) and its horizontal distance from the antelope was about 500 ft (150 m) (Luz and Smith 1976). In the laboratory, the hearing of desert kangaroo rats (*Dipodomys deserti)* was affected when individuals were exposed to recorded dune buggy noise of 78 to 110 dB (Brattstrom and Bondello 1983). It took three weeks for their hearing to recover after exposure. Rodents within about 300 ft (100 m) of the ACWA site during construction might experience some temporary hearing loss, which could reduce their ability to detect predators. Pronghorn antelope and mule deer would likely respond to noise and human activity by avoiding areas within 0.5 mi (0.8 km) of ongoing construction.

6.14.3.2 Impacts of Operations

A screening-level ecological risk assessment was conducted to assess the risk from air emissions generated by an ACWA pilot test facility at PCD for the Neut/Bio and Neut/SCWO technologies. Screening-level risk assessments typically are based on very conservative assumptions that are intended to be protective of environmental resources; use of such assumptions enables chemicals that pose negligible risk to be eliminated from further consideration, while chemicals that do pose potential significant threats can be examined further. Soil concentrations from the deposition of airborne emissions during normal operations were compared with ecotoxicological benchmark values that are based on conservative ecological endpoints developed by the EPA (EPA 2001). For chemicals for which EPA has not developed soil screening values, values developed by state agencies were used in the analysis. Table 6.14-1 lists the number of chemicals evaluated from the air emissions for each ACWA technology. No

TABLE 6.14-1 Chemical Emissions of Potential Concern Based on a Screening-Level Ecological Risk Assessment of Air Emissions from Routine Operation of an ACWA Pilot Facility at PCD

Technology	No. of Chemicals Evaluated	Chemicals of Potential Concern from Stack Emissions[a]
Neut/Bio	65	None
Neut/SCWO	45	None

[a] Chemical emitted for destruction of mustard with an HQ of >1 based on 12-h/d, 6 d/wk operation.

chemicals resulted in an HQ of >1. Chemicals or elements for which no ecotoxicological benchmark values were known could not be evaluated in the screening-level ecological risk assessment.

The risks to ecological receptors (soil invertebrates, plants, and wildlife) were considered to be negligible if the screening-level risk assessment showed negligible effects on soils at PCD. The comparison of soil deposition and a chemical-specific benchmark value is expressed as a HQ — that is, a number generated by dividing the soil concentration by the soil benchmark value. Soil concentrations resulting in an HQ of ≤1 are considered to pose negligible risk to ecological receptors; chemicals having an HQ of >1 are considered contaminants of potential concern that might affect ecological receptors and should be further evaluated.

A total of 45 chemicals in the ACWA emission inventory were subjected to the screening-level ecological risk assessment for the Neut/SCWO technology. A simple model (the same one as that used for Neut/Bio) was used to estimate soil concentrations of emissions from the Neut/SCWO pilot test facility. Several conservative measures were used in the model. All stack emissions from the boiler, diesel generator, filter farm stack, and SCWO vent were assumed to be deposited within the PCD installation boundaries. Deposition quantities were assumed to be proportional to the annual wind frequency, with four equal quadrants in a circular pattern around proposed Areas A, B, and C. Other assumptions and a detailed description of the analysis are provided elsewhere (Tsao 2001a).

None of the chemicals evaluated exceeded the soil benchmark values and thus would not result in an HQ of >1. The highest HQ (for cadmium [HQ = 0.38]) is almost three times less than the soil benchmark value. The next highest HQ (for toluene) is almost 20 times below the benchmark value. For any of the toxic air pollutants emitted from the stacks to achieve an HQ of >1, the deposition radius would have to be limited to 0.50 mi (0.80 km), a distance not physically possible given the stack heights and existing wind characteristics, which would result in metals and organic compounds being carried much greater distances.

Air concentrations and deposition emission constituents from a pilot test facility using either of the two technologies being considered for PCD would pose negligible ecological risk to terrestrial biota. Consequently, routine operations of a pilot test facility would result in negligible impacts on terrestrial habitat and vegetation.

Operation of Neut/Bio or Neut/SCWO would result in increased human activity in the northeast quadrant of PCD. An increase in traffic along access roads caused by worker vehicles and the periodic delivery of supplies would increase the number of roadkills of rodents and reptiles. Anticipated noise levels of 55 to 60 dBA near the facility boundary would have only minor impacts on birds and mammals. Any abrupt noise levels would startle birds and might cause them to temporarily abandon their nests. These levels would probably not interfere with the auditory function of birds and mammals.

During full operation, an estimated maximum of 5,100,000 million gal (19,000 m^3) of sanitary effluent would be generated each year. It is anticipated that sanitary effluent would be discharged into a lined evaporative lagoon next to the test facility. Some water would be present at all times in the lagoon, which could attract resident songbirds and shorebirds such as killdeer and spotted sandpiper. Waterfowl would not be likely to use the lagoon, since it would have only small areas of standing water and would not support wetland vegetation.

6.14.4 Impacts of No Action

Continued storage of chemical agents at PCD would not adversely affect plant communities or wildlife populations in the vicinity of Munitions Storage Area A during normal maintenance and monitoring of the storage bunkers, vegetated areas, and cleared areas. Periodic mowing of vegetation between the bunkers has prevented shrub species from establishing there. This type of vegetation control would probably continue in the future.

6.15 AQUATIC HABITATS AND FISH

6.15.1 Current Environment

Aquatic resources at PCD include species typically associated with ponds and creeks. The only permanent bodies of standing water on PCD are Lynda Ann Reservoir, the AWS Pond, and Spring Fed Pond located in the northeastern part of PCD (see Figures 6.12-1 and 6.17-1). Chico Creek is an intermittent stream located in the western portion of PCD. Boone Creek and

Haynes Creek are also intermittent streams located in the eastern portion of PCD. They are typically dry during the summer (Rust and E-E Management 1999).

The largest water body on PCD is Lynda Ann Reservoir (surface area of about 18 acres [7 ha]), which is located near the southeastern portion of the munitions storage area within the Boone Creek drainage. Recharge of the reservoir is from surface drainage and a small upstream spring. Approximately 90% of the shoreline is covered by cattails and bulrushes. The reservoir provides recreational fishing opportunities for PCD personnel and the public. It is stocked periodically with channel catfish (*Ictalurus punctatus)* and stocked annually with cutthroat trout (*Salmo clarkii)*. The plains killfish (*Fundulus zebrinus)*, fathead minnow (*Pimephales promelas*), and brassy minnow (*Hybognathus hankinsoni*) were the most abundant species collected during seining (Rust and E-E Management 1999).

The AWS Pond is a 2-acre (0.8-ha) impoundment near the former TNT Washout Facility located in the southwestern portion of PCD, approximately 3.5 mi (5.6 km) southwest of Munitions Storage Area A. In 1987, all fish were removed from the pond with rotenone. In 1988, the USFWS stocked the pond with 36 southern redbelly dace (*Phoxinus erythrogaster)*, a Colorado state endangered fish species (Rust and E-E Management 1999). This species has become well established, as evidenced by the number of individuals captured by dip nets in 1995. A school of 750–1000 individuals was observed in the AWS pond on several occasions during 1995 (Rust and E-E Management 1999). The USFWS does not consider AWS Pond to be suitable for fishing.

The Spring Fed Pond is about 0.1 acre (0.4 ha) in size and is located 2 mi (3 km) southeast of Munitions Storage Area A. The pond periphery is composed of cattails and bulrushes. Submergent vegetation is quite dense and includes algae (*Chara spp.)*, pondweed (*Potamogeton spp.)*, and coontail (*Ceratophyllum spp.)*. The only two fish species collected from Spring Fed Pond were the fathead minnow and brassy minnow.

Chico Creek flows during spring snowmelt and after summer rains; low flows occur during the remainder of the year. The aquatic biota of Chico Creek are similar to those of intermittent streams in semiarid ecosystems of the Great Plains. Wetland and aquatic vegetation in areas protected from grazing occurs along the periphery of the creek. Green and blue-green algae and diatoms form mats on the surface of small pools within the creek during fall and winter. Native fish captured during seining of Chico Creek included mostly herbivorous, cyprinid species that are typically small (i.e., less 6 in. [15 cm] at adult size). Fish species recorded included longnose dace (*Rhinichthys cataractae)*, sand shiner (*Notropus stramineus)*, bigmouth shiner (*N. dorsalis)*, red shiner (*Cyprinella lutrensis)*, plains minnow (*Hybognathus placitus*), brassy minnow, fathead minnow, and central stoneroller (*Campostoma anomalum)*.

6.15.2 Site-Specific Factors

Aquatic organisms, including fish, are not expected to be affected by any factors related to the construction or operation of an ACWA pilot test facility. Potential ecological risk from the indirect effects of air emissions is discussed in Section 6.15.3.

6.15.3 Impacts of the Proposed Action

6.15.3.1 Impacts of Construction

No aquatic resources occur in the areas that would be affected by construction, so they are not considered in the assessment of construction-related impacts.

6.15.3.2 Impacts of Operations

Projections of air emissions were evaluated to determine ecological impacts that might result from the normal (i.e., incident-free) operation of either pilot test facility technology.

Neutralization/Biotreatment. Potential ecological impacts from normal test facility operations under the Neut/Bio technology would be the same as those under the Neut/SCWO technology, except for the differences in the kinds of organic compounds released and slight differences in the quantities of trace metals released (Kimmell et al. 2001). Concentrations of organic compounds and trace metals would not be at levels that would adversely affect ecosystems downwind of the pilot test facilities during normal operations.

Neutralization/SCWO. Metals and organic compounds in emissions from normal test facility operations would be deposited on the ground in very low concentrations and would not adversely affect aquatic biota. Annual emission rates of all trace constituents (Kimmell et al. 2001) and particulates would be well below levels that would affect ecosystems through biouptake and biomagnification in the food chain. Given such low emissions, a screening-level ecological risk assessment would not be warranted. Potentially harmful trace metals such as mercury, lead, selenium, chromium, and cadmium would be released at rates of less than 2×10^{-9} lb/yr (0.9 µg/yr) if test facilities would operate 12 hours per day and six days per week continuously for one year (estimate was derived from values in Kimmell et al. 2001). Trace elements would be dispersed over a large geographic area, resulting in deposition amounts that would be nondetectable or below levels known to be harmful to aquatic communities. These emission estimates are very conservative, since facilities would not operate continuously for more than a few months at any one time during pilot testing. Releases of organic compounds would also be very low; they would range from 1×10^{-8} to 2×10^{-17} lb/yr (estimate was derived from values in Kimmell et al. 2001). They would not result in any adverse impacts on aquatic ecosystems located downwind of the facilities.

6.15.4 Impacts of No Action

Continued storage of chemical agents at PCD would not adversely affect aquatic communities during normal maintenance and monitoring of the storage bunkers, vegetated areas, and cleared areas.

6.16 PROTECTED SPECIES

6.16.1 Current Environment

The information presented here on threatened and endangered species is based largely on surveys by Rust and E-E Management (1999). The USFWS provided a list of protected species that are known to occur in Pueblo County (Carlson 2000). The Colorado Natural Heritage Program database (CNHP 1999) was also used to determine sensitive species and plant communities that have been documented. Table 6.16-1 provides information on protected species and sensitive plant communities occurring at PCD in 1995 and 1997. The table reflects recent changes in status that occurred for some species since the survey report was published. It also lists protected species that were not observed during the surveys but may occur on PCD as occasional visitors or transients. No federally endangered or threatened animal or plant species are known to occur at PCD (Rust and E-E Management 1999). The USFWS (Carlson 2000) reported that the bald eagle (*Haliaeetus lencocephalus*) and Mexican spotted owl (*Strix occidentalis lucida*) (both federal threatened species) and the endangered whooping crane (*Grus americana*) "could occur" in Pueblo County, Colorado. There is no habitat at PCD suitable for the Mexican spotted owl, which typically inhabits coniferous forested areas in mountainous terrain and canyons with rock cliffs (Kingery 1998). The whooping crane and bald eagle have not been observed at PCD but may occur as transients or occasional visitors.

The mountain plover (*Charadrius montanus*), a federal proposed threatened species, occurs at PCD in shortgrass prairie habitats. Mountain plovers typically prefer sparsely vegetated areas or disturbed sites (Knopf 1996). Plovers were observed on overgrazed shortgrass prairie sites during the summer breeding season; they were located about 0.5 mi (0.8 km) east of Lynda Ann Reservoir and approximately 3 mi (5 km) southeast of Area A.

TABLE 6.16-1 Federal and State Protected Species and Sensitive Communities Observed and Potentially Occurring at PCD[a]

Scientific Name	Common Name	Federal Status[a]	State Status[b]	CNHP Status[c]
Documented Occurrence				
Plants				
Gaura neomexicana coloradensis	None	T	-	-
Asclepius uncialis	Dwarf milkweed	-	-	S1, S2
Animals				
Zapus hudsonius preblei	Preble's meadow jumping mouse	LT	T	S1
Cynomys ludovicianus	Black-tailed prairie dog	C	SC	
Athene cunicularia	Burrowing owl	FS	T	S3B, S4B
Buteo regalis	Ferruginous hawk	FS	SC	S3B, S4N
Charadrius montanus	Mountain plover	PT	SC	S2B, SZN
Chilidonias niger	Black tern	FS	-	S3B, S4B, SZN
Lanius ludovicianus	Loggerhead shrike	FS	-	S3B, S4B, SZN
Rana blairi	Plains leopard frog	-	SC	S3
Rana pipiens	Northern leopard frog	FS	SC	S3
Sistrurus catenatus	Massasauga	-	SC	
Phoxinus erythrogaster	Southern red-belly dace	FS	E	S1
Hybognathus placitus	Plains minnow	-	SC	SH
Hybognathus hankinsoni	Brassy minnow	-	T	-
Plant Communities				
Sarobatus vermiculatus/ Sporabolus aeroides	Black greasewood/alkali socaton community	-	-	SU
Oligosporus filifolia/Andropogon hallii	Sand sagebrush/sand bluestem community	-	-	S2
Populus deltoides – Salix amygdaloides/Salix exigua	Plains cottonwood – Peachleaf willow/coyote willow community	-	-	S3
Symphoricarpos occidentalis	Snowberry community	-	-	S3
Not Observed at PCD but May Occur as Occasional Transients or Introduced Species				
Grus americana	Whooping crane	LE	E	SZN
Haliaeetus leucocephalus	Bald eagle	LT	T	S1B, S3N
Plegadis chihi	White-faced ibis	FS	-	S2B, SZN
Typanuchus pallidicinctus	Lesser prairie chicken	FS	T	S2
Etheostonia cragini	Arkansas darter	C	T	S2
Fundulus sciadicus	Plains topminnow	FS	SC	S2
Machybopsis (Hybopsis) aestivalis tetranemus	Speckled chub (Arkansas River population)	FS	SC	S1
Bufo punctatus	Red-spotted toad	-	SC	S3, S4

See next page for footnotes.

TABLE 6.16-1 (Cont.)

[a] C = federal candidate species: taxa for which the U.S. Fish and Wildlife Service has on file sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened
FS = federal sensitive species: species considered to be sensitive by the U.S. Forest Service or U.S. Bureau of Land Management because of significant current or predicted downward trends in population numbers or density, or downward trends in habitat capability to support the species' existing distribution
LE = federal endangered
LT = federal threatened
PT = federal proposed threatened

[b] E = state endangered species
SC = state species of concern
T = state threatened species

[c] Colorado Natural Heritage Program
S1 = critically imperiled in the state because of extreme rarity (five or fewer occurrences, or very few remaining individuals) or because of biological factors making the species vulnerable to extirpation from the state
S2 = imperiled in the state because of rarity (6 to 20 occurrences) or because of other factors demonstrably making it very vulnerable to extirpation from the state
S3 = vulnerable = rare in state (21 to 100 occurrences)
G3 = vulnerable throughout its range or found locally in S (state) restricted range (21 to 100 occurrences)
G4 = apparently secure globally, although it might be quite rare in parts of its range, especially at its periphery
S1B = breeding season imperilment; not a permanent resident; extreme rarity
S2B = breeding season imperilment; not a permanent resident
S3B = breeding season vulnerable; not a permanent resident
S4B = breeding season imperilment; not a permanent resident
S4N = nonbreeding season secure; not a permanent resident
S3, S4 = watch listed; specific occurrence data are collected and periodically analyzed to determine whether more active tracking is warranted
SH = historically known from the state; not verified for an extended period
SU = unable to assign rarity, often because of low search effort or cryptic nature of the community
SX = unranked; some evidence that species may be imperiled, but awaiting formal rarity ranking
SZN = migrant whose occurrences are too irregular, transitory, and/or dispersed to be reliably identified, mapped, and protected

Sources: Rust and E-E Management (1999); Colorado State University (1999); Carlson (2000); Canestorp (2000); Kaczmarek (2000).

The black-tailed prairie dog (*Cynomys ludovicianus*), a federal candidate species, has been observed in shortgrass prairie habitats at PCD. Prairie dogs have been observed at several locations on PCD, typically in colonies of 3–15 individuals.

The burrowing owl (*Athene cunicularia*), ferruginous hawk (*Buteo regalis*), northern harrier (*Circus cyaneus*), black tern (*Chilidonias niger*), and loggerhead shrike (*Lanius ludovicianus*) are all considered federal sensitive species by the U.S. Bureau of Land Management (BLM) and the U.S. Forest Service. The black tern and burrowing owl are migratory species that inhabit the PCD during the summer breeding season. The other three species are permanent residents and breed at PCD. The ferruginous hawk and burrowing owl were observed mostly in shortgrass prairie habitat, while the northern harrier was observed in all habitat types except riparian woodland. Ferruginous hawks nested in a tamarisk tree in shortgrass prairie on the northeast portion of PCD. The black tern was observed twice during the summer at Lynda Ann Reservoir.

6.16.2 Site-Specific Factors

It is expected that impacts from construction on protected species would be the same regardless of the technology evaluated, given the similarity in space requirements, construction activities, and time requirements for constructing the pilot test facilities. Impacts on protected species might result from the clearing of vegetation during construction of an ACWA pilot test facility and associated infrastructure. Increased human activity from the presence of the on-post work force and increases in vehicular traffic might also affect federal and state protected or sensitive wildlife species.

6.16.3 Impacts of the Proposed Action

6.16.3.1 Impacts of Construction

The following discussion identifies the impacts on protected species that might result from building a facility within Area A, B, or C (Figure 6.1-4) and from developing the associated infrastructure (e.g., electric power supply, gas and water pipelines, access roads). Mitigation measures that could minimize or prevent impacts on ecologically sensitive communities in these areas are presented in Section 6.24.

Because no federal-listed threatened or endangered species are known to occur at PCD, they would not be affected by construction activities. One federal candidate species (the black-tailed prairie dog) and one proposed threatened species (mountain plover) are known to occur in shortgrass prairie at PCD. They could be affected by construction noise, the presence of construction crews, and habitat loss. A black-tailed prairie dog colony was observed during site visits in December 1999 and February 2000 in an area located about 0.25 mi (0.4 km) southwest of Area C. Prairie dogs could be affected by construction activities occurring in the southern portion of Area C, particularly if construction equipment, parking areas, or laydown/assembly areas disturbed shortgrass prairie habitat within or immediately next to the active colony. Noise levels during construction periods and increased human activity would also affect prairie dogs.

Although mountain plovers have not been documented in the vicinity of Area A, B, or C, they have occurred during the breeding season on grazed shortgrass prairie communities in southeastern portions of PCD. Their occurrence suggests they could inhabit similar habitat next to the southern boundary of Area C. Noise and loss of habitat in the vicinity could adversely affect mountain plovers during the breeding season.

Federal sensitive species that could be affected by habitat loss from construction include the loggerhead shrike and the northern plains leopard frog. The loggerhead shrike would be affected by loss of shrubland habitat used for food and cover in Areas A and B. The leopard frog is known to occur in the Boone and Haynes Creek watersheds and would probably not be affected by loss of habitat resulting from the construction of an access road or the electric transmission line in Corridor 3. If an access road were constructed along this corridor, mitigation measures would be taken to avoid work in areas where standing water accumulates during rainy periods; such measures would reduce the potential for impacts on leopard frogs.

The southern red-bellied dace, a Colorado state endangered species inhabiting the AWS Pond, would not be affected by construction of pilot test facilities and infrastructure upgrades. No other state sensitive species are known to occur in northern portions of PCD in the three areas considered for siting pilot test facilities (Kazmarek 2000).

6.16.3.2 Impacts of Operations

No impacts on endangered, threatened, or candidate species would result from normal test facility operations.

6.16.4 Impacts of No Action

Continued storage of chemical agents at PCD would not adversely affect protected species during normal maintenance and monitoring of the storage bunkers, vegetated areas, and cleared areas.

6.17 WETLANDS

6.17.1 Current Environment

National wetland inventory maps (DOI 1999) were examined to obtain current information on the wetlands occurring along the Haynes Creek, Boone Creek, and Chico Creek watersheds in the northern portion of PCD. Wetland surveys were conducted at PCD in June 1998 by using criteria developed by the COE (1987) for jurisdictional (i.e., naturally occurring) wetlands. On the basis of indicators set forth in the criteria for vegetative, soil, and hydrologic conditions that must be present for an area to be classified as a wetland, wetland sites were identified and mapped. The national wetland inventory maps and results of the 1998 wetlands surveys were used to create Figure 6.17-1. The proximity of wetlands to potential utility corridors and access roads is discussed in the sections below for each of the three watersheds. Table 6.17-1 shows acres of wetlands and water and total acres in each of the wetland types identified at PCD. Wetlands at PCD are commonly associated with ponds, seeps, and streams (Rust and E-E Management 1999). Common plants occurring in PCD wetlands include cattails (*Typha latifolia, T. angustifolia)*, sedges (*Carex spp.)*, spikerushes (*Eleocharis spp.)*, rushes (*Juncus balticus, J. effusus)*, bulrushes (*Scirpus spp.)*, three-square bulrush (*Schoenoplectus pungens)*, skunkbrush (*Rhus aromatica trilobata)*, western snowberry (*Symphoricarpos occidentalis)*, and smooth scouring rush (*Equisetum hyemale)*.

6.17.1.1 Haynes Creek

Six small palustrine wetlands with emergent or aquatic bed type vegetation occur within the portion of Haynes Creek watershed that traverses the northeast section of PCD (Figure 6.17-1). None of these wetlands exhibits characteristics typical of wetlands that surround open water. These wetlands are semipermanently or permanently flooded. A total wetland area of 20.6 acres (8.3 ha) was documented at these locations (Rust and E-E Management 1996). Most sites had a single-stratum vegetative structure and showed impacts from grazing pressure such as soil compaction and trampled vegetation. Vegetation was not distributed in a zonal pattern that was observed elsewhere along drainage areas within PCD. Only 3 acres (1 ha) of open water was present at the six sites during the June 1998 surveys.

The six small palustrine wetlands are located about 6,500 ft (2 km) northeast of the southern boundary of Area A. The closest wetland to utility Corridor 3 is about 0.3 mi. (0.5 km) southeast of the point where the utility corridor crosses the Haynes Creek drainage (Figure 6.17-1). Several wetlands occur in the Haynes Creek watershed northeast of the PCD boundary and beyond the eastern boundary. Some wetlands northeast of PCD within the Haynes Creek watershed are associated with livestock watering ponds on adjacent private property. An additional 10 small wetlands (<0.1 acre) occur above and below the three larger wetlands. All these wetland areas are about 0.9–1.0 mi. (1.5–1.6 km) downstream of Areas A and B and are within 500 ft (150 m) of utility Corridor 2.

6.17.1.2 Lynda Ann Reservoir and Boone Creek

The Boone Creek watershed has five wetlands on PCD that total 13.7 acres (5.5 ha). The largest contiguous wetland is associated with Lynda Ann Reservoir located about 3.5 mi (5.6 km) south-southeast of Area A. An estimated 4.2 acres (1.7 ha) of wetlands and 14 acres (5.7 ha) of open water make up the Lynda Ann Reservoir. A multilayered vegetative structure is present; plains cottonwood (*Populus deltoides)* dominates the canopy. Coyote willow (*Salix exigua)* is in the mid-canopy layer, and great bulrush (*Scirpus validus)* and yellow sweet clover

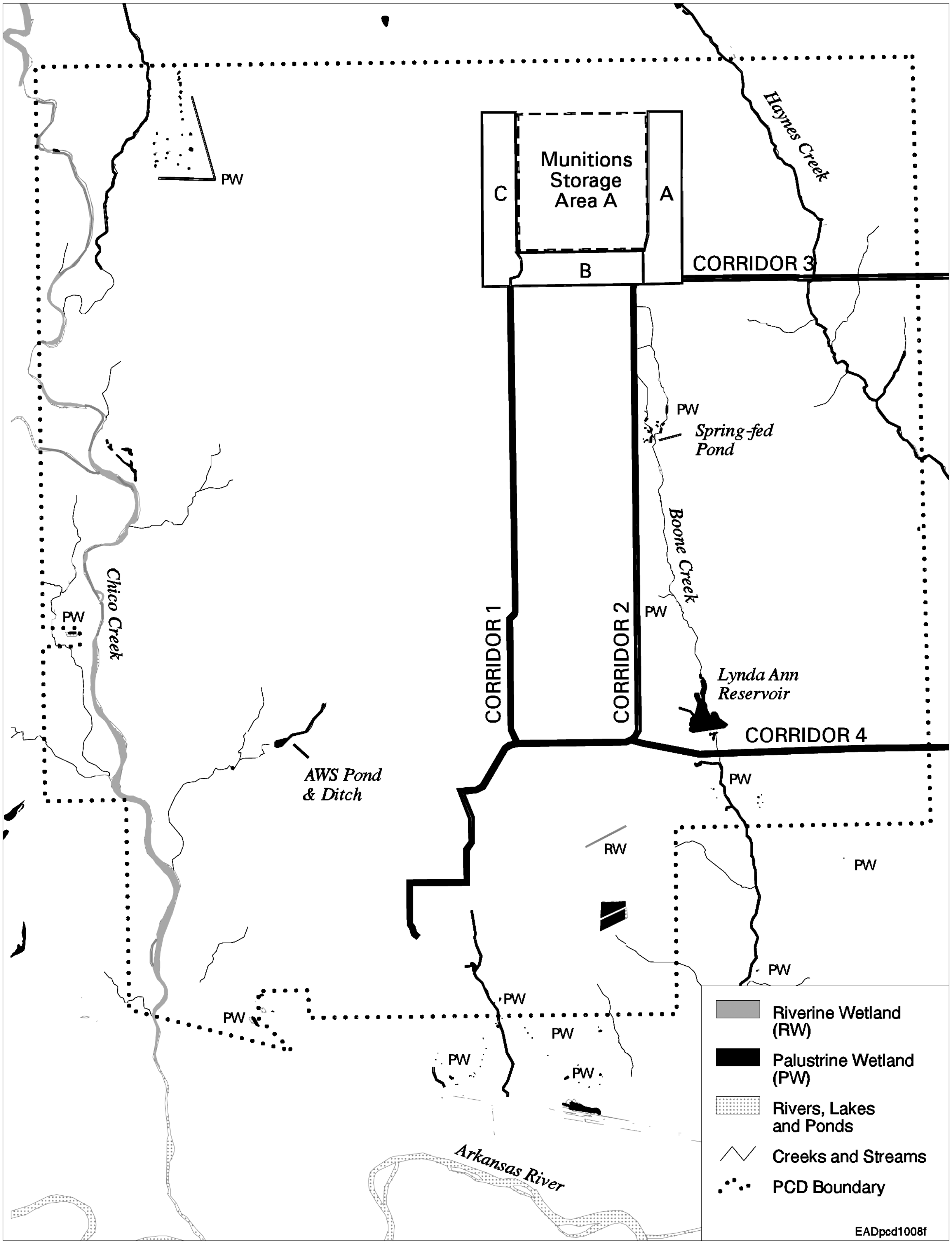

FIGURE 6.17-1 Wetlands at PCD as Identified in U.S. Fish and Wildlife Service National Wetland Inventory Maps

TABLE 6.17-1 Wetlands at PCD Identified during the 1998 Surveys

	Approximate Area (acres)[a]		
Site	Wetland	Water Surface	Total
Haynes Creek	21	3	24
Lynda Ann Reservoir	4	14	18
Boone Creek north of Lynda Ann Reservoir[b]	7.5	0.5	8
Boone Creek south of Lynda Ann Reservoir	2	0	2
Ammunition Workshop (AWS) Pond	0.3	0.5	0.8
Ammunition Workshop (AWS) Ditch	0.8	0	0.8
Hillside seeps	0.9	0	0.9
Chico Creek	No estimates	No estimates	No estimates
Total	36	18	54

[a] 1 acre = 0.4 ha.

[b] Includes acreage of wetlands around Spring Fed Pond.

Source: Rust and E-E Management (1999).

(*Melilotus officinalis)* make up the dominant vegetation in the herbaceous layer. Three wetlands totaling 7.5 acres (3 ha) occur in the Boone Creek drainage above Lynda Ann Reservoir. Two of the Boone Creek wetlands have multilayered vegetative communities. Common species at these locations include the plains cottonwood, tamarisk (*Tamarix sp.*), greasewood, and great bulrush.

6.17.1.3 Seepage Areas

Numerous seepage areas occur along bluffs of drainageways at PCD. These areas were estimated to include about 0.9 acre (0.4 ha) of wetlands vegetation. These wetlands are located in the northwestern portion of the PCD, downstream of Lynda Ann Reservoir, downgradient of the pond near the remediation facility, and in the southwestern corner of PCD. Just south of the PCD boundary, several seeps occur along bluffs above the Arkansas River Valley (Rust and E-E Management 1999). A 2-acre (0.8-ha) spikerush-dominated wetland is located about 0.5 mi (0.8 km) south of Lynda Ann Reservoir. Most of the wetland vegetation at this location was destroyed or damaged by cattle grazing in late summer and fall of 1997. The vegetative zones in seep wetlands consist of saltgrass (*Distichlis spicata)*, saltgrass/rushes, three-square bulrush, and cattails/bulrushes. Ground cover is nearly 100% in many seep areas, which range in size from a few square feet to irregularly shaped strips along bluffs that are 200 to 300 ft (60 to 90 m) long.

6.17.1.4 Chico Creek

No quantitative wetland surveys were conducted in Chico Creek, located along the western section of PCD. The nearest palustrine emergent wetlands to Area C are located along Chico Creek about 2.0 mi (3.2 km) west of the center of Area C (see Figure 6.17-1). Wetland areas associated with the Chico Creek watershed include vegetation around shallow pools, in old bends, and in high water channels. During 1995, lower portions of Chico Creek on PCD that had been heavily grazed were eroding. Common riparian wetland vegetation found there includes cattails, great bulrush, three-square bulrush, spikerush, coyote willow, and scouring rush. The southern portions of Chico Creek are characteristically flatter and contain more open floodplain and braided channel. The development of wetland vegetation is limited by stream scouring during occasional high flows. Dominant species include cattails, great bulrush, three-square bulrush, and coyote willow. The Chico Creek watershed does not include drainage from Area C.

6.17.2 Site-Specific Factors

Site-specific ACWA pilot test facility factors include construction activities, releases, and spills, as discussed in the following sections. These factors are associated with construction of the proposed test facility on about 25 acres (10 ha) and installation of the infrastructure, parking lots, and sanitary waste treatment facility. Transportation of the workforce and building materials to the site and vehicular traffic during facility operations are also considered to be factors.

6.17.3 Impacts of the Proposed Action

6.17.3.1 Impacts of Construction

No wetlands would be affected by construction activities. Construction of an access road along Corridor 3 would avoid any wetlands in the Haynes Creek and Boone Creek watersheds. All wetlands at PCD are too far from potential pilot test facility construction sites to be affected (Figure 6.17-1). The wetland nearest to potential construction activities is the Spring Fed Pond in the Boone Creek watershed located more than 0.5 mi (0.8 km) from Area A. Impacts from construction of an access road and power lines along utility corridors would not result in erosion or change the surface water flow to adversely affect a small wetland located on Haynes Creek drainage, about 0.3 mi (0.5 km) below Corridor 3. Runoff from construction activities would be contained, if necessary, by using erosion control measures.

6.17.3.2 Impacts of Operations

Wetlands downwind of test facilities would not be affected by emissions from normal operations.

6.17.4 Impacts of No Action

Continued storage of chemical agents at PCD would not adversely affect wetlands during normal maintenance and monitoring of the storage bunkers, vegetated areas, and cleared areas.

6.18 CULTURAL RESOURCES

6.18.1 Current Environment

6.18.1.1 Archaeological Resources

Between 1994 and 1996, approximately 11,300 acres (4,600 ha) of PCD were surveyed for archaeological sites to complete the current inventory of archaeological resources at PCD (Figure 6.18-1). Forty-five sites and 128 isolated finds[12] were recorded. Three sites — 5PE1719, 5PE1930, and 5PE2093 — were recommended as eligible for listing on the National Register of Historic Places (NRHP); however, further testing was recommended for 32 of the sites (Larson and Penny 1995; Foothill Engineering Consultants [FEC] 1998).

More than 80% of the sites recorded (37 of 45) are located along Chico, Boone, and Haynes Creeks, within or near the edges of the creek valleys (Larson and Penny 1995; FEC 1998). These sites are predominately lithic scatters containing flaked stone debris and tools and small, open camps with evidence of possible features such as hearths. The majority of sites date between the Late Archaic (1,000 B.C. to A.D. 100) through the Middle Ceramic. Two localities contain artifacts dating as early as the Late Paleo-Indian period. Additional prehistoric sites may be present in the undisturbed portions of the facility.

Archaeological survey results indicate that there are few sites pertaining to the historic period at PCD, and none of the recorded sites have been directly attributed to the ethnohistoric

---

[12] An isolated find is defined as one stone tool, five or fewer pieces of lithic debris, a single historic artifact type (e.g., lass, ceramic), or a scatter of glass or ceramics where all the sherds appear to be from the same vessel.

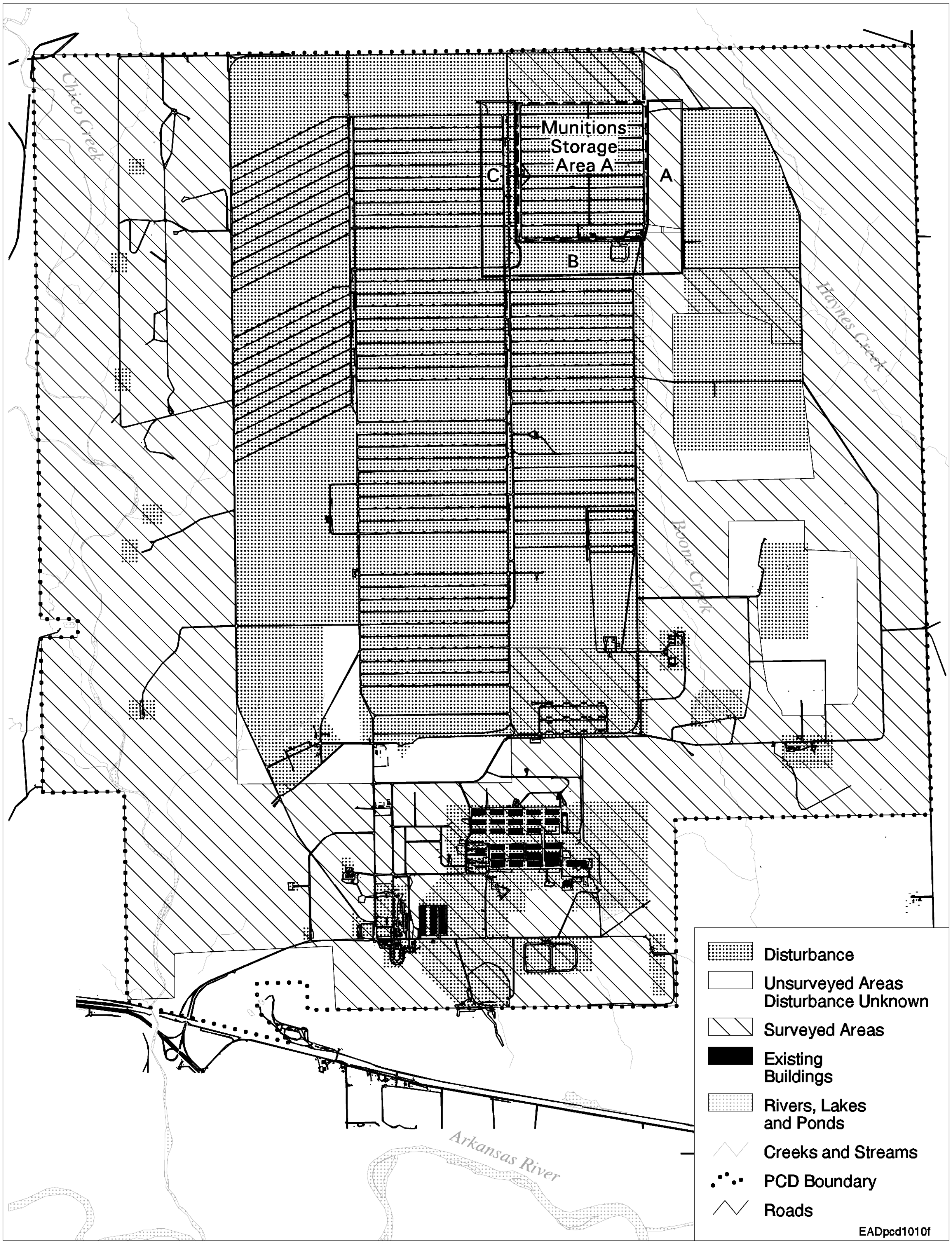

FIGURE 6.18-1 Archaeological Survey Areas and Areas of Disturbance at PCD

period. The three historic sites that have been recorded at PCD date between 1880 and 1942 (when the property was acquired by the government). Twelve of the isolated finds are historic, consisting of glass or historic ceramic sherds. Additional testing of one site (5PE1735) was recommended. This site, which has visible foundations, appears to have been an early twentieth century ranch. The other historic archaeological resources were considered not eligible for the NRHP (Larson and Penny 1995; FEC 1998).

6.18.1.2 Traditional Cultural Properties

A traditional cultural property is defined as a property "eligible for inclusion in the National Register because of its association with the cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community" (Parker 1995). No traditional cultural properties are known to occur within the proposed facility locations. Interested Native American governments have been consulted regarding the proposed action.

6.18.1.3 Historic Structures

A survey and evaluation of historic structures at PCD was initially completed in 1984 (McDonald and Mack Partnership 1984). The result of this assessment of 27 buildings at PCD was that none of them was eligible for listing on the NRHP. The Colorado State Historical Preservation Officer (SHPO) found this assessment inadequate and recommended that all structures on PCD be reevaluated. In 1996, Front Range Research Associates, Inc. (FRRA) finalized a survey of historic structures at PCD (Simmons and Simmons 1998). The contractor concluded that four districts and one building were potentially eligible for listing on the NRHP. The districts included one World War II district, consisting of earthen-covered igloos, aboveground igloos, warehouses, and administration and support buildings, and three Cold War era districts: Hi Pardner Park, the Pershing missile demilitarization area, and the nuclear weapons storage area (within Munitions Storage Area B). Building 1, the post headquarters, was the only individual building recommended as being eligible for the NRHP. A programmatic agreement (PA) signed in 1997 by the U.S. Army, Colorado SHPO, and Advisory Council on Historic Preservation states that the recommendations of the FRRA report are acceptable and that the above-mentioned building and districts are eligible for listing. PDADA concurred with the PA. The PA also states that the unsurveyed structures in Munitions Storage Area A, which house part of the nation's chemical weapons stockpile, are also eligible for the NRHP. The PA further states that documentation of facilities on PCD has been completed and that "no further documentation is required to mitigate the effects of leasing, licensing, and/or disposal of facilities at the Depot" (U.S. Army et al. 1997).

6.18.2 Site-Specific Factors

Factors that need to be considered with regard to significant archaeological sites, traditional cultural properties, and historic structures under the ACWA program include these:

- Destruction or disturbance of cultural resources could occur during construction activities.

- Contamination of cultural resources could occur during an accidental chemical release or spill. This might may lead to the establishment of temporary restrictions on access to the property or possibly to the destruction or disturbance of the resource if soils need to be removed during cleanup.

- Secondary impacts could be associated with the construction or operation of a proposed facility, such as:

  - Increased pedestrian or vehicular traffic in the area could increase the potential for inadvertent or intentional damage to cultural resources by casual passerbys or amateur collectors or

  - Increased erosion potential as a result of construction activities could disturb archaeological sites next to the construction area.

6.18.3 Impacts of the Proposed Action

6.18.3.1 Impacts of Construction

On the basis of previous survey results and the level of ground disturbance in the proposed construction areas, construction of an ACWA pilot facility, including the establishment of a staging area and construction of a power corridor and any additional access routes, would be unlikely to adversely affect eligible cultural resources.

Archaeological Resources. The areas north and east of Munitions Storage Area A, which are potential locations for ACW destruction facilities, were surveyed for archaeological resources (Larson and Penny 1995; FEC 1998). Seven sites and nine isolated finds were recorded within the immediate vicinity of the potential project area (in Sections 2 and 3 of T.20 S and R.22 W and Sections 34 and 35 of T.19 S and R.22 W). None of the sites are eligible for the NRHP; therefore, the use of Area A, east of Munitions Storage Area A, would not affect significant cultural resources. Areas B and C, south and west of Munitions Storage Area A, have not been surveyed. However, they are within the deeply disturbed bunker construction area, where the potential for finding intact archaeological remains that would meet NRHP eligibility criteria is low. Nevertheless, an archaeological survey of these areas might be required if, for some reason, the SHPO would need confirmation that the site is disturbed before concurring on a "no adverse effect" determination for this project. If cultural material is unexpectedly encountered during these ground-disturbing activities, operations should cease immediately, and the SHPO and a qualified archaeologist should be consulted to evaluate the significance of the cultural artifacts.

Traditional Cultural Properties. No traditional cultural properties are known to occur within the construction area for the proposed ACWA facilities. Native American governments have been consulted to determine whether traditional cultural properties are present near the Munitions Storage Area A area. Copies of the consultation letters and any responses received are presented in Appendix F. No impacts on traditional cultural properties are anticipated during construction.

Historic Structures. The structures within Munitions Storage Area A were determined to be eligible as a historic district. However, these facilities were sufficiently documented (mitigated) per the stipulations of the PA, and further review of potential impacts to these structures by the SHPO is not required (U.S. Army et al. 1997). There would be no adverse impacts on the Munitions Storage Area A Historic District from constructing an ACW destruction system at PCD.

6.18.3.2 Impacts of Operations

Archaeological Resources. Routine operation of a pilot facility would not involve ground-disturbing activities or other activities (i.e., transportation of munitions) in locations not previously heavily disturbed. None of the nearby archaeological sites are eligible for the NRHP, so increased pedestrian or vehicular traffic in the area would not cause an adverse impact. Therefore, operations would have no impact on archaeological resources.

Traditional Cultural Properties. No traditional cultural properties are known to occur within the operations area for the proposed ACWA facilities. Native American governments have been consulted to determine whether traditional cultural properties are present near the Munitions Storage Area A area. Copies of the consultation letters and any responses received are presented in Appendix F. No impacts on traditional cultural properties are anticipated during operation.

Historic Structures. The bunkers in the Munitions Storage Area A Historic District were designed and are used to store the weapons stockpile. Munitions would be removed from this stockpile during operation of the proposed ACWA pilot facility. According to the PA, these structures have been mitigated, and removal of ACWs for operation of the pilot test facility would not adversely affect their integrity.

6.18.4 Impacts of No Action

6.18.4.1 Archaeological Resources

Archaeological resources would not be affected by the no action alternative (i.e., continued storage of chemical weapons that might otherwise be destroyed by pilot testing) because ground disturbance is not associated with the current mission.

6.18.4.2 Traditional Cultural Properties

No traditional cultural properties are known to occur within the chemical munitions storage area. Native American governments have been consulted to determine whether traditional cultural properties are present near the Munitions Storage Area A area. Copies of the consultation letters and any responses received are presented in Appendix F. No impacts on traditional cultural properties are anticipated as a result of the no action alternative.

6.18.4.3 Historic Structures

Historic structures at PCD would not be affected by the no action alternative. Chemical munitions that might otherwise be removed and destroyed during pilot testing would continue to be stored in the Munitions Storage Area A Historic District. Such use is compatible with the history and origin of the storage bunkers and is consistent with the requirements of the PA.

6.19 SOCIOECONOMICS

6.19.1 Current Environment

Socioeconomic data for PCD describes a region of influence (ROI) surrounding the site that is composed of only one county: Pueblo County. The ROI is based on the current residential locations of government workers directly connected to PCD activities and captures the area in which these workers spend their wages and salaries. More than 90% of PCD workers currently reside in Pueblo County, with almost 90% of workers living in the city of Pueblo itself (Marrero 2000). The majority of impacts from an ACWA facility would be expected to occur in these locations.

6.19.1.1 Population

The population of Pueblo County was 141,472 in 2000 (U.S. Bureau of the Census 2001b), and it was projected to reach 143,000 in 2001 (Table 6.19-1). In 2000, 102,121 people (72% of the county total) resided in the city of Pueblo itself, with 102,000 people expected to be living in the city in 2001 (U.S. Bureau of the Census 2001b). During the 1980s, both the city and county as a whole had experienced small declines in population, although the state as a whole had experienced a modest growth rate of 1.3% over the same period. In contrast, over the period 1990–1999, the population grew slightly in both the city and county. The growth rate in the city was somewhat less than 0.4%, and the growth rate in the county as a whole was 1.4%. Over the same period, the population in the state grew at a rate of 2.7%. Boone (323 persons in 2000), immediately to the southeast of PCD, is the only other incorporated community in the vicinity of the site (U.S. Bureau of the Census 2001b).

6.19.1.2 Employment

Total employment in Pueblo County in 1999 was 47,994 (U.S. Bureau of the Census 2001a), and it was projected to reach 51,400 in 2001 (Allison 2001). The economy of the county is dominated by the trade and service industries, with employment in these activities currently

TABLE 6.19-1 Population in Pueblo, Pueblo County, and Colorado in Selected Years

Location	1980[a]	1990[a]	Average Annual Growth Rate (%) 1980–1990	2000[b]	Average Annual Growth Rate (%) 1990–2000	2001[c] (Projected)
City of Pueblo	101,686	98,640	–0.3	102,121	0.4	102,000
Pueblo County	125,972	123,051	–0.2	141,472	1.4	143,000
Colorado	2,889,735	3,294,394	1.2	4,301,261	2.7	4,420,000

[a] U.S. Bureau of the Census (1994).

[b] U.S. Bureau of the Census (2001b).

[c] Allison (2001).

contributing to more than 75% of all employment in the county (see Table 6.19-2). Manufacturing, which has traditionally been a strong local source of employment, only contributes a little more than 8% of total county employment. Annual average employment growth in the county was 3.5% during the 1990s (U.S. Bureau of the Census 1992c, 2001a).

Employment at PCD has been stable over the last five years, with 150 government employees working at the site, 78 of whom are employed at PCD (Marrero 2000). In addition, approximately 25 contractors and several military personnel work at the site. Since base realignment in 1993, a number of commercial and industrial tenants have occupied land and buildings formerly used by the military. Tenants employ 30 people (Oburn 2000).

Unemployment in the county declined steadily from the 1980s, when it averaged more than 10%, to a rate averaging 6.5% during the 1990s (Table 6.19-3). Unemployment in the county currently stands at 4.8%, compared with 3.6% for the state (U.S. Bureau of Labor Statistics 2001).

TABLE 6.19-2 Employment in Pueblo County by Industry in 1999

Employment Sector	Number Employed	% of County Total
Agriculture	1,259[a]	2.6
Mining	52	0.1
Construction	3,567	7.4
Manufacturing	4,103	8.5
Transportation and public utilities	850	1.8
Trade	8,608	17.9
Finance, insurance, and real estate	2,066	4.3
Services	27,429	57.2
Total	47,994	

[a] 1997 data.

Sources: U.S. Bureau of the Census (2001a); USDA (1999).

TABLE 6.19-3 Unemployment Rates in Pueblo County and Colorado

Location and Period	Rate (%)
Pueblo County	
1990–2000 average	6.5
2001 (current rate)	4.8
Colorado	
1990–2000 average	4.3
2001 (current rate)	3.6

Source: U.S. Bureau of Labor Statistics (2001).

6.19.1.3 Personal Income

In 1999, total personal income in Pueblo County was $3.0 billion. It was projected to reach $3.4 billion in 2001, based on an annual average rate of growth of 6.2% over the period 1990–1999 (Table 6.19-4). County per capita income also rose in the 1990s and was projected to reach $23,600 in 2001; it was $14,189 at the beginning of the period.

TABLE 6.19-4 Personal Income in Pueblo County

Personal Income	1990[a]	1999[b]	Average Annual Growth Rate (%) 1990–1999	2001[c] (Projected)
Total (millions of $)	1,746	3,003	6.2	3,390
Per capita ($)	14,189	21,525	4.7	23,600

[a] U.S. Bureau of the Census (1994).

[b] U.S. Department of Commerce (2001).

[c] Allison (2001).

6.19.1.4 Housing

Housing stock in the county grew at an annual rate of 1.5% over the period 1990–2000 (Table 6.19-5). The total number of housing units was projected to reach 59,800 in 2001, reflecting the relatively slow annual growth in county population. Growth in the city of Pueblo was slightly lower at 0.5%, with the total number of housing units projected to reach 43,400 in 2001. More than 8,100 new units were added to the existing housing stock in the county during the period 1990–2000, of which more than 2,260 were constructed in the city of Pueblo. Vacancy rates in 2000 were 6.5% in the city and 7.4% in the county as a whole for all types of housing. The annual average growth rate between 1990 and 2000 indicates that there would be 4,400 vacant housing units in the county in 2001, of which almost 1,520 are projected to be rental units available to construction workers at the proposed facility.

6.19.1.5 Community Resources

Community Fiscal Conditions. Construction and operation of the proposed facility might result in increased revenues for local government jurisdictions, including counties, cities, and school districts in the city and county. Revenues would come primarily from state and local sales taxes associated with employee spending during construction and operation. Revenues

TABLE 6.19-5 Housing Characteristics in Pueblo and Pueblo County

Type of Housing	1990[a]	2000[b]	2001[c] (Projected)
City of Pueblo			
Owner-occupied	24,837	26,460	26,600
Rental	13,487	13,847	13,900
Unoccupied	2,538	2,814	2,800
Total units	40,862	43,121	43,400
Pueblo County			
Owner-occupied	31,946	38,449	39,200
Rental	15,111	16,130	16,200
Unoccupied	3,815	4,347	4,400
Total units	50,872	58,926	59,800

[a] U.S. Bureau of the Census (1994).

[a] U.S. Bureau of the Census (2001b).

[a] Allison (2001).

would be used to support additional local community services currently provided by each jurisdiction.

Sales taxes in Pueblo are currently set at 7.5%, and include a city tax of 3.5%, a county tax of 1%, and a state tax of 3%. There is also a 4.3% local tax on lodging and a combined state and federal tax on gasoline and diesel fuel. In 1996, property taxes in the city amounted to 10% of the total assessed value for residential property and 30% of the value for commercial property. State income taxes are currently 4.75% of adjusted gross income (Kornelly and Associates/KPMG Inc. 1999). Tables 6.19-6 and 6.19-7 present data on revenues and expenditures by local government jurisdictions and school districts in Pueblo County.

Community Public Services. Construction and operation of the proposed facility would result in increased demand for community services in the county, cities, and school districts likely to host relocating construction workers and operations employees. Additional demands would also be placed on local medical facilities and physician services. Table 6.19-8 presents data on employment and levels of service (number of employees per 1,000 population) for public safety and general local government services and physicians. Tables 6.19-9 and 6.19-10 provide staffing data for school districts and hospitals. Table 6.19-11 presents data on employment and levels of service for physicians.

6.19.1.6 Traffic

Vehicular access to PCD is afforded from U.S. Highway (US) 50, which links the site with the city of Pueblo and Pueblo Airport to the west and with smaller communities to the east. Other roads used by employees working at PCD include State Route (SR) 96, which intersects with US 50 south of PCD and runs east through North Avondale to the community of Boone. Business Route (BR) 50 intersects with US 50 and runs west through Avondale toward Pueblo. North Avondale Boulevard connects North Avondale with Avondale.

Table 6.19-12 shows average annual daily traffic flows over these road segments, together with congestion level (level of service) designations developed by the Transportation Research Board (1985). The designations range from A to F; A through C represent good traffic conditions with some minor delays experienced by motorists, and F represents jammed roadway conditions.

6.19.2 Site-Specific Factors

The socioeconomic analysis covers the effects on population, employment, income, housing, community resources, and traffic from the proposed action and no action alternatives.

TABLE 6.19-6 Local Government Financial Characteristics in Pueblo and Pueblo County (millions of 1998 $)

Financial Category	City of Pueblo	Pueblo County
Revenues		
Taxes	47.3	24.9
Licenses and permits	0.2	0.1
Intergovernmental	2.3	4.5
Charges for services	0.3	3.1
Fines and forfeits	0.8	0.1
Miscellaneous	0.8	2.5
Total[a]	51.7	35.1
Expenditures		
General government	5.1	14.6
Public safety	20.2	12.7
Highways and streets	2.5	1.2
Health, welfare, and sanitation	3.3	2.8
Culture and recreation	2.8	0.3
Debt service	0.0	0.0
Intergovernmental	2.2	0.3
Other	3.0	1.7
Total[a]	39.1	33.6
Revenues minus expenditures	12.6	1.5

[a] The sum of individual row entries and column totals may not correspond because of independent rounding.

Sources: City of Pueblo (1999); Pueblo County (1999).

6.19.3 Impacts of the Proposed Action

Table 6.19-13 summarizes the socioeconomic impacts from constructing and operating an ACWA pilot test facility. The impacts of no action are provided as well for comparison.

TABLE 6.19-7 School District Financial Characteristics in Pueblo County (millions of 1998 $)

Financial Category	School District 60[a]	School District 70[b]
Revenues		
Local sources	22.0	8.8
State sources	59.1	17.8
Federal sources	0.2	0.1
Other	–3.0[c]	–1.2[d]
Total	78.3	25.5
Expenditures		
Administration and instruction	76.1	14.7
Services	0.0	9.3
Debt service	0.1	0.1
Total	76.2	24.1
Revenues minus expenditures	2.1	1.4

[a] School District 60 serves the city of Pueblo.

[b] School District 70 serves the remainder in Pueblo County.

[c] Includes the reassignment of $3.8 million in revenues to the special revenue fund.

[d] Includes the reassignment of $1.4 million in revenues to the special revenue fund.

Sources: School District 60 (1999); School District 70 (1999).

6.19.3.1 Impacts of Construction

Neutralization/Biotreatment. The potential socioeconomic impacts from constructing and operating a Neut/Bio treatment facility at PCD would be relatively small. Construction activities would create direct employment of about 600 people in the peak construction year and an additional 570 indirect jobs in the ROI. Construction activities would increase the annual average employment growth rate by 0.2% over the duration of construction. A Neut/Bio facility would produce approximately $36 million of income in the peak year of construction.

TABLE 6.19-8 Public Service Employment in Pueblo, Pueblo County, and Colorado

	Pueblo County[a]		City of Pueblo[a]		Colorado[b]
Employment Category	Number Employed	Level of Service[c]	Number Employed	Level of Service[c]	Level of Service[c]
Police protection	187[d]	5.2	236[e]	2.3	2.5
Fire protection[f]	50	1.4	143[e]	1.4	1.0
General local government services	762[g]	21.1	308[e]	3.0[h]	33.4
Total	999	27.6	687	6.7[h]	36.9

[a] Source of population data was U.S. Bureau of the Census (2001b).

[b] U.S. Bureau of the Census (2000).

[c] Level of service represents the number of employees per 1,000 persons in each jurisdiction.

[d] Leach (2000).

[e] Alley (2000).

[f] Does not include volunteers.

[g] Amador (2000).

[h] Judicial and social services for the city of Pueblo are provided by Pueblo County.

TABLE 6.19-9 School District Data for Pueblo, Pueblo County, and Colorado in 1998

	Pueblo County		City of Pueblo		Colorado
Employment Category	Number Employed	Student to Teacher Ratio	Number Employed	Student to Teacher Ratio[a]	Student to Teacher Ratio[a]
Teachers	343	18.8	1,063	16.7	17.7

[a] Student to teacher ratio represents the number of students per teacher in each school district.

Source: Colorado Department of Education (2000).

TABLE 6.19-10 Medical Facility Data for Pueblo County in 1999

Hospital	Number of Staffed Beds	Occupancy Rate (%)[a]
Parkview Medical Center	255[b]	60[b]
St. Mary-Corwin Regional Medical Center	273[b]	47[b]
County total	528	-

[a] Perfect of staffed beds occupied

[b] Data source, by permission: SMG Marketing Group, Inc., © copyright 2001.

TABLE 6.19-11 Employment of Physicians in Pueblo County and Colorado in 1997

	Pueblo County		Colorado
Employment Category	Number Employed	Level of Service[a]	Level of Service[a]
Physicians	358	2.7	2.7

[a] Level of service represents the number of employees per 1,000 persons in each jurisdiction.

Sources for physician numbers and population data: American Medical Association (1999); U.S. Bureau of the Census (2001).

In the peak year of construction, about 1,140 people would in-migrate to the ROI. While in-migration would have a marginal effect on population growth, new residents would require 27% of vacant rental housing in the peak year. No significant impact on public finances would occur as a result of in-migration, and only 22 additional local public service employees would be required to maintain existing levels of service in the four local public service jurisdictions in Pueblo County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding the site.

Neutralization/SCWO. The potential socioeconomic impacts from constructing and operating a Neut/SCWO facility at PCD would be relatively small (Table 6.19.13). Construction activities would create direct employment of approximately 680 people in the peak construction

TABLE 6.19-12 Average Annual Daily Traffic (AADT) in the Vicinity of PCD

Road Segment	Traffic Volume (AADT)	Level of Service[a]
US 50 east of Pueblo Airport	12,800	B
US 50 west of intersection with SR 96	6,300	A
US 50 north of intersection with BR 50	3,600	A
US 50 east of Avondale	4,750	A
BR 50 east of Avondale	1,150	A
SR 96 east of North Avondale	1,500	A
SR 96 west of Boone	1,700	A
North Avondale Boulevard	190[b]	A

[a] Allison (2001).

[b] Smith (2000).

Source: Tinney (2000).

year and an additional 540 indirect jobs in the ROI. Construction activities would increase the annual average employment growth rate by 0.2% over the duration of construction. Direct Neut/SCWO-related employment and related wages and salaries at PCD would also produce about $37 million of income in the peak year of construction.

In the peak year of construction, about 1,200 people would in-migrate to the ROI, both as a result of SCWO employment on post and as a result of the overall growth in the ROI economy through the local procurement of materials and services and through employee spending. While in-migration would have a marginal effect on population growth, new residents would occupy 28% of vacant rental housing during the peak year. No significant impact on public finances would occur as a result of in-migration, and 24 additional local public service employees would be required to maintain existing levels of service in the four local public service jurisdictions in Pueblo County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding the site.

6.19.3.2 Impacts of Operations

Neutralization/Biotreatment. The potential socioeconomic impacts from constructing and operating a Neut/Bio facility at PCD would be relatively small. Operational activities would create about 640 direct jobs annually and an additional 530 indirect jobs in the ROI. A Neut/Bio facility would produce about $44 million annually during operations.

TABLE 6.19-13 Effects of Construction, Operations, and No Action at PCD on Socioeconomics[a,b]

Impact Category	Neut/Bio Construction	Neut/Bio Operation	Neut/SCWO Construction	Neut/SCWO Operation	No Action
Employment (number of jobs in ROI)					
Direct	600	640	680	640	78
Indirect	570	530	540	580	60
Total	1,170	1,170	1,220	1,220	138
Income (millions of $ in 2000 in ROI)					
Direct	21.3	31.1	23.5	31.1	4.5
Indirect	14.4	12.9	13.4	14.3	1.4
Total	35.7	44.0	36.9	45.4	5.9
Population (number of new residents in ROI)	1,140	750	1,200	790	0
Housing (number of new units in ROI)	420	270	440	290	0
Public finances (% impact on fiscal balance)					
City of Pueblo	1	1	1	1	0
Pueblo County	<1	<1	<1	<1	0
Pueblo County schools[d]	1	1	1	1	0
Public service employment (number of new employees in Pueblo County)[c]					
Police officers	3	2	3	2	0
Firefighters	1	1	2	1	0
General	4	3	4	3	0
Teachers[c]	11	7	12	8	0
Physicians	3	2	3	2	0
Hospitals (number of new staffed hospital beds in Pueblo County)	4	3	5	3	0
Traffic (impact on current levels of service in Pueblo County)	None	None	None	None	None

[a] Impacts are shown for the peak year of construction (2004) and the first year of operations (2009).

[b] The sum of individual row entries and column totals may not correspond because of independent rounding.

[c] Includes impacts that would occur in Pueblo and Pueblo County school districts.

About 750 people would move to the area at the beginning of operations. However, in-migration would have only a marginal effect on population growth and would require less than 32% of vacant owner-occupied housing during facility operations. No significant impact on public finances would occur as a result of in-migration, and 15 additional local public service employees would be required to maintain existing levels of service in the four local public service jurisdictions in Pueblo County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding the site.

Neutralization/SCWO. The potential socioeconomic impacts from constructing and operating a Neut/SCWO facility at PCD would be relatively small (Table 6.18.15). Operational activities would create about 640 direct jobs annually and an additional 580 indirect jobs in the ROI. Direct Neut/SCWO-related employment and related wages and salaries at PCD would also produce about $45 million annually during operations.

About 790 people would move to the area at the beginning of Neut/SCWO facility operation. However, in-migration would have only a marginal effect on population growth and would require about 34% of vacant owner-occupied housing during facility operations. No significant impact on public finances would occur as a result of in-migration, and 16 additional local public service employees would be required to maintain existing levels of service in the four local public service jurisdictions in Pueblo County. In addition, on-post employee commuting patterns would have no impact on levels of service in the local transportation network surrounding the site.

6.19.4 Impacts of No Action

Current PCD site activities have only moderately significant socioeconomic impacts (Table 6.18-15). PCD currently employs 78 workers. Wage and salary expenditures by PCD employees on goods and services have created an additional 60 indirect jobs in the ROI surrounding the site and increased the annual average employment growth rate in the ROI by 0.01% over the period 1990 to 2000. PCD related wage and salary expenditures have also created an estimated $5.9 million in annual income in the ROI.

6.20 ENVIRONMENTAL JUSTICE

On February 11, 1994, President Clinton issued Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations* (59 FR 7629). This executive order, along with its accompanying cover memo, calls on federal agencies to incorporate environmental justice as part of their missions. It directs them to address, as appropriate, disproportionately high and adverse human health or environmental effects of their actions, programs, or policies on minority and low-income populations. Sections 6.20.1 through 6.20.4 of the EIS address environmental justice issues for the populations defined below.

This EIS used data from the two most recent decennial censuses (1990 and 2000) to evaluate environmental justice in the context of the ACWA at PCD. The 2000 census provides detailed data on race and ethnicity necessary for a systematic definition of minority populations. Although more than a decade old, the 1990 census nevertheless provides the most recent data available on income, which enabled the identification of low-income populations. To remain consistent with these data sources, the EIS employs the following definitions for minority and low-income:

- *Minority* — individuals who classify themselves as belonging to any of the following racial groups: Black (including Black or Negro, African American, Afro-American, Black Puerto Rican, Jamaican, Nigerian, West Indian, or Haitian); American Indian, Eskimo, or Aleut; Asian or Pacific Islander; or "Other Race" (U.S. Bureau of the Census 1991). For present purposes, individuals characterizing themselves as belonging to two or more races also are counted as minorities. This study also includes individuals identifying themselves as Hispanic in origin, technically an ethnic category, under minority. To avoid double-counting, tabulations included only White Hispanics; the above racial groups already account for non-White Hispanics.

- *Low-Income* — individuals falling below the poverty line. For the 1990 census, the poverty line was defined by a statistical threshold based on a weighted-average that considered both family size and the ages of individuals in a family. For example, the 1990 poverty threshold annual income for a family of five with two children younger than 18 years was $15,169, while the poverty threshold for a family of five with three children aged less than 18 years was $14,796 (U.S. Bureau of the Census 1992a). If a family fell below the poverty line for its particular composition, the census considered all individuals in that family to be below the poverty line. Low-income figures in the 1990 census reflect incomes in 1989, the most recent year for which entire annual incomes were known at the time of the census.

For this EIS, an analysis of minority and low-income populations was done by using census data for two demographic units: counties and census block groups. A block group is a geographic unit consisting of a cluster of blocks that is used by the Census Bureau to present data (U.S. Bureau of the Census 1991). Block groups contain enough blocks to encompass about 250–550 housing units, with the ideal one containing about 400 housing units. Because housing density varies over space, the geographic sizes of block groups vary; smaller units tend to occur in denser areas, such as urban areas. This dual focus on counties and block groups enabled the evaluation of environmental justice issues to remain consistent with the geographical focus of analyses in two issue areas where environmental justice is of particular concern: socioeconomics and human health. To maintain consistency with the socioeconomic analysis, the subsections on current conditions and impacts in this section of the EIS consider Pueblo County to be the core county for PCD. To maintain consistency with the human health analysis, the environmental justice analysis considers population characteristics in census block groups within a 30-mi (50-km) radius of PCD. The block groups considered include parts of El Paso, Lincoln, Otero, and Pueblo Counties and all of Crowley County.

To define disproportionate representations of either minority or low-income populations, this EIS uses values for the United States as a whole as reference points, thereby providing an identical comparison for all four installations considered in this EIS. This choice of a reference point, which is central to environmental justice analyses, reflects a desire to remain consistent with Executive Order 12898 and is consistent with the need to select a meaningful reference point for any given impact assessment (Council on Environmental Quality [CEQ] 1997; EPA 1998a). The 2000 census indicates that the United States contains 30.9 % minority persons (U.S. Bureau of the Census 2001c), while the 1990 census indicated that 13.1% of persons for whom poverty status was known were considered low-income population in 1989 (U.S. Bureau of the Census 1992c).

6.20.1 Current Environment

Of the Pueblo County residents recorded in the 2000 census, 42.3% were classified as minority on the basis of the above definition (U.S. Bureau of the Census 2000c). This percentage is slightly higher than the minority percentage in the United States as a whole. The largest percentage of minority persons in Pueblo County (38.0% of the total population) was of Hispanic origin. The 1990 census recorded that 20.2% of the Pueblo County population were below the poverty level (U.S. Bureau of the Census 1992c); this percentage was slightly higher than the percentage in the United States as a whole. Note that the figures for minority and low-income populations did not account for seasonal farm workers, who are present in Pueblo County in large numbers at certain times of the year and include a large proportion of minority and low-income persons (and who are very difficult to track statistically with much reliability). If these seasonal workers would be included, the disproportionality already identified would increase accordingly.

Of the 160 census block groups defined in the 2000 census as being partially or totally within a 30-mi (50-km) radius of PCD, 109 contained minority populations in excess of the minority representation in the United States (Figure 6.20-1). These 109 block groups contained a total of 56,049 minority persons in 2000. Block groups with disproportionately high minority populations included the scattered farming communities of Crowley, Manzanola, and Ordway, as well as nearly all of the city of Pueblo.

Of the 176 census block groups defined in the 1990 census as lying partially or totally within a 30-mi (50-km) radius of PCD, 115 had low-income populations in excess of the 13.1% calculated for the United States as a whole (Figure 6.20-2). These block groups contained a total

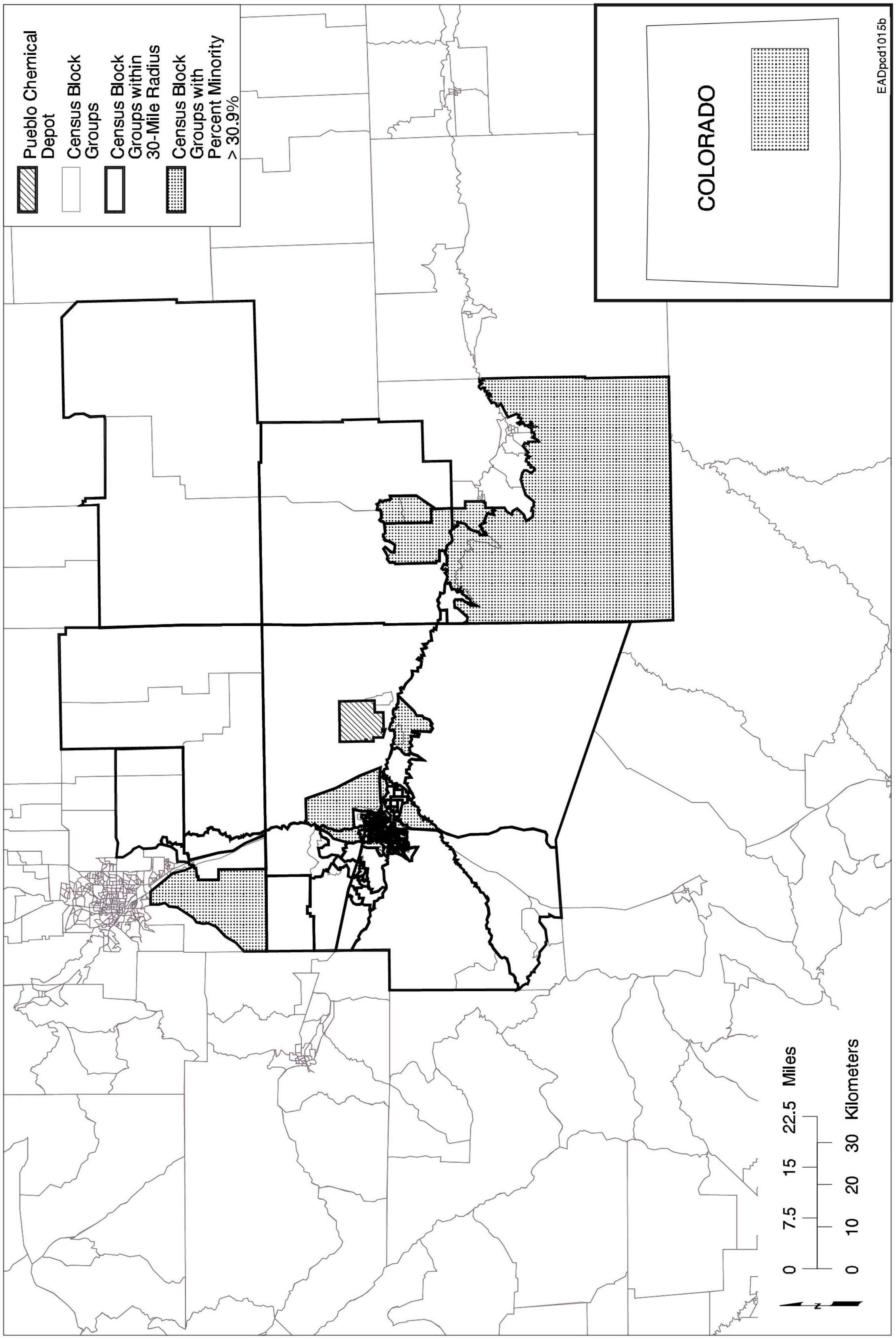

FIGURE 6.20-1 Census Block Groups surrounding PCD with Minority Populations Greater than the National Average in 2000 (Source: U.S. Bureau of the Census 2001d)

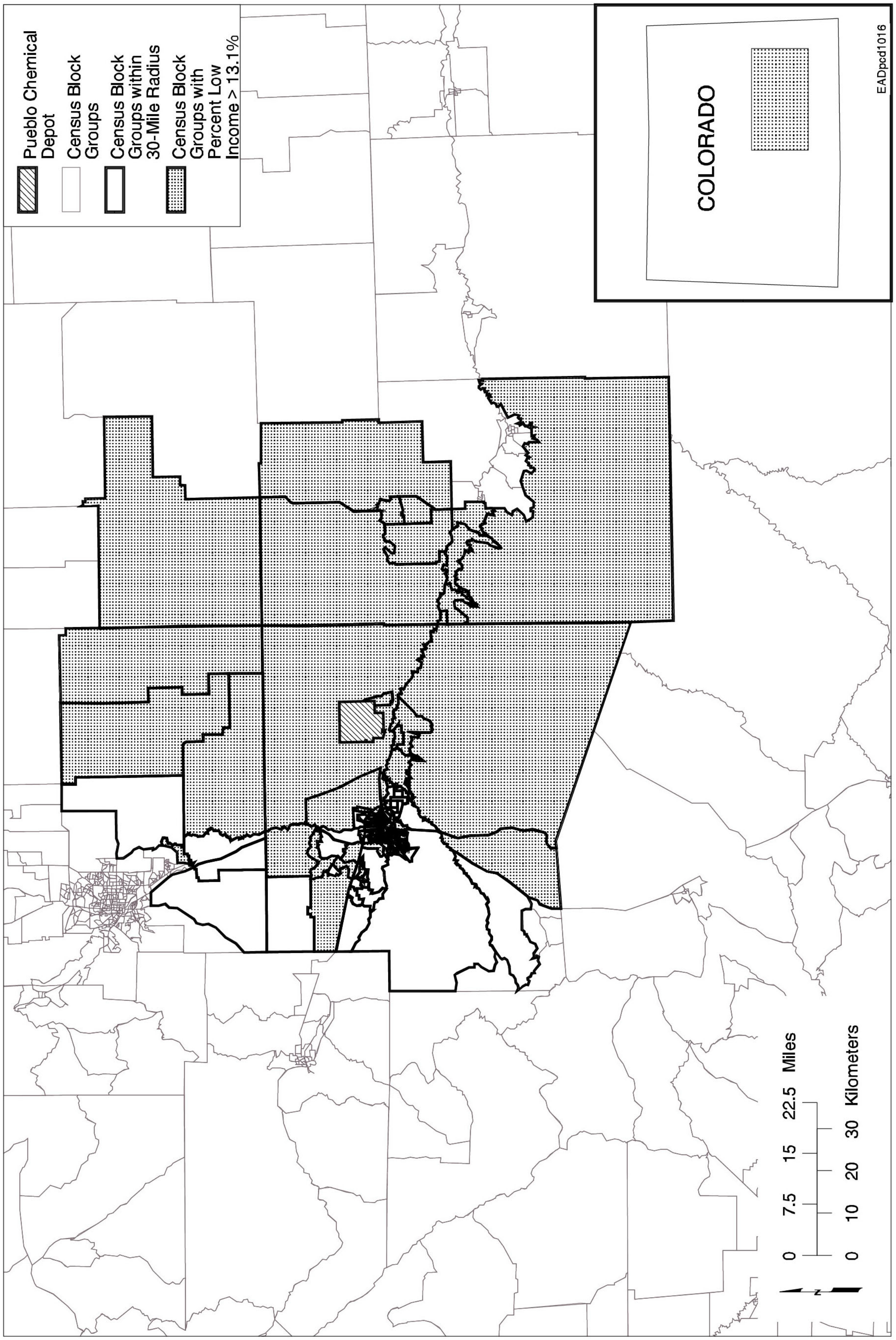

FIGURE 6.20-2 Census Block Groups surrounding PCD with Low-Income Populations Greater than the National Average in 1989 (Source: U.S. Bureau of the Census 1992c)

of 23,310 low-income persons in 1989. Block groups with a disproportionately high representation of low-income populations included the same four communities noted in the preceding paragraph, along with the small communities of Boone, Fowler, Olney Springs to the east of PCD, and Pueblo West to the west of PCD.

6.20.2 Site-Specific Factors

Factors considered in this EIS with potential implications for environmental justice are any activities associated with the ACWA program at PCD. Included are impacts associated with construction, operations, and accidents. The evaluation of environmental justice consequences focuses on socioeconomic and human health impacts, two categories that directly affect all people, including minority and low-income populations.

To address Executive Order 12898, this analysis focuses on impacts that are both high and adverse and that disproportionately affect minority and low-income populations. Although it seems logical that certain characteristics of many environmental justice populations — such as having limited access to health care and reduced or inadequate nutrition — might make such populations disproportionately vulnerable to environmental impacts, there do not appear to be any scientific studies that support this contention for the types of impacts considered in this EIS. The absence of such information precludes any analysis that considers increased sensitivity of minority and low-income populations to impacts. To help compensate for this limitation, the analysis of human health impacts includes conservative assumptions and uncertainty factors to accommodate for potentially sensitive subpopulations (see Section 6.7.2.2). The present analysis considers that a disproportional effect could occur only if the proportion of a population is in excess of the proportion in the United States as a whole, as discussed above under existing conditions. Therefore, significant environmental justice impacts are those that would have a high and adverse impact on the population as a whole and that would affect areas (Pueblo County or census block groups within 30-mi [50-km] of PCD) containing disproportionately high minority or low-income populations.

6.20.3 Impacts of the Proposed Action

6.20.3.1 Impacts of Construction

The primary socioeconomic impacts of construction under either alternative technology, discussed in Section 6.19.5.1, would be an increase in short-term employment and income. They would also include small increases in demand for local housing, schools, and public services. None of these impacts would be high or adverse; local governments and the existing housing stock should be able to accommodate increased demands, and the increased employment and income would be a positive consequence of construction. High and adverse impacts in other areas similarly would not be anticipated during construction of an ACWA facility at PCD (see Section 6.7.2.1). As a result, no environmental justice impacts are anticipated during construction.

6.20.3.2 Impacts of Operations

The primary socioeconomic impacts of operating an ACWA facility, discussed in Section 6.19.5.2 for both technologies, would be increases in employment and income. They would also include small increases in demand for local housing, schools, and public services. Once again, none of these impacts would be high or adverse; local governments and the existing housing stock should be able to accommodate increased demands, and the increased employment and income would be a positive consequence of construction. As a result, no environmental justice impacts are anticipated during operations.

As discussed in Section 6.7.2.2, occupational hazards to workers and releases of agents or other hazardous materials represent the main impacts that could occur during routine operations under both alternative technologies. However, the risk of a noncancer health effect and the risk of cancer from hazardous chemicals released during normal operations would be very low for both workers and the public. These impacts would not be high and adverse, and, as a consequence, no environmental justice impacts are anticipated during normal operation.

6.20.4 Impacts of No Action

As discussed in Section 6.19.6, socioeconomic impacts of continued operations at PCD would be small: primarily a continuation of small, positive economic impacts and a slight increase in demand for housing, schooling, and public services. None of these impacts would be considered high or adverse. Similarly, high and adverse human health impacts on either the workers at PCD or the general public are not anticipated (see Section 6.7.3). As a result, no environmental justice impacts are anticipated under the no action alternative.

6.21 ACCIDENTS INVOLVING ASSEMBLED CHEMICAL WEAPONS

6.21.1 Potential Accidental Releases

This analysis of accidents provides an estimate of the upper range of the potential impacts that might occur as a result of a hypothetical accident related to the proposed action (ACWA pilot testing) or related to the no action alternative (continued storage of the chemical weapons). The accidents selected for analysis were the accidents that were shown to have the highest risk in previous Army analyses (Science Applications International Corporation [SAIC] 1996). The highest-risk accidents are defined as those with the highest combined consequences (in terms of human fatalities) and probability of occurrence. For existing continued storage conditions and for operations, the highest-risk accidents would involve the release of chemical agent; release of other materials would result in lower consequences and risks. In general, the accidents considered in this EIS have a fairly low frequency of occurrence. The accident considered for continued storage (aircraft crash into a storage igloo) has an estimated frequency on the order of 1×10^{-6} per year (i.e., one occurrence in 900,000 years). The accident considered for the pilot facilities (earthquake impacting the unpack area) has a higher estimated frequency of approximately 5×10^{-5} (i.e., one occurrence in 21,000 years).

6.21.1.1 Scenarios

The hypothetical highest-risk accident for ACWA pilot testing assumes that an earthquake would cause the part of the unpack area where munitions are located to fall. The hypothetical highest-risk accident for continued storage assumes an aircraft would crash into a munitions storage igloo with a subsequent fire and the release of agent from all the munitions in the igloo. It is recognized that during operation of an ACWA pilot facility, the risk of a storage accident (as presented under the no action alternative in Section 6.21.3) is also present; however, in Section 6.21.2, the focus is on the consequences of accidents related to pilot testing in order to differentiate between facility risks and storage risks.

Impacts from accidents occurring during transport of agent from the storage igloos to the pilot testing facility were not assessed for this EIS, because the risks from these accidents would be less than those from the accidents included. Accident scenarios and probabilities from on-site transportation are discussed in a PEIS support document (GA Technologies 1987). Potential accidents from handling the munitions inside the igloos were considered, but, at PCD, these accidents are not the highest-risk accidents.

For the pilot facility accident scenario, data given in the PCD Phase I quantitative risk assessment for a baseline incineration facility (SAIC 1996) were used to estimate the maximum amount of agent that could be released during an earthquake. Both ACWA technology providers would use a modified baseline process for ACW access (General Atomics 1999; Parsons and Allied Signal 1999); therefore, it was assumed that the unpack area configuration would not deviate significantly from the baseline. For PCD, it was assumed that the maximum number of munitions in the unpack area would be the contents of four on-site containers (ONCs) containing 155-mm projectiles at the time of the crash. (This assumption results in the largest possible amounts of chemical agent present in the unpack area among the munition types present at PCD.)

ONCs are used to transport munitions at the Tooele Chemical Agent Disposal Facility, but the Army is investigating the feasibility of using modified ammunition vans. A change in the transport system used might also entail changes in the dimensions and capacity of the unpack area or a similarly functioning building or area. Such changes should not invalidate the impact estimates given here, because the assumption on number of munitions present in the unpack area was meant to represent a high-end estimate of the amount of agent that could be released in an earthquake. These accident impact estimates should be representative for either type of transportation system.

For the storage igloo accident scenario, it was assumed that an aircraft crash could release the entire contents of a storage igloo. The probability of such an event occurring is low (on the order of 10^{-6}), but it increases slightly with increasing length of continued storage. For this scenario, the maximum amount of agent at risk was obtained from estimates of the maximum amount of mustard agent stored in any single PCD igloo (DeMers 1999).

6.21.1.2 Methods of Analysis

Potential accidental releases of chemical agent to the atmosphere and the associated consequences of such releases were assessed by using the D2PC[13] Gaussian dispersion model (Whitacre et al. 1987). Two meteorological conditions were assumed in the modeling to assess accident impacts. E-1 conditions consist of a slightly stable atmosphere (stability class E) with light winds (1 m/s). D-3 conditions consist of a neutral atmosphere (stability class D) with moderate winds (3 m/s). E-1 conditions would produce conservative impacts for the assessed accident scenarios. They represent accidents that would occur during the night or during a relatively short period after sunrise. The D-3 conditions would result in more rapid dilution of an accidentally released agent than would E-1 conditions. D-3 conditions represent accidents that would occur during daytime. When D-3 meteorological conditions are assumed, the size of the estimated plume is smaller. In conducting D2PC modeling, it was assumed that no plume depletion by agent deposition would occur. This is a conservative assumption for estimating the area potentially affected by an accidental release, because assuming that more agent remains in the plume allows farther plume travel before concentrations are diluted below the toxicological endpoint levels. The D2PC model default mixing height assumptions were used for modeling. The D2PC model limits its application to accident release scenarios that could produce impacts at distances of less than or equal to about 30 mi (50 km).

For modeling mustard agent instantaneous releases, the “time after functioning” (TAF) parameter was assumed to be 20 hours. (The TAF was applicable only for accident modeling involving mustard agent instantaneous releases; it is defined as the time after detonation required to remove the agent source by decontaminating it or by containing it so it would no longer enter the atmosphere [Whitacre et al. 1987]).

[13] The Army has completed the development and validation of a new model (D2Puff). However, the new model is not accredited for use at all installations.

6.21.1.3 Exposures and Deposition

For each of the accident scenarios assessed, the impacts of agent release were modeled by using D2PC-generated plumes with dosages estimated to result in adverse impacts for a certain percentage of the human population exposed (i.e., LCt_{50} = dosage corresponding to 50% lethality; LCt_{01} = dosage corresponding to 1% lethality; no deaths = dosage below which no deaths are expected in the human population exposed; no effects = dosage below which no adverse impacts are expected in the human population exposed). The distances to which these various plumes were predicted to extend were used as the starting point for the analyses of impacts to the various resources of concern under the proposed action and no action alternatives, as detailed in Sections 6.21.2 and 6.21.3 below. These distances are summarized in Table 6.21-1. For reference, the minimum distance from the hypothetical accident locations (i.e., Munitions Storage Area A storage area or the unpack area within the proposed facility locations) to the PCD installation boundary is about 0.7 mi (1.1 km), and the distance to the on-site administrative area is about 4 mi (6.4 km). For all the hypothetical accidents assessed, the no effects plume contour extends into off-post areas and out (i.e., extending from 4 to 30 mi [7 to 50 km]). The extent of the no deaths contour varies from 0.4 to 30 mi (0.6 to 50 km), depending on the meteorological conditions assumed.

6.21.2 Impacts of Accidents during the Proposed Action

6.21.2.1 Land Use

Impacts from an accidental agent release during operation of an ACWA pilot test facility would generate serious negative impacts on land use outside the installation, including the death and quarantine of livestock, interruption of agricultural productivity, and disruption of local industrial activities (see Section 6.21.2.9). Although capable of generating serious negative consequences, the likelihood of such an accident is extremely remote, consequently producing a very low overall risk.

6.21.2.2 Waste Management and Facilities

Hazardous Waste. The highest-risk accident scenario for ACWA pilot testing activities is an earthquake impacting the unpack area. Waste generated under this scenario would be primarily soil and debris contaminated from the dispersion of agent. An undeterminable amount of contaminated wastes could be produced by cleanup of a spill or accident involving dispersion of agent. Spill and emergency response plans and resources would be in place to contain, clean up, decontaminate, and dispose of wastes according to existing standards and regulations.

TABLE 6.21-1 HD Plume Distances Resulting from Accidents at an ACWA Pilot Test Facility (Proposed Action) or in Munitions Storage Area A (No Action) at PCD[a]

Effect	Impact Distance, mi (km)[b]	Exposure Dose (mg-min/m^3)[c]	Impact Area	
			km^2	acres
Proposed action, D-3 (i.e., earthquake impacts; unpack area)				
1% lethality	0.31 (0.50)	150	0.03	7.4
No deaths	0.38 (0.62)	100	0.04	9.9
No effects	4.0 (6.5)	2	2.7	670
Proposed action, E-1 (i.e., earthquake impacts; unpack area)				
1% lethality	1.2 (1.9)	150	0.18	44
No deaths	1.5 (2.4)	100	0.27	67
No effects	>30 (>50)	2	52	13,000
No action, D-3 (aircraft crash into Munitions Storage Area A igloo)				
1% lethality	2.4 (3.9)	150	1.1	270
No deaths	3.1 (5.0)	100	1.7	420
No effects	>30 (>50)	2	200	49,000
No action, E-1 (aircraft crash into Munitions Storage Area A igloo)				
1% lethality	15 (24)	150	13	3,200
No deaths	23 (36)	100	26	6,400
No effects	>30 (>50)	2	140	35,000

[a] Distances and plume areas in table are from D2PC output. Meteorological conditions of either D stability and 3-m/s wind speed or E stability and 1-m/s wind speed and a “time after functioning” of 20 hours (for instantaneous mustard releases) are assumed.

[b] Impact distances downwind of accident that would have 1% lethality, no deaths, or no effects on humans (see Table 6.21-2).

[c] Dosage for duration of accident at specific impact distance. The dosages correspond to default values used in the D2PC code (Whitacre et al. 1997).

Chemical agents are listed in the Colorado hazardous waste regulations (6 CCR 1007-3, Section 261.33(e)). If an accident that would involve a listed hazardous waste were to occur, any contaminated residue, soil, water, or other debris resulting from the cleanup of that agent would also be considered a listed hazardous waste (6 CCR 1007-3, Section 261.3).

Pursuant to Colorado hazardous waste regulations, debris contaminated with a listed hazardous waste may be exempt from regulation as hazardous waste if a demonstration test shows that the waste does not exhibit any hazardous characteristics or if the CDPHE determines, considering the extent of contamination, that the debris is no longer contaminated with hazardous waste (6 CCR 7-1001, Section 261.3(f)). "Debris" is defined as solid material exceeding a 60-mm particle size; it includes manufactured objects, plant or animal matter, and natural geologic material. A mixture of debris and other material is subject to regulation as debris if a visual inspection indicates that the mixture is composed primarily of debris, by volume.

For contaminated soil or water that does not meet the definition of debris, the Army can consider filing a petition to delist the contaminated medium if a demonstration test shows that the waste does not contain the constituent that caused the CDPHE to list the chemical agent or if the hazardous constituent in the medium does not meet the criteria when the factors used by the CDPHE to list the chemical agent (6 CCR 7-1001, Section 206.22) are considered.

Nonhazardous Waste. Considering the particular accident conditions and pursuant to demonstration, the Army might be able to dispose of some or most of the cleanup material as nonhazardous waste in a local landfill.

6.21.2.3 Air Quality

Depending on the amount, an accidental release of HD agent at PCD during operation of an ACWA pilot test facility could have short-term but very significant adverse impacts on air quality, in terms of human injuries and fatalities (see Section 6.21.2.4). However, deposition of agent from air onto the ground surface and/or degradation in the environment would occur within a relatively short period of time. HD decomposes in air relatively quickly; its half-life is about 1.4 days (see Appendix A). Therefore, long-term (e.g., more than a few days after release) adverse air quality impacts would not be expected from an accidental release of HD.

6.21.2.4 Human Health and Safety

For each of the accident scenarios assessed, the impacts of agent release were modeled by using plumes with dosages estimated to result in death for a certain percentage of the population exposed (i.e., LCt_{50} = dosage corresponding to 50% lethality; LCt_{01} = dosage corresponding to 1% lethality; no deaths = dosage corresponding to 0% lethality). The assumption was made that for any accident, the wind would be toward the direction where the largest number of people live. By using site-specific population data, the potential numbers of fatalities for each accident were estimated. Further details on the methods used to estimate number of fatalities are given in Appendix H. This evaluation did not specifically estimate the numbers of nonfatal injuries that would occur for each accident scenario, because there would be great variation in the number and severity of nonfatal injuries, depending on exposure concentration and duration and depending on variations in the populations exposed.

The population at risk at PCD (i.e., persons residing within a 30-mi [50-km] radius of the post) is about 180,000 people. The accident scenario of an earthquake impacting the unpack area would apply to both the Neut/Bio and Neut/SCWO alternatives during processing. This accident scenario would result in a 1% lethality distance of 1.2 mi (1.9 km), when E-1 meteorological conditions are assumed. (Table 6.21-2). The corresponding estimated number of fatalities among the general public would be zero. The estimated number of fatalities for the on-post population would also be zero. In addition, if such an accident occurred under D-3 meteorological conditions, the 1% lethality distance would decrease to 0.31 mi (0.50 km), and the estimated number of fatalities for both the general public and the on-post population would be zero.

Fewer than five individuals occupy the nearest residence just beyond the northern boundary of PCD, a distance of about 1 mi (1.6 km) from the nearest alternative pilot facility location and from the nearest storage igloo. This residence has been an important part of the community and PCD emergency planning efforts. PPE, including suits and gloves, and powered air-purifying respirators (PAPRs) are in place for six individuals to use, if necessary, during safe evacuation or shelter-in-place. These safety precautions should prevent injury to the residents at that location in the event of an accident. However, if an accident were to occur, the individuals might not be able to take protective action quickly enough to prevent injury or death.

The TTC located at the northern boundary of the site employs approximately 230 individuals. The structures on the TTC site are near the central-eastern area, about 5 mi (8 km) from the PCD site boundary. If the wind were blowing toward the TTC at the time of an accident involving an earthquake (proposed action), the no effects plume could extend to 4.0 mi (6.5 km) from the release location under worst-case meteorological conditions (see Table 6.21-1). Therefore, it is unlikely that fatalities or injuries would occur among TTC employees unless some of them were much nearer to the PCD boundary at the time of the earthquake accident.

The plume distance for the earthquake accident scenario does not extend to off-site locations. Therefore, no special consideration of potentially sensitive subpopulation exposures is required for this scenario.

For the human health impacts assessment, an internally initiated accident was also modeled (i.e., an accident caused by equipment failure or human error at the pilot facility). The internally initiated accident that was modeled involved a rupture in the 500-gal (1,900-L) agent holding tank or the connecting piping in the MDB that could result in the release of the tank's entire contents. For such an accident, it was found that the amount of mustard released from the facility stacks via the building's heating, ventilation, and air conditioning (HVAC) system would be negligible, because mustard is relatively nonvolatile and because the room where the leak would occur is relatively small and would contain the agent, providing only a limited surface area for agent evaporation. In addition, the facility's pollution abatement system should capture most or all of the agent that might evaporate from the spill.

TABLE 6.21-2 Fatality Estimates for Potential Accidents Involving HD Release at PCD[a]

Accident Scenario[b]	Distance (mi) To LCt_{50} Dose	Distance (mi) To LCt_{01} Dose	Distance (mi) To No Deaths Dose	On-Post Population at Risk (no. of persons)[c] Source to LCt_{50}	On-Post Population at Risk (no. of persons)[c] LCt_{50} to LCt_{01}	On-Post Population at Risk (no. of persons)[c] LCt_{01} to No Deaths	Maximum Estimated Fatalities for On-Post Population[d]
Continued storage highest-risk accident (applicable to no action and proposed action)							
Aircraft crash into storage area with fire: D-3	1.0	2.4	3.1	0	6	2	2
Aircraft crash into storage area with fire: E-1	4.8	15	23	200	80	0	170
Facility highest-risk accident (applicable for proposed action, Neut/SCWO or Neut/Bio)							
Earthquake impacting unpack area: D-3	0.16	0.31	0.38	0	0	0	0
Earthquake impacting unpack area: E-1	0.54	1.2	1.5	0	0	2	0

Accident Scenario[b]	Off-Post Public Population at Risk (no. of persons)[c] Source to LCt_{50}	Off-Post Public Population at Risk (no. of persons)[c] LCT_{50} to LCt_{01}	Off-Post Public Population at Risk (no. of persons)[c] LCT_{01} to No Deaths	Maximum Estimated Fatalities for Off-Post Population[d]
Continued storage highest-risk accident (applicable to no action and proposed action)				
Aircraft crash into storage area with fire: D-3	0	0	0	0
Aircraft crash into storage area with fire: E-1	1	970	10,871	298
Facility highest-risk accident (applicable for proposed action, Neut/SCWO or Neut/Bio)				
Earthquake impacting unpack area: D-3	0	0	0	0
Earthquake impacting unpack area: E-1	0	0	0	0

[a] Scenarios are highest-risk accidents for pilot facilities and for continued storage (no action).

[b] D-3 corresponds to meteorological conditions of D stability with 3-m/s wind speed, and E-1 corresponds to conditions of E stability with 1-m/s wind speed. All accidents are assumed to occur with the wind blowing toward the location of maximum public or on-post population density.

[c] Population at risk indicates the number of individuals working (for on-post populations) or residing (for off-post populations) within the area encompassed by the plume. LCt_{50} value used was 600, assuming a 25-L/min breathing rate (SAIC 1996; Goodheer 1994; Burton 2001). LCt_{01} and no deaths values were defaults from D2PC code (Whitacre et al. 1987), as given in Table 6.21-1. LCt_{50} value proposed by National Research Council (1997b) of 900 for HD (for 15-L/min breathing rate) was not used in this assessment; this value has not been formally approved for use by the Army.

[d] Total fatalities were calculated by assuming (1) a fatality rate of 75% in the area between the point of agent release and the 50% lethality dosage contour, (2) a fatality rate of 25% in the area between the 50% lethality dosage contour and 1% lethality dosage contour, and (3) a fatality rate of 0.5% in the area between the 1% lethality dosage contour and no deaths dosage contour.

The assessment did not find any difference between the technology systems with respect to accident impacts during pilot facility operations. This finding is attributable to the fact that acute health risks are mainly determined by the quantity of agent released in an accident (the source term). Once neutralization would occur inside the pilot facility, the acute health risks associated with an accidental release of process by-products (e.g., hydrolysate solution) would be negligible in comparison with the risks associated with the release of an agent. Because the alternative technologies would operate at similar throughput rates, with similar total amounts of agent present at the front end of the process (in the unpack area and during munitions disassembly), the assumed source terms from the bounding accidents would be the same.

The main potential differences in accidents involving releases of agent for the different technology systems being tested would be related to the method used to access agent and explosives in the munitions. Cryofracture would be used for separation of energetics in some processes, and the reverse assembly process would be used in others. Assessments of the consequences of accidents involving these separation processes are not presented because the impacts would be substantially smaller than those of the other externally and internally initiated events considered. Also, the currently available vendor design data do not indicate any differences in the two processes that would result in substantially different consequences from those that would result from an accidental release of agent during munitions disassembly.

The Neut/Bio process uses seven process chemicals: sodium hydroxide, sulfuric acid, hydrogen peroxide, ferrous sulfate, liquid nitrogen, aqueous ammonia, and dextrose. The Neut/SCWO process uses five major process chemicals: sodium hydroxide, phosphoric acid, kerosene, liquid oxygen, and liquid nitrogen. Several of the chemicals used in both technologies are flammable or reactive (e.g., sodium hydroxide, sulfuric acid, kerosene), and several exhibit irritant properties through inhalation or dermal contact. However, all are common industrial chemicals with well-established handling procedures and safety standards. According to PMACWA (1999), “the risk from gaseous emissions of these chemicals is minimal, but more work is needed to demonstrate the effectiveness of the containment design in the event of an accidental ignition of energetics during processing.” The effectiveness of the containment design is being further addressed by the ACWA technology providers in engineering design studies.

6.21.2.5 Soils

Under the accident scenarios considered for ACWA pilot testing activities at PCD, contamination of surface soils could extend over an area beyond the installation boundaries. Given the nature of the accidents, it is assumed that mustard agent would be widely deposited downwind on surface soils as fine particles or droplets. Fine particles of mustard agent would rapidly degrade (Munro et al. 1999; see Appendix A). In extended cold weather (e.g., freezing temperatures), after about two weeks, the mustard would be present at only negligible levels of less than 0.0001% of the original deposition, and after about 3.5 months (2,215 hours), all of the mustard would be gone.

Near the agent release, pools or larger pieces of mustard (depending on the temperature) might be deposited. However, this mustard, which would degrade more slowly than fine particles, would be removed during cleanup operations and would not have a long-term impact on the surface soils. Contaminated soils excavated during cleanup would be disposed of in accordance with applicable requirements.

6.21.2.6 Water Resources

The mustard deposited on the soil after an earthquake accident would be deposited as fine particles, and no large volumes of mustard would be deposited downwind of the accident site as solid mustard. Near the impact site, pools or pieces of mustard (depending on the temperature) might be present. This mustard would be removed during cleanup operations and would not pose a long-term threat or be a source of water contamination.

The fine mustard particles on the soil surface downwind of the accident would dissipate quickly. Under cold conditions, the mustard might be present for as long as 2,000 hours (3 months). However, even under cold conditions, within two weeks, the amount present would be negligible, less than 0.0001% (Munro et al. 1999) of the original deposition. Under warmer conditions, the mustard would dissipate within a few days of deposition. These estimates are based on tests of mustard droplets on the surface. Because the mustard particles deposited downwind of the accident would be very small, it is expected that the mustard would dissipate in less time than predicted in these estimates.

Transportation of mustard by surface runoff or subsurface flow would be minimal. At 33°F (0.6°C) (30-h half-life), only 0.01% of the mustard would remain after about 16 days (400 hours). At 77°F (25°C) (4- to 8-min half-life), concentrations would be reduced by the same amount in only 80 min (1.3 h) (Munro et al. 1999). Surface runoff might mobilize the fine mustard droplets present on the soil surface, but the turbulent water would hydrolyze this mustard rapidly. To be transported into the subsurface by infiltrating water, the mustard would need to be dissolved, and, once dissolved, it would hydrolyze rapidly. Under cold conditions, which allow for the longest hydrolization half-life of approximately 30 hours, the mustard would be transported less than 100 ft (30 m) in groundwater before decomposing. Saturated hydraulic conductivity ranges from 0.4 to 400 ft/d (0.1 to 120 m/d), so mustard could reach the groundwater under cold conditions. At 77°F (25°C), there would be little chance for any mustard to reach the groundwater table. Estimated groundwater velocity ranges from 0.02 to 3 ft/d (0.006 to 0.9 m/d), with a median value of 0.8 ft/d (0.24 m/d) (Section 6.11.1.1). In 30 days, with the water at 33°F (0.6°C), the concentration of mustard would be only 0.00001% of the initial concentration, and the mustard would travel only 0.6 to 90 ft (0.2 to 27 m) from the source in the groundwater. At 77°F (25°C), it would take only 100 min for the mustard concentration to reach the same reduced level, and the mustard would travel less than 1 ft (30 cm). In addition, initial concentrations reaching the groundwater would be relatively low because of degradation and dilution in the vadose zone.

It is very unlikely that conditions would exist to allow impacts on the water supply wells. If the water were cold and an appropriate rainfall event occurred immediately after the accident, groundwater supply wells within the 1% lethality contour (including those immediately adjacent to Munitions Storage Area A) might conceivably be minimally affected for a short time following an accident, but this result would be unlikely. Impacts on other groundwater resources would be none to negligible. Moreover, groundwater resources off the installation would not be affected.

Impacts on the Spring Fed Pond on Boone Creek would be short-lived. Concentrations would rapidly decrease as a result of degradation and dilution and would be reduced to 0.01% of the initial concentrations within 80 min at 77°F (25°C) and within 16 days at 33°F (0.6°C).

It is unlikely that mustard would reach the Spring Fed Pond because it would be diluted by overland flow, but, if it did, impacts would be minimal and short-lived. Surface runoff might contain some mustard when it reached the pond. But within a few hours to a day, depending on the temperature, these concentrations would be negligible. Dilution from the overland flow and mixing in the pond would also reduce the initial concentration of mustard reaching the pond. In addition, for any appreciable amount of mustard to reach the pond from overland flow, a rainfall event large enough to produce surface runoff, but small enough to not significantly dilute the dissolved mustard, would have to occur within a few hours of the accident.

Impacts on other surface streams and rivers (other than the Spring Fed Pond on Boone Creek) in the area would be none to negligible and short-lived. Degradation times for surface water would be the same as those discussed above for groundwater. Surface water that reached the Arkansas River, which is approximately 5 mi (8 km) away, would have only negligible amounts of mustard remaining because of degradation and significant dilution.

The mustard degradation product TDG, if present at all, would occur at very low concentrations in either surface or groundwater resources. Because of the relatively low toxicity of TDG and its low concentration, impacts of mustard degradation products on all water resources would be none to negligible.

6.21.2.7 Biological Resources

Accident analyses were conducted for a scenario that involved an earthquake causing munitions in part of the unpack area to fall. Ecological impacts from a major accident associated with operation of an ACWA pilot test facility were assessed on the basis of atmospheric concentration estimates made by using the D2PC model (Whitacre et al. 1987). Model output was used to conduct impact analyses for vegetation, wildlife, aquatic habitats and fish, protected species, and wetlands.

Terrestrial Habitats and Vegetation, Wildlife, and Aquatic Habitats and Fish. On the basis of the limited qualitative reports on the phytoxicity studies of mustard, it is not possible to provide an approximate area of impacts for acute exposure of terrestrial plants caused by an accidental release of mustard. In all likelihood, an accidental release of mustard would cause a certain degree of defoliation and retarded germination downwind from the accident location (Opresko et al. 1998). However, hydrolysis of mustard would probably occur quickly after deposition on plant surfaces and soils (see Appendix A). Model runs for an earthquake during mustard processing under D-3 (daytime) meteorological conditions showed an average mustard deposition area of 3 ha (7.4 acres) in the 1% human lethality area that extends to 0.31 mi (0.50 km) downwind of the accident site (see Table 6.21-1).

The deposition plume areas would be elliptical in shape and would occur mostly downwind of an accident. The location and geometry of the plume areas would vary, depending on the atmospheric stability and wind direction at the time of an accident. At PCD, the prevailing winds that would result in the greatest consequences from an accident would be from the north and northeast. A release of HD would thus have a higher probability of affecting ecosystems located south and southwest of the test facility. However, the release could presumably affect ecosystems in any direction, depending on the direction and speed of the wind at the time of the accident. Because of the limitations of the D2PC model, the size of habitat potentially exposed to agent cannot be reasonably approximated.

A screening-level ecological risk assessment was conducted to determine impacts of the bounding accident on three common mammalian species observed in shortgrass prairie and northern sandhill prairie habitats on northern portions of PCD. Species were the pronghorn antelope, Ord's kangaroo rat, and the black-tailed prairie dog. No benchmark values were found for exposure of birds, reptiles, and amphibians to mustard (HD).

Risks to ecological receptors from the accident were characterized by using the hazard quotient (HQ) approach. The HQ is the ratio between the air concentration of a contaminant (i.e., HD) and a contaminant-specific benchmark concentration representing a no observed effect exposure concentration on the basis of results from laboratory studies. HQs were calculated on the basis of inhalation benchmark values developed for use in ecological risk assessments of wildlife exposed to combustion products at Anniston Army Depot (U.S. Army Center for Health Promotion and Preventive Medicine [USACHPPM] 1999a). The HQ values can vary from zero to infinity. Values greater than one show a potential risk to the ecological receptor from the exposure. It is important to note that HQ values greater than one indicate only the potential for adverse risks (or effects) to individual animals and not actual impacts on them. Actual impacts would depend on many factors, such as the length of exposure to an HD plume, the air concentration, and species sensitivities to various atmospheric concentration levels. HQ values were based on air concentrations estimated by the D2PC model under the air stability expected during typical nighttime conditions (wind speed of 1 m/s) and daytime conditions (wind speed of 3 m/s). Benchmark values were adjusted for differences in inhalation rates on the basis of the body mass of the three species examined. Distances from the source of release due to an earthquake were determined for HQ values of less than one on the basis of D2PC model output for both the "no observed adverse effects level" (NOAEL) and "lowest observed adverse effects level" (LOAEL) exposures (Table 6.21-3). Details of the HQ calculations are provided in Tsao (2001b).

A comparison of the NOAEL for the three mammalian species was made for scenarios involving an earthquake causing munitions in part of the unpack area to fall. HQ values for NOAEL would be less than one for all three species at distances ranging from 6.2 to 6.8 mi (10 to 11 km) from the accident site (see Table 6.21-3). All wildlife species evaluated would be less sensitive than humans on the basis of calculated NOAEL distances in comparison with a no effects distance for humans ranging from 4.0 to >30 mi (6.5 to >50 km) (see Table 6.21-1).

Acute effects from an accidental release would occur quickly after exposure. Exposures of wildlife to HD at a distance of 6.8 mi (11 km) downwind from the accident site would result in mortality, particularly to those species with small home ranges such as small mammals, reptiles, and amphibians that would remain in the HD exposure plume during the accident. Mammals that did survive within this distance would suffer from blistering of the skin, irritation to the respiratory system, eye irritation, and other chronic effects known to occur to humans and laboratory animals (Appendix B in Army 1988).

TABLE 6.21-3 Distance from Accident Site That Would Result in No or Lowest Adverse Effects on Wildlife for Proposed Action at PCD[a]

	Distance (mi) with Hazard Quotient of <1[b]			
	Daytime Conditions		Nighttime Conditions	
Species	LOAEL[c]	NOAEL[d]	LOAEL[c]	NOAEL[d]
Ord's kangaroo rat	1.2	1.2	3.1	4.3
Pronghorn antelope	0.56	1.2	1.9	3.1
Black-tailed prairie dog	1.2	1.9	3.1	4.3

[a] Scenario is an earthquake causing munitions to fall at the unpack area.

[b] Hazard quotient = (dose at a given distance from the source) divided by (benchmark value of HD for receptor species). The concentration is obtained by using the D2PC model and assuming a wind speed of 3 m/s during daytime conditions and 1 m/s during nighttime conditions and a plume exposure duration of 20 min.

[c] LOAEL = lowest observed adverse effects level; the maximum distance from the site at which an adverse effect would be expected to occur.

[d] NOAEL = no observed adverse effects level; the distance from the site beyond which no adverse effects would be expected to occur.

No data were found on the uptake of HD through ingestion under field conditions. Some uptake of HD deposited on vegetation, particularly within a distance of 6.8 mi (11 km) downwind of the release, could occur by herbivores during the first few days after the accident. Hydrolysis of HD would likely occur during the first one to two days after the accident, resulting in various degradation products. No data were found on exposures of wildlife to HD degradation products under field conditions. A recent article that reviews the toxicity of CWA degradation products suggested that TDG could persist in soils following an accidental release (Munro et al. 1999). Laboratory exposures of rats for 90 days to various levels of TDG resulted in a NOAEL of 500 mg/kg/d. Even if all HD degraded to TDG (low likelihood of occurrence) within the deposition area, it would be highly unlikely that a herbivore would receive a dose through the food pathway that would be above the NOAEL reported for laboratory rats (Munro et. al. 1999).

Aquatic organisms inhabiting the Spring Fed Pond on Boone Creek, southeast of Munitions Storage Area A, would likely die from initial exposure to HD. Within a relatively short period, HD would hydrolyze and not persist within the water column. Some impacts on aquatic invertebrates and fish could occur in Lynda Ann Reservoir, AWS Pond, and Chico Creek following the accident. The extent of impacts on aquatic organisms would depend on the sensitivities of individual species, the aerial concentration and deposition of HD, and how quickly breakdown would occur. HD would hydrolyze in water bodies more rapidly during windy conditions, when more turbulence typically occurs at the water surface.

The long-term impacts on terrestrial and aquatic ecosystems from an accident releasing mustard are likely to be minimal. The persistence of HD and HT in soil and on vegetation is estimated to range from one day to about one week (ATSDR 1992). The high reactivity of HD with water suggests that biouptake and biomagnification in local ecosystems would be unlikely. Within a plant's vascular system, hydrolysis would likely result in the breakdown of HD before it became concentrated in plant tissues (ATSDR 1992).

The area that would be affected by an earthquake that would cause munitions to fall at an unpack area (proposed action alternative) would be smaller than the area that would be affected by a release of HD caused by an aircraft crashing into a storage igloo (i.e., the no action alternative).

Protected Species. The impacts on protected species would be very similar to those on mammalian species as presented in the previous subsection. Because of the scarcity and distant locations of federal and state protected species from the accident location, impacts on this group of species would be less than those on other terrestrial wildlife. The concentration distances projected by the D2PC model used for short-term accident analysis for protected species are the same as those used for wildlife analysis (i.e., plume area is elliptical in shape and would occur mostly downwind of the accident). The location and geometry of the plume areas would vary, depending on the atmospheric stability and wind direction at the time of an accident. Thus, the accident could presumably affect ecosystems in any direction, depending on the wind direction and speed at the time of an accident.

A qualitative discussion of the impacts on the federal and state protected species and the rare plant communities are discussed below. These species included terrestrial vertebrates (Preble's meadow jumping mouse and mountain plover), aquatic biota (plains minnow and a northern leopard frog), and a reptile (massasauga). The risks are characterized qualitatively because the results of a screening-level ecological risk assessment were not available at the time of writing. Information will be updated when available.

Terrestrial Vertebrates: Preble's Meadow Jumping Mouse, Black-Tailed Prairie Dog, Burrowing Owl, Ferruginous Hawk, Mountain Plover, Black Tern, and Loggerhead Shrike. Accidents that occur at night would be more severe than accidents that occur during the day time because of the meteorological influence typical of nighttime conditions. Nevertheless, the short-term impacts on terrestrial vertebrates would be severe, but the long-term impact would be minimal because of the short half-life of mustard.

Aquatic Vertebrates: Southern Red-Belly Dace, Plains Minnow, Plains Leopard Frog, and Northern Leopard Frog. Some short-term impacts on the aquatic species could occur; however, the long-term impacts would be minimal. Mustard would hydrolyze and would not persist in the water column.

Aquatic Invertebrates. No federal and state protected invertebrates have been located on PCD. Therefore, there would be no adverse impacts on this biological category.

Reptiles: Massasauga. No toxicity study of the effects of mustard on reptiles was available. However, impacts on the massasauga could occur. The long-term impact would be minimal because of the short half-life of mustard.

Designated Rare Terrestrial Plant Communities. The rare plant communities near the location of the accident (Table 6.16-1) would be exposed to mustard. However, hydrolysis of mustard would probably occur quickly after deposition on plant surfaces and soils downwind from the accident (see Appendix A).

Wetlands. Wetlands near the site of the accident would be exposed to mustard. Plant species exposed to mustard downwind of the accident would not be likely to become contaminated to a large extent because of the tendency of mustard to break down relatively quickly by hydrolysis.

6.21.2.8 Cultural Resources

The occurrence of an accident, either during the proposed action or no action, could result in impacts on cultural resources within the area exposed to agent. The building materials used in historic structures or the exposed surfaces of archaeological sites could become contaminated during an accident. At a minimum, public access to these historic properties would be temporarily denied until contamination was degraded by exposure to light and moisture or by active decontamination.

For the hypothetical accident assessed here, only temporary impacts (i.e., access restrictions) would be expected on cultural resources located outside the maximum radial distance for no effects of 30 mi (50 km) (see Table 6.21-1). Access restrictions could last for a few days or longer, depending on the degree of contamination and the length of time required to certify that access to these properties could again be permitted. It is expected that low levels of mustard agent contamination would degrade in a few hours under certain conditions, while larger quantities might take several weeks to degrade.

Significant historic properties located within 30 mi (50 km) of the accident (see Appendix H) could be affected by temporary but extended restriction periods until the contaminant was degraded by light and moisture. If the contaminant was deposited as a liquid, the Army might require that the properties of concern undergo various decontamination procedures before they could be released for access by the public. These decontamination procedures could potentially damage the property. However, deposition of liquid agent in quantities that would require decontamination procedures that could damage or destroy cultural resources would most likely be confined to the pilot test facility or storage site where significant cultural properties are already mitigated (i.e., Munitions Storage Area A Historic District) or where none exist. Extended public access restrictions, lasting until the contaminant dissipated, would be the most likely measure for preserving culturally significant properties.

6.21.2.9 Socioeconomics

The accidental release of chemical agent at PCD would have the potential to affect the socioeconomic environment through two means. First, changes might occur in the demand for crops and livestock produced within a 30-mi (50-km) radius around the facility. Second, evacuation of employees from work places might be required. For the bounding case scenarios for both the proposed action (earthquake) and the no action alternative (aircraft crash into a munitions storage igloo), agent release could result in adverse socioeconomic impacts within 30 mi (50 km) of PCD (as indicated by the extent of the no effects plume under E-1 meteorological conditions; see Table 6.21-1).

Agriculture. The most significant impact of an accident on agriculture would be if all crops and livestock produced in a single season were interdicted (either by federal or state authorities) and removed from the marketplace. Although the impacts from losses in agricultural output on the economy of the counties within the 30-mi (50-km) radius surrounding PCD in this scenario would be significant (Table 6.21-4), it is unlikely that the severity of these losses would be any different for the no action and the proposed action alternatives.

TABLE 6.21-4 Socioeconomic Impacts of Accidents at PCD Associated with the Proposed Action and No Action[a]

Parameter	Neut/SCWO	Neut/Bio	No Action
Impacts from a one-year loss of agricultural output			
100% loss of agricultural output			
Employment (no. of jobs)	4,450	4,450	4,450
Income (millions of $)	200	200	200
75% loss of agricultural output			
Employment (no. of jobs)	3,340	3,340	3,340
Income (millions of $)	150	150	150
50% loss of agricultural output			
Employment (no. of jobs)	2,220	2,220	2,220
Income (millions of $)	100	100	100
Impacts from a single-day evacuation of businesses			
100% of economic activity affected			
Sales (millions of $)	22	22	22
Employment (no. of jobs)	63,000	63,000	63,000
Income (millions of $)	15	15	15
75% of economic activity affected			
Sales (millions of $)	16	16	16
Employment (no. of jobs)	47,000	47,000	47,000
Income (millions of $)	11	11	11
50% of economic activity affected			
Sales (millions of $)	11	11	11
Employment (no. of jobs)	31,000	31,000	31,000
Income (millions of $)	8	8	8

[a] Impacts from no action and the proposed action are presented for the first year of operation of an ACWA facility (2009).

Businesses and Housing. The evacuation of businesses as a result of an accident at PCD would probably only be temporary. However, disruption to the economy in the area likely to be evacuated (the CSEPP Protective Action Zone [PAZ] surrounding PCD, consisting of Pueblo County) could be significant. In the worst-case scenario, all business sales and employee income in the PAZ would be lost as a result of the evacuation. An evacuation that might be required after an accident might last many days; since the exact duration of an evacuation could not be determined, the consequent overall effect on local economic activity could not be determined either. The impacts from a temporary, single-day evacuation of businesses in the PAZ are shown in Table 6.21-4. The data in the table may be used to estimate the impacts from an evacuation over a multiple-day period.

Since it is likely that the presence of chemical agent and the risk of accidents at the site are already captured in housing values in the vicinity of the site, an accident would probably not create significant additional impacts on the housing market unless residents were prevented from quickly returning to their homes.

6.21.2.10 Environmental Justice

For a scenario of an earthquake impacting the unpack area, agent release could result in high and adverse impacts within 30 mi (50 km) of PCD (as indicated by the extent of the no effects plume under E-1 meteorological conditions; see Table 6.21-1). The bounding accident maximum distance would be the same under both alternative technologies and the no action alternative. In such a situation, minority and low-income populations could suffer fatalities and serious injuries disproportional to their representation in the United States as a whole, if the wind direction at the time of the accident put the agent plume in the direction of census tracts with high numbers of minority or low-income populations (see Section 6.20.1 for identification of these census tracts). Such severe human health impacts would have similarly high and adverse socioeconomic consequences for Pueblo County, including the removal of some of the work force and the interruption of agricultural activity (see Section 6.21.2.9). However, such accidents have a very low frequency of occurrence, on the order of 5×10^{-5} per year (i.e., one occurrence in 21,000 years), so the risk of the resultant disproportionate impacts would be very low; such impacts are not anticipated.

6.21.3 Impacts of Accidents during No Action (Continued Storage)

6.21.3.1 Land Use

Land use impacts from accidents under the no action alternative would be the same as those discussed under the proposed action (Section 6.21.2.1).

6.21.3.2 Waste Management and Facilities

Waste management impacts from accidents under the no action alternative would be the same as those discussed under the proposed action (Section 6.21.2.2).

6.21.3.3 Air Quality

After an accidental release of mustard agent from a storage igloo at PCD, deposition of agent from air onto the ground surface and/or degradation in the environment would occur within a relatively short period of time (see Section 6.21.2.3). Therefore, long-term (e.g., more than a few days after release) adverse air quality impacts would not be expected from an accidental release of HD.

6.21.3.4 Human Health and Safety

The U.S. Army and Federal Emergency Management Agency (FEMA) routinely conduct CSEPP exercises, in coordination with the communities surrounding PCD and with their participation. These exercises are required under a 1988 memorandum of understanding (MOU) between FEMA and the Army. Because chemical agent is currently stored at the PCD site, some risk from accidents is already present. For example, agent could be released if a pallet were accidentally dropped during daily operations (i.e., maintenance and inspection). The most probable event would be that the pallet would be dropped from 4 feet, the average height that a pallet could be dropped during normal operations. This event would involve three rounds of munitions spilling their contents onto the igloo floor. Emergency response preparation for potential accidents of this type (e.g., maximum credible events for daily operations during normal PCD operations) is routinely evaluated under CSEPP (Freil 1997).

The human health consequences from the hypothetical accident scenario (an aircraft crash into a storage igloo) were estimated in terms of the numbers of fatalities. Under E-1 meteorological conditions, this scenario resulted in a 1% lethality distance of about 15 mi (24 km), 298 fatalities in the general public, and 170 on-post fatalities (see Table 6.21-2). If such an accident would occur under D-3 meteorological conditions, no off-post fatalities and two on-post fatalities would be expected.

Fewer than five individuals occupy the nearest residence just beyond the northern boundary of PCD, a distance of about 1 mi (1.6 km) from the nearest alternative pilot facility location and from the nearest storage igloo. This residence has been an important part of community and PCD emergency planning efforts. PPE, including suits and gloves, and PAPRs are in place for six individuals to use, if necessary, during safe evacuation or shelter-in-place. These safety precautions should prevent injury to the residents at that location in the event of an accident. However, if an accident were to occur, the individuals might not be able to take protective action quickly enough to prevent injury or death.

The TTC located at the northern boundary of the site employs approximately 230 individuals. The structures on the TTC site are near the central-eastern area, about 5 mi (8 km) from the PCD site boundary. On the basis of the assumption that most workers at the TTC site would be present during daytime hours, accident modeling that assumes D-3 meteorological conditions is most applicable for the site. The no deaths distance for the storage igloo accident under D-3 meteorological conditions is about 3.1 mi (5 km) (Table 6.21-2). If one of these accidents would occur at a time when the wind was blowing toward the TTC, some of the employees might experience toxicity from exposure to HD. It is unlikely that any fatalities would occur to these employees (unless some were much nearer to the PCD boundary at the time of the accident). If a bounding accident did occur at night when the wind direction was toward the TTC and during E-1 meteorological conditions, workers present at the TTC at the time would be at risk of injury or death.

If it is assumed that children and/or the elderly are substantially more susceptible to the effects of agent exposure than healthy adult males, then the estimated number of fatalities could increase. When a method is used that assumes there is increased risk to sensitive subpopulations (i.e., that the subpopulations are 10 times more susceptible to fatality from agent exposure than the general public; see U.S. Army 1997b), the number of fatalities among the general public associated with continued storage accident scenarios could increase by a factor 2.6 (details of this assessment are provided in Appendix H). For the worst-case storage accident, if children and the elderly are assumed to be up to 10 times more sensitive to lethal effects than are healthy male adults, and if an aircraft is assumed to crash into a HD storage igloo under E-1 meteorological conditions, up to about 780 fatalities (300×2.6) would be expected in the general population.

6.21.3.5 Soils

Potential impacts on soils associated with the accident scenarios considered under the no action alternative would be the same as those discussed under the proposed action (Section 6.21.2.5).

6.21.3.6 Water Resources

Potential impacts on water resources associated with the accident scenarios under the no action alternative would be the same as those discussed under the proposed action (Section 6.21.2.6).

6.21.3.7 Biological Resources

The impact from an accident involving an aircraft crash into a storage igloo in Munitions Storage Area A, followed by fire, was evaluated for the no action alternative. The methodology used for assessing impacts on biological receptors associated with the no action alternative accident scenario was the same as that used for the proposed action accident evaluation (see Section 6.21.2.7). Table 6.21-1 presents the HD exposures that could result from the bounding accident scenario for the distance intervals representing 1% lethality, no deaths, and no effects for humans. Table 6.21-5 presents the distances from the accident site for HQ values of less than one. The values are based on the D2PC model output for both the NOAEL and LOAEL exposures of the three wildlife species evaluated.

Under E-1 meteorological conditions, some effects on all species would be expected within a distance of 19 mi (31 km) downwind of the accident. During daytime conditions, all species evaluated could be affected by a release of HD at distances much closer to the accident site than distances during a nighttime release. The pronghorn antelope would be least sensitive to HD exposure. No adverse effects on the black-tailed prairie dog would be expected at distances greater than 12 mi (19 km) from the accident during the daytime. These distances are highly

TABLE 6.21-5 Distance from Accident Site That Would Result in No or Lowest Adverse Effects on Wildlife for No Action Alternative at PCD[a]

	Distance (mi) with Hazard Quotient of <1[b]			
	Daytime Conditions		Nighttime Conditions	
Species	LOAEL[c]	NOAEL[d]	LOAEL[c]	NOAEL[d]
Ord's kangaroo rat	6.2	11	12	18
Pronghorn antelope	4.3	6	10	13
Black-tailed prairie dog	6.8	12	14	19

[b] Scenario is an aircraft crash into a munitions storage igloo.

[b] Hazard quotient = (dose at a given distance from the source) divided by (benchmark value of HD for receptor species). The concentration is obtained by using the D2PC model and assuming a wind speed of 3 m/s during daytime conditions and 1 m/s during nighttime conditions and a plume exposure duration of 20 min.

[c] LOAEL = lowest observed adverse effects level; the maximum distance from the site at which adverse effects would be expected to occur.

[d] NOAEL = no observed adverse effects level; the distance from the site beyond which no adverse effects would be expected to occur.

conservative and are based on several assumptions that might overestimate HD atmospheric releases, dispersal, and species sensitivity under field conditions following an accident.

Impacts on vegetation from mustard deposited due to an aircraft crash would be very similar to those discussed for the proposed action (Section 6.21.2.7). The impacts on protected species from exposure to chemical agents released following an accident during continued storage would be very similar to impacts from an accident under the proposed action (Section 6.21.2.7). The impacts on wetland vegetation from an aircraft crash into a storage igloo during continued storage would be very similar to those from an earthquake affecting the unpack area under the proposed action (Section 6.21.2.7).

6.21.3.8 Cultural Resources

Potential impacts on cultural resources associated with the accident scenarios under the no action alternative would be the same as those discussed under the proposed action (Section 6.21.2.8). See Appendix H for the listing of historic properties that could be affected by the modeled accidents under the no action alternative.

6.21.3.9 Socioeconomics

Potential impacts on socioeconomics associated with the accident scenarios under the no action alternative would be the same as those discussed under the proposed action (Section 6.21.2.9).

6.21.3.10 Environmental Justice

Potential impacts on environmental justice associated with the accident scenarios under the no action alternative would be the same as those discussed under the proposed action (Section 6.21.2.10).

6.22 CUMULATIVE IMPACTS

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

An ACWA pilot test facility would take up to 34 months to construct and would operate for up to 36 months. This short operational time frame would reduce the potential for cumulative impacts.

This cumulative impacts analysis does not cover areas in which the proposed action and other reasonably foreseeable future actions would have no impacts or only localized impacts. Thus, the following areas were not analyzed for cumulative impacts:

- Geological resources,
- Cultural resources, and
- Communications infrastructure.

In addition, cumulative impacts were not assessed for accidents. Accidents are low-probability events whose exact nature and time of occurrence cannot reasonably be foreseen. Although their impacts may be large, these impacts cannot be added in a reasonably predictable manner to the impacts of other reasonably foreseeable future actions.

Finally, the analyses in this EIS were based on the assumption that a single, full-scale ACWA pilot test facility would be built. If two or more ACWA pilot facilities were built, they would share common facilities, and each one would be smaller than the full-scale pilot facility. Collectively, they would be similar in size to a full-scale pilot facility, and it is highly unlikely that they would exceed the size of a combined full-scale pilot facility and baseline incinerator. Therefore, on an installation without a baseline incinerator, the impacts of two ACWA pilot facilities and/or an increase in weapons throughput would reasonably be bounded by the impacts of the full-scale pilot facility or the combined full-scale pilot facility and baseline incinerator, and their impacts together would reasonably be bounded by the impacts of the full-scale pilot plant facility. Thus, this cumulative impacts analysis should represent the impacts from either one or two ACWA pilot test facilities.

Government and private organizations were contacted to identify reasonably foreseeable on-post and off-post actions for inclusion in this cumulative impacts analysis. Organizations contacted included the following:

- Pueblo Chemical Depot,
- Pueblo Colorado City Department of Planning and Economic Development,

- Colorado State Air Pollution Control Division,
- El Paso County Planning,
- Pueblo County Planning and Development,
- Transportation Technology Center,
- Pueblo Development Authority,
- Rio Grande Portland Cement Company, and
- West Plains Energy.

6.22.1 Other Reasonably Foreseeable Future Actions

The impacts of past and present actions were considered in previous sections of Chapter 6 under the discussions of the affected environment. They are summarized here, when needed, in the corresponding discussions of cumulative impacts.

6.22.1.1 On-Post Actions

Some on-post actions are already included in the proposed action as defined and analyzed in this EIS. These include building an access road to the ACWA site, building an electrical substation, building a power distribution system, and building wastewater treatment lagoons. Other reasonably foreseeable on-post actions included here in Section 6.22 in this cumulative impacts analysis include:

- Upgrading roads and
- Constructing and operating new facilities, including a Personnel Support Building, parking lot, and waste transfer area.

The impacts of these actions were assessed on the basis of information from discussions with post personnel (Smith 2001; Light 2000).

The only other potential on-post Chem Demil action would be the construction and operation of a baseline incinerator. An EIS for a baseline incinerator at PCD has been prepared

(U.S. Army 2001), but it is not known whether such a facility will be built. To account for this uncertainty, cumulative impacts are assessed in this section of the EIS under two scenarios:

- Impacts from the construction and operation of an ACWA pilot test facility (proposed action) combined with other reasonably foreseeable on-post and off-post actions that do not include a baseline incinerator, and

- Impacts from the construction and operation of an ACWA pilot test facility (proposed action) combined with other reasonably foreseeable on-post and off-post actions, including a baseline incinerator.

6.22.1.2 Off-Post Actions

The reasonably foreseeable off-post actions have been identified broadly as industrial expansion, including the Rio Grande Portland Cement plant; housing growth and development; and some commercial development.

6.22.2 Land Use

Most of the land surrounding PCD is undeveloped ranchland used for grazing. The TTC is adjacent to the northern boundary of PCD. Past and present land use on PCD has been primarily for industrial and related purposes, including administrative, residential, and recreational uses. The reuse plan adopted in 1995 reserved more than 5,200 acres (2,100 ha) for Chem Demil activities and designated about 40% of the land for potential livestock grazing, wildlife management, and open space. Use of land adjacent to Munitions Storage Area A for an ACWA pilot test facility is consistent with current and future land use under the reuse plan and would generate no significant adverse impacts on on-post or off-post land use.

6.22.2.1 Cumulative Impacts with Other Actions

An ACWA pilot test facility as well as other on-post actions would be consistent with proposed installation reuse (Section 6.2.4). The 85 acres (34 ha) disturbed by construction of the ACWA pilot test facility would represent about 0.4% of the total area of PCD. No impacts on land use would be expected from construction or operation of an ACWA pilot test facility (Section 6.2). The Personnel Support Center, its associated parking, and the waste transfer area would disturb about another 7.5 acres (3.0 ha), about 0.03% of the total area of PCD. The city of Pueblo is expanding its housing base. Most residential and commercial development is occurring to the north and south of the city, not eastward toward PCD (Smith 2001). No new large facilities are expected at the Airport Industrial Park or near PCD. Major new facilities are located 12 mi

(20 km) or further from PCD, and any impacts from them would be reduced in accordance with their distance from the installation. These and other anticipated activities in the vicinity of PCD would not contribute to significant adverse impacts on land use when aggregated with impacts from on-post actions.

6.22.2.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

If built, a baseline incinerator would be located in Area A, B, or C, the same general area as that in which the ACWA pilot test facility would be located (U.S. Army 2001). Building a baseline incinerator in one of these locations would be consistent with proposed installation reuse, and the incinerator's impacts on land use would not be expected to vary significantly from those of an ACWA pilot test facility, nor would the combination of two facilities change land uses in the area. Building a baseline incinerator could disturb up to another 85 acres (34 ha) of land in addition to that disturbed by building an ACWA pilot test facility (U.S. Army 2001). The total area disturbed by a baseline incinerator together with an ACWA pilot test facility, the Personnel Support Center, its associated parking, and the waste transfer area, would amount to about 0.8% of PCD's area. The cumulative land use impacts of a baseline incinerator, an ACWA pilot test facility, and other reasonably foreseeable actions should not be significant.

6.22.3 Infrastructure

Table 6.22-1 presents the expected utility demands for a baseline incinerator at PCD.

TABLE 6.22-1 Estimated Annual Utility Demands for a Baseline Incinerator at PCD

Utility	Annual Demand
Electric power (GWh)	29
Natural gas (scf)	460,000,000
Process water (gal)	16,000,000
Potable water (gal)	6,400,000
Sewage produced (gal)	7,500,000

Source: Folga (2001).

6.22.3.1 Electric Power Supply

Cumulative Impacts with Other Actions. The current infrastructure would need to be expanded to meet the electric power needs of an ACWA pilot test facility (Section 6.3.1). With other reasonably foreseeable future on-post actions, the cumulative needs would exceed those of an ACWA pilot test facility alone. Recent electric consumption at PCD has been about 10 to 12 GWh/yr (EDAW et al. 1994). Depending on the ACWA technology chosen, more than 60 GWh/yr of additional electric power might be needed while other on-post uses were still being supplied (Table 6.3-1 and U.S. Army 2001). Discussions with local planners indicated no current or foreseen problems supplying electric power in the Pueblo County area (Smith 2001), and the need for additional power could be met by existing providers.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. Building a baseline incinerator would require an electric infrastructure beyond that needed by an ACWA pilot test facility alone. Recent electric consumption at PCD has been about 10 to 12 GWh/yr (EDAW et al. 1994). Depending on the ACWA technology chosen, more than 89 GWh of additional power would be needed annually for both facilities while other on-post uses were still being supplied (Table 6.3-1 and U.S. Army 2001). Discussions with local planners indicated no current or foreseen problems supplying electric power in the Pueblo County area (Smith 2001), and the need for additional power could be met by existing providers.

6.22.3.2 Natural Gas Supply

Cumulative Impacts with Other Actions. The current infrastructure could not supply the natural gas needs of ACWA pilot test facility (Section 6.3.2). Additional infrastructure might also be needed for other reasonably foreseeable on-post facilities. New pipelines would be required to meet the overall gas supply needs. Depending on the ACWA technology chosen, more than 149 million scf (4,220,000 m^3) of natural gas might be needed annually, while other on-post uses were still being supplied (Table 6.3-1). The main gas line at PCD was sized to meet the requirements of Chem Demil activities, and Excel Energy could supply this amount of natural gas to PCD (Section 6.3.2.). Discussions with local planners indicated no current or foreseen problems supplying natural gas in the Pueblo County area (Smith 2001).

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. If a baseline incinerator were built, additional pipelines and stations would be needed beyond those required for an ACWA pilot test facility alone. Depending on the ACWA technology chosen, an ACWA pilot test facility might require as much as 149 million scf (4,220,000 m^3) of natural gas annually (Table 6.3-1). A baseline incinerator might require an additional 460 million scf (13 million m^3) annually (Table 6.22-1). The main gas line at PCD was sized to meet the requirements of Chem Demil activities, and Excel Energy could supply this amount of natural gas to PCD (Section 6.3.2.). Discussions with local planners indicated no current or foreseen problems supplying natural gas in the Pueblo County area (Smith 2001).

6.22.3.3 Water (Supply and Sewage Treatment)

Cumulative Impacts with Other Actions. New water distribution pipelines would be needed to supply water to an ACWA pilot test facility (Section 6.3.3). Additional pipelines would be needed to supply other possible on-post actions.

Water use during operations of an ACWA pilot test facility would exceed water use during construction. Operational process and potable water use by an ACWA pilot test facility could be up to 24 million gal/yr (92,000 m^3/yr). Water use by other reasonably foreseeable on-post uses would increase these demands but would be smaller. Current use is about 1.4 million gal/yr (5,300 m^3/yr), which would result in a total use of more than 26 million gal/yr (98,000 m^3/yr). This amount is less than historical peak withdrawals.

Constructing and operating an ACWA pilot test facility and other reasonably foreseeable on-post facilities would increase the amount of sanitary wastes requiring disposal. An ACWA pilot test facility would generate as much as 7.5 million gal/yr (28,000 m^3/yr) of sanitary sewage. Other reasonably foreseeable on-post actions would generate additional, but smaller, amounts. The on-post evaporative lagoons might need to be expanded to handle the additional load.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. Additional on-post infrastructure would be needed to supply water to both an ACWA pilot test facility and a baseline incinerator. If a baseline incinerator were built, additional delivery and storage systems beyond those required by an ACWA pilot test facility would be needed.

Water use during operations of an ACWA pilot test facility and a baseline incinerator Would exceed water use during construction. Operational process and potable water use by an ACWA pilot test facility could be up to 24 million gal/yr (92,000 m^3/yr). A baseline incinerator could use up to 22 million gal/yr (85,000 m^3/yr) (U.S. Army 2001). Water use by other reasonably foreseeable on-post uses would increase these demands but would be smaller. Current use is about 1.4 million gal/yr (5,300 m^3/yr), which would result in a total use of more than 46 million gal/yr (180,000 m^3/yr). This amount is less than historical peak withdrawals.

Constructing and operating both an ACWA pilot test facility and a baseline incinerator would about double the amount of sanitary wastes requiring disposal to more than 15 million gal/yr (57,000 m^3/yr). The on-post evaporative lagoons might need to be expanded to handle the additional load.

6.22.4 Waste Management

Cumulative impacts on waste management from the construction and operation of an ACWA pilot test facility, with or without a baseline incinerator and other reasonably foreseeable facilities, should be minimal. Discussions with local planners indicated that current off-post hazardous and nonhazardous waste disposal capacities appear adequate (Smith 2001).

Hazardous wastes are stored at a number of locations around PCD. In 1999, PCD disposed of about 129,000 lb (63,100 kg) of hazardous wastes off post. This quantity included 83,000 lb (38,000 kg) of contaminated soils (Table 6.4-1). Nonhazardous solid wastes are collected and disposed of off post by a licensed solid waste hauler. Sanitary wastewater is treated on post in the East Lagoon System (Section 6.4).

6.22.4.1 Cumulative Impacts with Other Actions

The quantities of construction wastes generated by an ACWA pilot test facility (Table 6.4-2) and other on-post actions would be small and have minimal impacts on waste management systems. Operation of either of the ACWA pilot test facility technologies would increase the amount of hazardous waste shipped off post by about 4,900% over 1999 levels. Both technologies would produce amounts of hazardous and nonhazardous wastes that, while representing a substantial increase in the amount of waste generated by PCD, would be minimal in the PCD vicinity (Tables 6.4-3 and 6.4-4). Even when added to other reasonably foreseeable hazardous wastes, these wastes would have a minimal impact on waste management systems.

Constructing and operating an ACWA pilot test facility and other reasonably foreseeable on-post facilities would increase the amount of sanitary wastes requiring disposal. An ACWA pilot test facility would generate as much as 7.5 million gal/yr (28,400 m^3/yr) of sanitary sewage (Table 6.3-1). Other reasonably foreseeable on-post future actions would generate additional sanitary sewage, but smaller amounts. The on-post evaporative lagoons might need to be expanded to handle the additional load.

6.22.4.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

The quantities of construction and operational wastes generated by a baseline incinerator would represent a substantial increase for PCD but would be minimal in the vicinity of the post (U.S. Army 2001). The total stockpile of munitions to be demilitarized is fixed. If both an ACWA pilot test facility and a baseline incinerator were built and operated, fewer munitions would be demilitarized in each, and fewer wastes would be produced by each than if a single facility was operating alone. Since either facility alone would produce minimal amounts of hazardous wastes, both together would produce wastes that, even when added to other reasonably foreseeable hazardous wastes, would have a minimal impact on waste management systems. A baseline incinerator would also produce brine salts, for which the ultimate disposal requirements are currently unclear (Section 6.4.3).

Constructing and operating both an ACWA pilot test facility and a baseline incinerator would about double the amount of sanitary wastes requiring disposal to more than 15 million gal/yr (57,000 m^3/yr). The on-post evaporative lagoons might need to be expanded to handle this load.

6.22.5 Air Quality

Emissions of toxic and hazardous air and pollutants are of interest primarily because of the impacts they could have on human health and biological resources. Sections 6.22.6 and 6.22.12 discuss potential cumulative impacts for these impact areas. This analysis assumes that an ACWA pilot test facility and a baseline incinerator would be constructed and operated at the same time.

6.22.5.1 Impacts of Construction

PM_{10} and $PM_{2.5}$ from fugitive emissions would be the pollutants of principal concern during construction. Emissions of pollutants from worker and delivery vehicles, construction equipment, fuel storage, and refueling operations would be small, and off-post concentrations would not exceed NAAQS levels (Section 6.5.3).

Cumulative Impacts with Other Actions. Construction of an ACWA pilot test facility would not result in ambient concentrations in excess of particulate NAAQS levels. Table 6.5-6 summarizes the maximum off-post particulate impacts from construction of an ACWA pilot test facility. By itself, construction of the facility would produce, at most, an impact that would be less than 21% of any particulate NAAQS level. Taking current on-post and off-post sources into account (the background levels), the total particulate concentration would be, at most, 55% of the NAAQS level. If construction of a Personnel Support Building, parking area, and waste transfer area along the southern edge of the Chem Demil area would occur at the same time as construction of the ACWA pilot test facility, these particulate levels would increase. These facilities would occupy about 5 acres (2 ha) (Light 2000) in addition to the 25 acres (10 ha) disturbed by construction of an ACWA pilot test facility. Even simultaneous construction of all these facilities would not cause off-post particulate levels to exceed NAAQS levels. Use of best construction practices (such as watering areas where ground-disturbing activities were occurring) would reduce impacts on particulate levels.

The Rio Grande Portland Cement plant currently under construction is located about 20 mi (35 km) southwest of Munitions Storage Area A. It would be a source of particulates.

However, given its distance from PCD, this plant and other reasonably foreseeable off-post future actions would not contribute significantly to PM_{10} or $PM_{2.5}$ levels in the vicinity of PCD.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. Table 6.22-2 presents the particulate air quality impacts from simultaneous construction of an ACWA pilot test facility and a baseline incinerator. These concentrations are overestimates, since they assume that both facilities would be constructed at the same location rather than in different areas; even so, they are still less than 91% of the NAAQS levels. If construction of a Personnel Support Building, parking area, and waste transfer area along the southern edge of the Chem Demil area would occur at the same time as construction of the ACWA pilot test facility, these particulate levels would increase. Given the overestimation involved in the results presented in Table 6.22-2, particulate levels in excess of the NAAQS levels would not be expected. The Rio Grande Portland Cement plant and other reasonably foreseeable on-post and off-post actions would not contribute significantly to PM_{10} or $PM_{2.5}$ levels in the vicinity of PCD.

TABLE 6.22-2 Air Quality Impacts from Construction of an ACWA Pilot Test Facility and a Baseline Incinerator at PCD and Other Nearby Actions[a]

		Concentration (μg/m^3)				
Pollutant	Averaging Time	Maximum Increment[b]	Background	Total	NAAQS	Percentage of NAAQS[c]
PM_{10}	24 hours	67	40	107	150	71 (45)
	Annual	4.7	17	22	50	43 (9.4)
$PM_{2.5}$	24 hours	34	25	59	65	91 (52)
	Annual	2.3	7	9.3	15	62 (15)

[a] See Section 6.5 for details on background and modeling.

[b] Values for ACWA pilot test facility impacts are based on Table 6.5-6. Values for baseline incinerator PM_{10} impacts are based on U.S. Army (2001). Values for baseline incinerator $PM_{2.5}$ impacts are assumed to be 50% of PM_{10} impacts during construction.

[c] Values are based on the total concentration, including the background concentration and maximum increment from simultaneous construction of an ACWA pilot test facility and a baseline incinerator. Values in parentheses are based on the construction of the facilities and ignore background levels.

6.22.5.2 Impacts of Operations

Colorado has an SAAQS for 3-hour SO_2 of 700 µg/m3, which is more stringent than the federal NAAQS. When two standards exist, the more stringent one is the applicable standard.

It is assumed that the construction of a Personnel Support Building, parking area, and waste transfer area would be completed before either the ACWA pilot test facility or baseline incinerator would begin operations.

Cumulative Impacts with Other Actions. As a percentage of the corresponding standard, the largest air quality increment from operating an ACWA pilot test facility by itself would be the 24-hour PM2.5 impact of 1.8 µg/m3, which is about 2.8% of the applicable standard level (Tables 6.5-7 and 6.5-8). When the impacts of other current on-post and off-post sources (the background levels) are taken into account, the largest air quality increment would be the annual PM2.5 impact of 7 µg/m3, about 47% of the applicable standard level. The Rio Grande Portland Cement plant would be located more than 22 mi (35 km) from Munitions Storage Area A. Operation of this facility would produce additional emissions of criteria pollutants, including particulates. However, given its distance from PCD, no significant increases in criteria pollutant concentrations in the vicinity of PCD would be expected. Additional on-post and off-post actions would add to the impacts from an ACWA pilot test facility operating alone, but their cumulative impact would not exceed applicable standard levels.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. Table 6.22-3 presents the air quality impacts from simultaneous operation of an ACWA pilot test facility and a baseline incinerator. These concentrations assume that the facilities are collocated. Except for NO_2, the values rely on baseline incinerator impacts modeled for ANAD and PBA. Although the modeled impacts would be different if done for PCD, these impacts were used because they are the best available indicators of impacts from a baseline incinerator. All impact estimates are under 50% of the applicable standard levels, and both Chem Demil facilities together contribute less than 8% of the applicable standard levels. Other reasonably foreseeable on-post actions would not be expected to contribute to significant atmospheric emissions, and reasonably foreseeable off-post facilities would not produce significant criteria pollutant concentrations in the vicinity of PCD.

TABLE 6.22-3 Air Quality Impacts from Operation of an ACWA Pilot Test Facility and a Baseline Incinerator at PCD and Other Nearby Actions

		Concentration ($\mu g/m^3$)				
Pollutant	Averaging Time	Maximum Increment[a]	Background	Total	Standard[b]	Percentage of Standard[c]
SO_2	3 hours	20	107	127	700	18 (2.8)
	24 hours	5.6	39	45	365	12 (1.5)
	Annual	0.51	8	8.5	80	11 (0.64)
NO_2	Annual	3.2	19	22	100	22 (3.2)
CO	1 hour	89	3,250	3,520	40,000	8.8 (0.22)
	8 hours	14	2,220	2,240	10,000	22 (0.14)
PM_{10}	24 hours	4.8	40	45	150	30 (3.2)
	Annual	0.41	17	17	50	35 (0.82)
$PM_{2.5}$[d]	24 hours	4.8	25	30	65	46 (7.4)
	Annual	0.41	7	7.4	15	49 (2.8)

[a] Sum of the increment for an ACWA pilot test facility and the increment for a baseline incinerator. The ACWA pilot test facility increment is based on larger modeled values for Neut/SCWO and Neut/Bio (Tables 6.5-7 and 6.5-8). The baseline incinerator NO_2 increment was taken from U.S. Army (2001) for PCD. Other baseline incinerator increments were assumed to be the larger of modeled values for ANAD and PBA (U.S. Army 1991, 1997b).

[b] More stringent of the NAAQS level or the SAAQS level.

[c] Values are based on the total concentration, including the background concentration and maximum increment from simultaneous operation of an ACWA pilot test facility and a baseline incinerator. Values in parentheses are based on operation of the facilities and ignore background levels.

[d] Not available in references. Overestimated as being equal to PM_{10}.

6.22.6 Human Health and Safety — Routine Operations

6.22.6.1 Impacts of Construction

PM_{10} and $PM_{2.5}$ from fugitive emissions would be the pollutants of principal concern during construction. Emissions of pollutants from worker and delivery vehicles, construction equipment, fuel storage, and refueling operations would be small, and off-post concentration would not exceed NAAQS levels (Section 6.5.3).

Cumulative Impacts with Other Actions. As noted in Section 6.22.5, the NAAQS levels would not be exceeded during construction of an ACWA pilot test facility alone or with other reasonably foreseeable on-post and off-post facilities. No adverse cumulative impacts on the health of the off-post public would occur.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. If built, a baseline incinerator would add to the particulate impacts of an ACWA pilot test facility. As noted in Section 6.22.5, NAAQS levels would not be exceeded during construction of an ACWA pilot test facility, a baseline incinerator, and other reasonably foreseeable on-post and off-post actions. No adverse cumulative impacts on the health of the off-post public would occur.

6.22.6.2 Impacts of Operations

Cumulative Impacts with Other Actions. On the basis of risks from agent processing and worst-case mustard emissions, the maximum increase in carcinogenic risk to on-post and off-post populations associated with either technology for an ACWA pilot test facility would be 2×10^{-7}, or 20% of the 1×10^{-6} level generally considered representative of negligible risk (Table 6.7-2). Noncarcinogenic risks would be less than 0.1% of the levels considered to present hazards. The maximum estimated concentration of agent from ACWA pilot test facility emissions would be 0.2% of the maximum allowable level recommended by the CDC (Table 6.6-3). Reasonably foreseeable future on-post actions would contribute negligible amounts to the concentrations of air toxics and would not emit agent. Any increases in health risks would be considered negligible.

As noted in Section 6.22.5, applicable standard levels would not be exceeded during operation of an ACWA pilot test facility, either alone or with other reasonably foreseeable on-post and off-post actions. No adverse cumulative impacts on the health of the off-post public would occur.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. The EIS for a baseline incinerator at PCD provides a risk perspective but no quantitative estimates for risks (U.S. Army 2001). The PCD EIS anticipates that the health risk assessment required by RCRA would find no significant health impacts.

This EIS uses the risks for the Johnson Atoll Chemical Agent Disposal System (JACADS) incinerator that were estimated on the basis of measured stack gas concentrations. Risk estimates based on representative conditions at PCD would differ from those derived for JACADS. However, the methodology used in assessing risks from JACADS emissions was very conservative (i.e., it overestimated risks). Thus the JACADS risks can be taken as reasonable indicators of the expected risks from a baseline incinerator at PCD.

The maximum increase in carcinogenic risk from agent processing and worst-case mustard emissions to on-post and off-post populations associated with either technology for an ACWA pilot test facility would be 2×10^{-7}, or 20% of the 1×10^{-6} level generally considered representative of negligible risk (Table 6.7-2). Noncarcinogenic risks would be less than 0.1% of the levels considered to present hazards. As summarized in the PCD EIS (Table 4-21 of U.S. Army 2001), the maximum risk for a baseline incinerator, if built, would be 6.2×10^{-7}, or 62% of the 1×10^{-6} generally considered representative of negligible risk. When additivity for the carcinogens is assumed (a common assumption in risk assessments), a baseline incinerator and an ACWA pilot test facility operating simultaneously would represent an increased carcinogenic risk of approximately 8.2×10^{-7}, or 82% of the benchmark level generally considered representative of negligible risk. The total risk would still generally be considered negligible.

Risks from the maximum possible release of agent from an ACWA pilot test facility were estimated by assuming that agent could be emitted continuously from the filter farm stack at the agent detection limit of the in-stack monitor. (Section 6.6). The detection limit is about 20% of the concentration allowed in the stack. Operations would be shut down if the detection limit were reached. Thus, the estimate of risk is conservative (i.e., it overestimates risk). The maximum estimated risk from ACWA pilot test facility emissions would be 0.2% of maximum allowable level recommended by the CDC (Table 6.6-3). U.S. Army (2001) estimates the maximum risk from the baseline incinerator conservatively and assumes emissions are at the allowable level. This EIS assumes lower emissions are at the detection limit. By adjusting the Army's results for lower emissions to put them at the detection limit, the maximum risk from the baseline incinerator would be 2.4% of the maximum allowable level recommended by the CDC. If an ACWA pilot test facility and a baseline incinerator were operating concurrently, the worst case would have agent levels equal to 2.6% of the allowable level. However, it is highly unlikely that such levels would be reached under routine operating conditions, because the two plants would have separate stacks, which would lead to lower maximum air concentrations than would occur if all emissions were from one stack. Also, the assumption of continuous agent release at the detection limit (Section 6.6.3) is very conservative and results in overestimates of possible agent releases.

If built, a baseline incinerator would add to the air quality impacts of an ACWA pilot test facility. As noted in Section 6.22.5, applicable standard levels would not be exceeded during operation of an ACWA pilot test facility, a baseline incinerator, and other reasonably foreseeable on-post and off-post actions. No adverse cumulative impacts on the health of the off-post public would occur.

6.22.7 Noise

This analysis assumes that an ACWA pilot test facility and a baseline incinerator would be constructed and operated simultaneously.

6.22.7.1 Cumulative Impacts with Other Actions

Construction of an ACWA pilot test facility would result in noise levels of less than 40 to 45 dBA at the nearest residence. Noise levels during operation would be comparable to ambient background, less than 35 dBA at the nearest residence (Section 6.8.3). These levels are less than the EPA's guideline of 55 dBA for protection of the public in typically quiet outdoor and residential areas. Even if the Personnel Support Building, parking lot, and waste transfer area were being built at the same time as the ACWA pilot test facility, the cumulative noise level at the nearest residence would be under the EPA's guideline.

6.22.7.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

Simultaneous construction and operation of an ACWA pilot test facility and a baseline incinerator at the same location would lead to a barely perceptible increase of less than 3 dBA at the nearest residence. The cumulative noise level would still be under the EPA's 55-dBA guideline. Even if the Personnel Support Building, parking lot, and waste transfer area were being built at the same time as these two facilities, the cumulative noise level at the nearest residence would be under EPA's guideline. Other reasonably foreseeable on-post and off-post actions would not contribute significantly to cumulative noise impacts.

6.22.8 Visual Resources

Current (and reasonably foreseeable future) actions on post appear to be in keeping with the existing visual character of PCD and consistent with the reuse plan.

6.22.8.1 Cumulative Impacts with Other Actions

Current (and reasonably foreseeable future) actions appear to be in keeping with the largely industrial nature of PCD (Section 6.9). Traffic and dust during construction of an ACWA pilot test facility and other on-post facilities would affect the visual character of PCD, but the effect would be intermittent and temporary. During operations, an ACWA pilot test facility could produce a small steam plume. Any plumes associated with other reasonably foreseeable facilities would also be small. No adverse visual impacts would result from the construction or operation of an ACWA pilot test facility and other on-post and off-post actions.

6.22.8.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

If built, a baseline incinerator would be located in the Chem Demil area, the same general area in which an ACWA pilot test facility would be located. This location would thus be in keeping with the largely industrial nature of PCD. Construction of a baseline incinerator would add to the visual impacts associated with an ACWA pilot test facility and other on-post actions. Increased traffic and dust during construction of both facilities would increase the effect on the visual character of PCD, but the effect would be intermittent and temporary. During operations, the baseline incinerator would produce a large steam plume that would add to the visual impact of an ACWA pilot test facility's plume. Any plumes associated with other reasonably foreseeable facilities would also be small. No adverse visual impacts would result from the construction or operation of an ACWA pilot test facility, a baseline incinerator, and other on-post and off-post actions.

6.22.9 Soils

With the exception of soil contamination resulting from air emissions during operations, the area that was analyzed with regard to cumulative impacts on soils was limited to the immediate on-post vicinity of the proposed sites. Activities that would disturb soils would have very localized impacts and hence little chance to contribute to cumulative impacts.

About 25 acres (10 ha) of soils would be affected by construction of an ACWA pilot test facility, and up to an additional 60 acres (24 ha) would be affected by development of the associated infrastructure. Area A and Corridors 1, 2, and most of 4 have been previously disturbed. Areas B and C and Corridor 3 are largely undisturbed (Section 6.10).

6.22.9.1 Cumulative Impacts with Other Actions

Construction activities associated with an ACWA pilot test facility, the Personnel Support Building, its parking area, and the waste transfer area in the vicinity of Areas A, B, and C would disturb up to 93 acres (37 ha) of soils and could contribute to soil erosion and accidental spills and releases. These are the same types of impacts associated with construction of an ACWA pilot test facility. These impacts would be temporary and would be minor if the best management practices noted in Section 6.10.3 were followed.

There would be no significant cumulative impacts on surface soils from the routine operation of an ACWA pilot test facility and other on-post and off-post actions. No significant impacts are expected from the ACWA pilot test facility itself (Section 6.10.3). Anticipated facilities near the Chem Demil site would have very low or no emissions associated with their operation. Reasonably foreseeable future off-post sources would have very low emissions and be located far enough away to preclude significant on-post deposition.

6.22.9.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

Construction activities associated with an ACWA pilot test facility, a baseline incinerator, the Personnel Support Building, its parking area, and the waste transfer area could disturb up to 180 acres (77 ha) and could contribute to soil erosion and accidental spills and releases. These are the same types of impacts associated with construction of an ACWA pilot test facility. These impacts would be temporary and would be minor if the best management practices noted in Section 6.10.3 were followed.

There would be no significant cumulative impacts on surface soils from the routine operation of an ACWA pilot test facility and other on-post and off-post actions. No significant impacts are expected from the ACWA pilot test facility itself (Section 6.10.3). A baseline incinerator would have low emissions and no operational impacts on soils (U.S. Army 2001). Anticipated facilities near the Chem Demil site would have very low or no emissions associated with their operation. Reasonably foreseeable off-post sources would have very low emissions and be located far enough away to preclude significant on-post deposition.

6.22.10 Groundwater

This analysis assumes that an ACWA pilot test facility and a baseline incinerator would be constructed and operated at the same time.

All water used at PCD is withdrawn from the terrace alluvial aquifer. PCD has junior water rights to extract 320 million gal/yr (1.2 million m^3/yr) from the aquifer. Past actions at PCD have withdrawn water at a rate of up to 94 million gal/yr (360,000 m^3/yr) from this aquifer (Section 6.3.3) and have caused groundwater contamination in the southern portion of the post (Section 6.11.1). The ICARGS and other ongoing restoration projects are addressing this contamination.

6.22.10.1 Cumulative Impacts with Other Actions

Water use during operations of an ACWA pilot test facility would exceed water use during construction. Operational process and potable water use by an ACWA pilot test facility could be up to 24.4 million gal/yr (92,000 m^3/yr) depending on the technology chosen (Table 6.3-1). Water use by other reasonably foreseeable on-post actions would increase these demands but would be smaller. Current use is about 1.4 million gal/yr (5,300 m^3/yr), which would result in a total use of more than 25.8 million gal/yr (98,000 m^3/yr) for operating an ACWA pilot test facility while still supplying other on-post uses. This use is less than historical peak withdrawals. PCD would need to purchase water rights from more senior water rights holders to withdraw additional water from its wells, potentially diverting water from off-post uses. These withdrawals would cause a cone of depletion in the aquifer during operation of the ACWA pilot test facility. After completion of the chemical demilitarization within 36 months, the withdrawals would cease, and the aquifer would recharge quickly. PCD is hydrologically isolated from off-post actions, so there would be no cumulative impact on groundwater quantity or quality.

During incident-free construction of an ACWA pilot test facility and other reasonably foreseeable on-post facilities, no contamination of groundwater would occur if standard precautions were taken to prevent spills and leaks during refueling and maintenance (Section 6.11.3).

The ACWA pilot test facility would be designed to contain small accidental releases, and the entire facility site would be surrounded by a berm. Water and other substances would not be released to the groundwater during routine operations and accidents or fluctuations during routine operations (Section 6.11.3). Other reasonably foreseeable future on-post facilities would not be expected to release substances to the groundwater during routine operations. Cumulative impacts on groundwater should be negligible.

6.22.10.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

Water use during operations of an ACWA pilot test facility and a baseline incinerator would exceed water use during construction. Operational process and potable water use by an ACWA pilot test facility could be up to 24.4 million gal/yr (92,000 m^3/yr), depending on the technology chosen (Table 6.3-1). A baseline incinerator could use up to 22.4 million gal/yr (85,000 m^3/yr) (U.S. Army 2001). Water use by other reasonably foreseeable on-post actions would increase these demands but would be smaller. Current use is about 1.4 million gal/yr (5,300 m^3/yr), which would result in a total use of more than 48 million gal/yr (180,000 m^3/yr) for operating both facilities while still supplying other on-post uses. This use is less than historical peak withdrawals. PCD would need to purchase water rights from more senior water rights holders to withdraw additional water from its wells, potentially diverting water from off-post uses. These withdrawals would cause a cone of depletion in the aquifer during operation of the ACWA pilot test facility. After completion of the chemical demilitarization, the withdrawals would cease, and the aquifer would recharge quickly. PCD is hydrologically isolated from off-post actions, so there would be no cumulative impact on groundwater quantity or quality.

During incident-free construction of an ACWA pilot test facility, a possible baseline incinerator, and other reasonably foreseeable on-post facilities, no contamination of groundwater would occur if standard precautions were taken to prevent spills and leaks during refueling and maintenance (Section 6.11.3) (U.S. Army 2001).

If built, a baseline incinerator would not be expected to release substances to the groundwater during routine operations (U.S. Army 2001). The ACWA pilot test facility would be designed to contain small accidental releases, and the entire facility site would be surrounded by a berm. Water and other substances would not be released to the groundwater during routine operations and accidents or fluctuations during routine operations (Section 6.11.3). Other reasonably foreseeable future on-post facilities would not be expected to release substances to the groundwater during routine operations. Cumulative impacts on groundwater should be negligible.

6.22.11 Surface Water

This analysis assumes that an ACWA pilot test facility and a baseline incinerator would be constructed and operated at the same time. All water used at PCD is taken from the terrace alluvium aquifer. No withdrawals from or discharges to surface waters are expected for an ACWA pilot test facility, a baseline incinerator, or other reasonably foreseeable on-post actions.

6.22.11.1 Cumulative Impacts with Other Actions

During construction of an ACWA pilot test facility and other on-post facilities, standard construction practices, such as siltation fences, should be used to control erosion. Standard precautions should be followed to prevent spills and leaks during equipment refueling and maintenance of construction equipment. With use of such mitigating practices, the overall cumulative impacts on surface waters from all construction activities would be negligible.

Routine operation of an ACWA pilot test facility would not result in additional releases to surface water. Domestic sewage from the facility would be treated in lined, evaporative lagoons. Cumulatively, these impacts would be small. There would be no cumulative impacts with reasonably foreseeable on- or off-post actions.

6.22.11.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

Standard practices and precautions for preventing spills and leaks should be followed during construction of a baseline incinerator. With use of such mitigating practices, the overall cumulative impact on surface waters from all construction activities would be negligible but would add to the impacts from an ACWA pilot test facility alone.

Routine operation of an ACWA pilot test facility and a baseline incinerator would not result in additional releases to surface water. Domestic sewage from the facilities would be treated in lined, evaporative lagoons. Cumulatively, these impacts would be small. There would be no cumulative impacts with reasonably foreseeable on- or off-post actions.

6.22.12 Biological Resources

Area A, which comprises 180 acres (70 ha), is largely undisturbed and ungrazed. Areas B and C, which comprise about 300 acres (120 ha), have been heavily disturbed (Section 6.13).

6.22.12.1 Terrestrial Habitats and Vegetation

Cumulative Impacts with Other Actions. Section 6.13 describes the impacts on terrestrial habitats and vegetation that might result from disturbing up to 85 acres (34 ha) of land, a small fraction of the 4,900 acres (2,000 ha) designated for wildlife management under the reuse plan, while constructing an ACWA pilot test facility and its associated infrastructure. Construction of other on-post facilities would increase vegetation loss as sites would be cleared; the acreage involved would be smaller than the acreage disturbed for an ACWA pilot test facility alone but is not known exactly. Using standard erosion and runoff controls could mitigate impacts on vegetation that would result from sedimentation and erosion. If possible, several areas should not be used as facility sites. Construction in the southern portions of Area A would avoid the sensitive northern sandhill prairie community in the northern portion of Area A. Construction in Area B would disturb greasewood scrub vegetation. Avoiding the most concentrated stands in the central and eastern portions of Area B would reduce impacts. Construction in the center of Area C would avoid impacts on the shortgrass prairie habitat that supports a colony of black-tailed prairie dogs, a candidate species for federal listing as threatened or endangered.

A screening-level ecological risk assessment for soils found that air emissions from routine operations of an ACWA pilot test facility would have negligible impacts on ecological receptors (Section 6.13). Given the small emissions potential of other reasonably foreseeable on-post actions, cumulative impacts on terrestrial habitats and vegetation would be negligible.

Impacts on terrestrial habitats and vegetation associated with off-post facilities would be related to the size of the developments and the land area occupied. Reasonably foreseeable off-post actions would have localized impacts that would add to the impacts of actions at PCD. The impacts of off-post actions could not be quantified but are expected to be minor.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. The PCD EIS (U.S. Army 2001) indicates that construction of a baseline incinerator would disturb 85 acres (34 ha) of land. The total disturbance with an ACWA pilot test facility would be 170 acres (77 ha), still a small fraction of the 4,900 acres (2,000 ha) designated for wildlife management under the reuse plan. This increased disturbance would result in increased vegetation loss. Using standard erosion and runoff controls could mitigate the additional impacts on vegetation due to sedimentation and erosion. As noted above, several areas should be avoided as facility sites if possible.

A screening-level ecological risk assessment for soils found that air emissions from routine operations of an ACWA pilot test facility would have negligible impacts on ecological receptors (Section 6.13). U.S. Army (2001) found deposition during routine operation of a baseline incinerator to be below levels known to affect terrestrial habitats and vegetation. In addition, the total stockpile quantity is fixed; if a baseline incinerator were built and operated, fewer munitions would be demilitarized in the ACWA pilot test facility, reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions, cumulative impacts on terrestrial habitats and vegetation from an ACWA pilot test facility, a baseline incinerator, and other potential facilities during routine operations should be negligible.

Impacts on terrestrial habitats and vegetation associated with off-post facilities are related to the size of the developments and the land area occupied. Reasonably foreseeable off-post actions would have localized impacts that would add to the impacts of actions at PCD. The impacts of off-post actions could not be quantified but are expected to be minor.

6.22.12.2 Wildlife

Area A, which comprises 180 acres (70 ha), is largely undisturbed and ungrazed. Areas B and C, which comprise about 300 acres (120 ha), have been heavily disturbed (Section 6.13).

Cumulative Impacts with Other Actions. Section 6.14 describes the impacts on wildlife that might result from disturbing up to 85 acres (34 ha) of land, a small fraction of the 4,900 acres (2,000 ha) designated for wildlife management under the reuse plan, while constructing an ACWA pilot test facility and its associated infrastructure. Each new, on-post construction activity would affect wildlife by increasing the loss of habitat and increasing human activity and construction traffic. Cumulatively, these increases would cause additional deaths among less mobile species, such as small mammals and lizards, and displace additional wildlife during the construction period. Increased noise would cumulatively displace additional small mammals and potentially lead to increased habitat abandonment by songbirds.

Additional operations on post would increase the number of workers and deliveries. The number of roadkills would increase with the consequent increase in traffic. The Personnel Support Center would increase traffic noise, but even with other on-post actions, there would be no appreciable cumulative increase in noise levels.

A screening-level ecological risk assessment of soils found that air emissions from routine operations of an ACWA pilot test facility would have negligible impacts on ecological receptors (Section 6.13). Other reasonably foreseeable on-post actions would have small amounts of emissions and would not have adverse impacts on wildlife. Reasonably foreseeable off-post actions would have localized impacts that would be expected to be minor. Cumulative impacts on wildlife would be negligible.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. Construction of an ACWA pilot test facility and a baseline incinerator would disturb up to 170 acres (77 ha) of land, a small fraction of the 4,900 acres (2,000 ha) designated for wildlife management under the reuse plan. Construction of a baseline incinerator would increase the loss of habitat and amount of human activity and construction traffic over the levels associated with an ACWA pilot test facility, cause additional deaths among less mobile species, and displace additional wildlife during the construction period. Noise levels and the area affected by noise would increase minimally, leading to displacement of additional small mammals and potential increases in habitat abandonment by songbirds.

A screening-level ecological risk assessment for soils found that air emissions from routine operations of an ACWA pilot test facility would have negligible impacts on ecological receptors (Section 6.13). The U.S. Army (2001) found deposition during routine operation of a baseline incinerator to be below levels known to affect wildlife. In addition, the total stockpile to be demilitarized is fixed; if a baseline incinerator were built and operated, fewer munitions would be demilitarized in the ACWA pilot test facility, reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions, cumulative impacts on wildlife from an ACWA pilot test facility, a baseline incinerator, and other potential facilities during routine operations should be negligible.

During facility operations, additional activities would cumulatively increase the number of roadkills, as worker and delivery traffic would increase.

Adding a baseline incinerator near an ACWA pilot test facility would result in an increase of less than 3 dBA in the noise levels associated with an ACWA pilot test facility alone. This and other new facilities would not make appreciable contributions to noise levels.

Impacts on wildlife associated with off-post facilities would be related to the size of the developments and the land area occupied. Reasonably foreseeable off-post actions would have localized impacts that would add to the impacts of actions at PCD. The wildlife impacts of off-post actions on wildlife could not be quantified but are expected to be minor.

6.22.12.3 Aquatic Habitats and Fish

Cumulative Impacts with Other Actions. No aquatic resources occur in the areas proposed for the ACWA pilot test facility or other reasonably foreseeable future on-post actions. There should be no impacts associated with construction.

Operation of the ACWA pilot test facility would not result in any adverse impacts on aquatic ecosystems (Section 6.15). Other reasonably foreseeable future on-post and off-post actions would either have small emissions or be far enough away from the ACWA pilot test facility to contribute negligible amounts to overall deposition. Cumulative impacts on aquatic habitats and fish during operations should be negligible.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. No aquatic resources occur in the areas proposed for the ACWA pilot test facility, the baseline incinerator, or other reasonably foreseeable future on-post actions. There should be no impacts associated with their construction.

A baseline incinerator would be unlikely to cause sufficient deposition to affect aquatic species adversely (U.S. Army 2001). The total stockpile to be demilitarized is fixed; if a baseline incinerator would be built and operated, fewer munitions would be demilitarized in the ACWA pilot test facility, reducing its overall emissions and deposition. Given the small emissions potential or their distance from the ACWA sites, cumulative impacts on aquatic habitats and fish from other reasonably foreseeable actions, an ACWA pilot test facility, and a baseline incinerator should be negligible.

6.22.12.4 Protected Species

Adverse impacts on protected species, if any, would result from construction and not operational activities and would depend on the location of the facility.

Cumulative Impacts with Other Actions. Construction in the southern portion of Area C would affect the shortgrass prairie habitat that supports a colony of black-tailed prairie dogs (candidate for federal listing). Mountain plovers are likely, but not confirmed, breeding residents of the grazed shortgrass prairie adjacent to the southern portion of Area C. Loss of shrubland habitat in Areas A and B could affect the loggerhead shrike (federally listed as a sensitive species). Avoiding these areas would avoid the potential for adverse impacts. Each additional facility in these areas would increase the potential for adverse impacts. Avoiding work in areas where standing water accumulates during rainy periods would reduce the potential for impacts on northern leopard frogs (federally listed as sensitive species) if infrastructure construction would occur along Corridor 3 (Section 6.16.3).

Operation of an ACWA pilot test facility would result in no adverse impacts to protected species (Section 6.16). Other reasonably foreseeable action would either have small amounts of emissions or be far enough away from the ACWA pilot test facility to contribute negligible amounts to overall deposition. Cumulative impacts on protected species from normal operation of an ACWA pilot test facility and other reasonably foreseeable actions would be negligible.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. Construction of the baseline incinerator in the areas noted above would increase the potential for adverse impacts on protected species beyond those associated with construction of an ACWA pilot test facility alone. Avoiding these areas, if possible, would avoid the potential for adverse impacts.

Routine operation of an ACWA pilot test facility would have negligible impacts on protected species (Section 6.16). The U.S. Army (2001) found that routine operation of a baseline incinerator would have negligible impacts on protected species. The total stockpile to be demilitarized is fixed; if a baseline incinerator would be built and operated, fewer munitions would be demilitarized in the ACWA pilot test facility, reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions, cumulative impacts on protected species from an ACWA pilot test facility, a baseline incinerator, and other potential facilities during routine operations should be negligible. Reasonably foreseeable future off-post actions could affect the same overall populations as those that are affected by other actions at PCD. These impacts could not be quantified but are expected to be minor.

6.22.12.5 Wetlands

Cumulative Impacts with Other Actions. There are no wetlands in the areas proposed for the ACWA pilot test facility (Section 6.17). Other reasonably foreseeable future actions would also avoid wetlands. If runoff from construction activities were contained by using standard erosion control measures, cumulative impacts from on-post actions would be negligible.

Routine operation of an ACWA pilot test facility would have negligible impacts on wetlands (Section 6.17). Given the small emissions potential of other reasonably foreseeable actions, or given their distance from the ACWA areas, cumulative impacts on wetlands from an ACWA pilot test facility and other potential actions should be negligible.

Cumulative Impacts with Other Actions, Including a Baseline Incinerator. There are no wetlands in the areas proposed for the baseline incinerator. Other reasonably foreseeable future actions would also avoid wetlands. If runoff from construction activities were contained by using standard erosion control measures, no cumulative impacts from on-post actions would occur.

Routine operation of an ACWA pilot test facility would have negligible impacts on wetlands (Section 6.17). A baseline incinerator would be unlikely to cause sufficient deposition to affect wetlands adversely (U.S. Army 2001). The total stockpile to be demilitarized is fixed; if a baseline incinerator is built and operated, fewer munitions would be demilitarized in the ACWA pilot test facility, reducing its overall emissions and deposition. Given the small emissions potential of other reasonably foreseeable actions, adverse cumulative impacts on wetlands from an ACWA pilot test facility, a baseline incinerator, and other potential facilities during routine operations should be negligible.

6.22.13 Socioeconomics

Construction and operation of ACWA technologies might result in cumulative impacts if construction and operations activities would occur concurrently with other existing or future activities on-post at PCD or in the ROI (see Section 6.19) surrounding the post.

6.22.13.1 Cumulative Impacts with Other Actions

The on-post development of alternate uses for PCD facilities could create additional demands on post utility and transportation infrastructures if reuse activities would occur concurrently with the construction or operation of an ACWA pilot test facility. However, other reasonably foreseeable on-post actions would probably employ far fewer people than would an ACWA pilot test facility using either technology. In the area surrounding the post, industrial, commercial, and residential development that could occur might also lead to cumulative impacts on local socioeconomic resources if impacts were not adequately planned for.

The cumulative socioeconomic impacts from the construction and operation of an ACWA pilot test facility together with existing or reasonably foreseeable economic development activities would be relatively small. In the next few years, a small number of local road extension projects, the Rio Grande Portland Cement plant, and a number of small commercial and industrial facilities in Airport Industrial Park are expected to be built. Except for the cement plant, which is expected to employ 100 workers once construction is finished by the end of 2002 (Smith 2001), more specific information on the size and precise timing of any of these projects was not available. However, judging from the impact of similar activities on other smaller communities elsewhere in the country, even if all of these projects were to occur during construction and operation of an ACWA pilot test facility, the potential cumulative impact on the economy of Pueblo County, local labor markets, local public and community services, and the local traffic network would be minor.

6.22.13.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

More significant cumulative socioeconomic impacts would occur if a baseline incinerator was constructed concurrently with an ACWA pilot test facility and other reasonably foreseeable off-post actions. Construction of both on-post projects would generate approximately 3,100 direct and indirect jobs in the peak year in the ROI, with employment during the operation of both facilities likely to be roughly 2,400. Construction and operations jobs for both facilities would be filled partially by workers moving into the ROI, which would have a moderate effect on the local housing market. Demand for housing would require approximately 40% of the vacant rental stock during the peak year of construction, and roughly 51% of vacant owner-occupied housing would be filled annually during operations. If current vacancy rates and housing developments already underway in the county continue, adverse cumulative impacts on housing should not occur.

Local labor markets would probably not be adversely affected by the concurrent construction and operation of an ACWA pilot test facility, a baseline incinerator, and reasonably foreseeable off-post activities. Unemployed workers in Pueblo County and adjacent El Paso County work in a variety of occupations and are sufficient in number to meet the demand for local labor that would be created by both projects.

Concurrent construction and operation of the two facilities and projected off-post activities might produce moderate impacts on the local transportation network near the post. Taken together, construction of both facilities would result in an additional 1,800 daily trips on US 50 West, the local road segment most heavily used by existing post employees; this would represent a 14% increase in annual average daily traffic. Concurrent operation of both facilities would result in an additional 1,400 daily trips, or an increase of 11% in annual average daily traffic on US 50 West. Changes in traffic levels over this road segment during construction and operation would not significantly affect the current level of service.

While additional local public service employees, medical services, and teachers would be needed if activities associated with a baseline incinerator, an ACWA pilot test facility, and other reasonably foreseeable off-post activities would occur concurrently, the increased demand would be moderate and concentrated in the peak year of construction. Given sufficient planning, local public service providers should be able cope with the additional demands by associated increases in city, county, and school district revenue collections.

6.22.14 Environmental Justice

Environmental justice impacts would be related to socioeconomic and human health impacts. No environmental justice impacts are anticipated from construction and routine operation of an ACWA pilot test facility (Section 6.20).

6.22.14.1 Cumulative Impacts with Other Actions

During construction and routine operations of either ACWA technology at PCD, high and adverse impacts on human health or socioeconomic activities are not anticipated (Sections 6.7 and 6.19). Moreover, the cumulative impacts associated with an ACWA pilot test facility and other reasonably foreseeable actions would probably not contribute to high and adverse impacts on populations (Sections 6.22.6 and 6.22.13). As a result, significant cumulative environmental justice impacts from construction and routine operations are not anticipated.

6.22.14.2 Cumulative Impacts with Other Actions, Including a Baseline Incinerator

If built, a baseline incinerator would add to the human health and socioeconomic impacts from an ACWA pilot test facility alone. These impacts would not be considered high and adverse (Sections 6.22.6 and 6.22.13). As a result, significant cumulative impacts on environmental justice from the construction and routine operation of an ACWA pilot test facility, a baseline incinerator, and other reasonably foreseeable actions are not anticipated.

6.23 AGRICULTURE

This section was prepared in response to public comment on the draft of this EIS (see Volume 2, Section 2, Part DD of this final EIS). This assessment describes agriculture near PCD and evaluates whether toxic air pollutants from pilot facility operations would impact crops and livestock. It also assesses potential agricultural losses from an accident involving release of chemical agent.

6.23.1 Current Environment

6.23.1.1 Land Use

The region of influence (ROI) used to assess impacts on agriculture consists of five counties located entirely or partly within an area 30 mi (50 km) around the site. This agricultural ROI contains 5.9 million acres (2.4 million ha) of land, of which 4.3 million acres (1.7 million ha) (73%) were farmland in 1997 (USDA 1999). In the ROI, there were approximately 2,700 farms in 1997, more than half of which were operated by full-time farmers (Table 6.23-1). Average farm size in the ROI counties ranged from 1,019 to 3,530 acres (412 to 1,429 ha).

6.23.1.2 Employment

Agriculture was historically only a moderately significant local source of employment in the five-county ROI, and its importance declined during the 1990s. In 1999, with 4,785 employees in farms and agricultural services, agriculture contributed 2% to total

TABLE 6.23-1 Farms and Crop Acreage in the Agricultural Region of Influence around PCD in 1997[a]

	Land (acres) and Farms (no.)	
Farms and Land	ROI	State
Land in farms (acres)	4,307,231	32,634,221
Number of farms	2,697	28,268
Full-time farms	1,425	15,399
Average farm size (acres)	1,019–3,530	1,154
Total cropland (acres)	674,545	10,509,384
Harvested cropland (acres)	350,297	5,896,984

[a] The agricultural ROI is composed of the following counties: Crowley, El Paso, Lincoln, Otero, and Pueblo.

Source: USDA (1999).

employment in the region. Within Pueblo County, there were 1,300 agricultural workers in 1999, about 3% of total county employment (U.S. Bureau of the Census 2001a). Information on numbers of migrant and seasonal farm workers was unavailable. Within the West Census Region in 1998, such farm workers were predominantly Hispanic (69%). Whites accounted for 29% of the total (Runyan 2000).

6.23.1.3 Production and Sales

Wheat, hay, corn, and sorghum are the primary crops harvested (Table 6.23-2). In Pueblo County, there are also more than 4,000 acres (1,600 ha) in vegetable production. Onions, peppers, and watermelons make up the largest portions of this acreage (Rhoades 2000). Cattle

TABLE 6.23-2 Agricultural Production in the Agricultural Region of Influence around PCD in 1997[a]

	Crops (acres) and Livestock (no.)	
Crops and Livestock	ROI	State
Selected crops harvested		
Wheat	159,045	2,515,100
Hay	109,125	1,607,991
Corn	37,480	1,016,128
Sorghum	11,294	148,004
Beans	3,645	116,544
Livestock inventory		
Cattle and calves	317,234	3,307,301
Hogs and pigs	8,331[b]	787,440
Sheep and lambs	9,442[b]	593,755
Layers and pullets	2,115[b]	3,793,457
Broilers sold	0[b]	11,933

[a] The agricultural ROI is composed of the following counties: Crowley, El Paso, Lincoln, Otero, and Pueblo.

[b] ROI inventory is an underestimate due to data unavailability for some counties.

Source: USDA (1999).

are the most important type of livestock produced. Farms in the agricultural ROI generated $282 million in agricultural sales in 1997, representing 6% of total agricultural sales in the state as a whole. The majority of sales (76%) consisted of livestock, with a smaller contribution made by crops (Table 6.23-3) (USDA 1999).

6.23.2 Site-Specific Factors

The only aspect of pilot facility operations that could have an impact on agriculture is the release of substances that could cause toxic effects on crops or livestock. Routine or fluctuating operations of a pilot facility or an accident could release organic or inorganic compounds, including agent or processing by-products, to the environment (see Sections 6.5 and 6.6). Atmospheric releases could result in the widespread dispersal and deposition of contaminants. Exposures might result in lethal effects, reduced growth or other limiting effects, or no observable effect.

6.23.3 Impacts of the Proposed Action

Impacts from construction and operations are discussed below. This analysis considers effects on agricultural production, employment, and sales. The impacts of no action are provided for comparison.

TABLE 6.23-3 Sales by Farms in the Agricultural Region of Influence around PCD in 1992 and 1997[a]

	Sales (millions of $)	
Product	1992	1997
Livestock	259,855	214,676
Harvested crops	53,014	67,769
Agricultural ROI total	312,869	282,445
State total	4,115,552	4,534,213

[a] The agricultural ROI consists of the following counties: Crowley, El Paso, Lincoln, Otero, and Pueblo.

Sources: USDA (1994, 1999).

6.23.3.1 Impacts of Construction

Construction impacts would be confined to the installation; therefore, no significant impacts on agriculture would be likely from facility construction activities.

6.23.3.2 Impacts of Routine Operations

During routine operations, crops and livestock in the vicinity of the pilot test facility would be exposed to atmospheric emissions from the boiler stack and process stack. All such facility emissions, including emissions of criteria pollutants, organic compounds, and trace elements, would be within applicable air quality standards (see Sections 6.5 and 6.6).

A screening-level ecological/agricultural risk assessment was conducted to assess the risk to agriculture resources from deposition of air emissions during routine operations of both of the pilot test technologies. For this evaluation, it was assumed that all emissions were deposited on the soils within a circle defined by the distance from the proposed pilot test site to the nearest PCD installation boundary. This assumption provides an upper limit on possible deposition at off-site locations. Actual deposition of pollutants would be less than this value and would tend to decline with distance from PCD. Within this area, the deposited emissions were assumed to be completely mixed into the top 1 cm (0.5 in.) of soil. The resulting pollutant concentration was compared with the lowest soil benchmark value available from the EPA and state sources. These benchmark concentrations for soil are based on conservative ecological endpoints and sensitive toxicological effects on plants, wildlife, and soil invertebrates. Soil chemical concentrations that fall below the benchmark are considered to have negligible risk. Those chemicals that exceed the benchmark values are considered to be contaminants of concern and would be evaluated in further detail. None of the chemicals emitted by a pilot test facility, when deposited on soils, would exceed the soil benchmark values, indicating that the risks of impacts on agriculture from maximum concentrations would be negligible (Tsao 2001a). Off-site concentrations would be substantially lower due to the effect of emission dilution over a larger area.

Most of the toxic air pollutants emitted by a pilot test facility (Section 6.6) would be from the boiler stack, a source type commonly found in any combustion facility that requires fuel to heat up the system. Boiler emissions would be followed in quantity by the emissions from the emergency diesel generator, which would operate only in case of power failure. The technology-specific emissions would contribute very little to the overall deposition of metals and organics onto soil. There is no evidence that deposited residuals from agent emitted due to fluctuating operations would bioaccumulate through the food chain (USACHPPM 1999b).

6.23.3.3 Impacts of Accidents

Section 6.21 describes potential accidents for both the proposed action and no action, including a catastrophic event that would release agent to surrounding land areas. Although extremely unlikely, release of agent might affect a major portion of the ROI. The largest impact of an accident on agriculture would result if all of the crops and livestock produced in a single season in the ROI were interdicted (either by federal or state authorities) and removed from the marketplace. The impacts from such losses in agricultural output on the economy of the counties within the 30-mi (50-km) radius surrounding BGAD would be significant. Table 6.23-4 presents three scenarios of regional losses of employment and income associated with 50, 75, or 100% loss of agricultural production (see Appendix G). These scenarios are presented for each of the pilot test technologies and for no action. The estimated losses do not include the losses that would occur in the case of death of breeding stocks of animals. Because scenarios involving widespread agent release were identified for both the proposed action and no action, the magnitude of such losses is unlikely to differ between the proposed action and no action.

TABLE 6.23-4 Agricultural Impacts of Accidents at PCD Associated with the Proposed Action and No Action[a]

Parameter	Neut/SCWO	Neut/Bio	No Action
Impacts to the regional economy from a one-year loss of agricultural output			
100% loss of agricultural output			
Employment (no. of jobs)	4,450	4,450	4,450
Income (millions of $)	200	200	200
75% loss of agricultural output			
Employment (no. of jobs)	3,340	3,340	3,340
Income (millions of $)	150	150	150
50% loss of agricultural output			
Employment (no. of jobs)	1,220	1,220	1,220
Income (millions of $)	100	100	100

[a] Impacts from no action and the proposed action are presented for the first year of operation of an ACWA facility (2009).

6.23.4 Impacts of No Action

6.23.4.1 Impacts of Routine Operations

The agricultural impacts of continuing routine operations at PCD would be negligible and as included in baseline conditions for the PCD region.

6.23.4.2 Impacts of Accidents

Potential impacts on agriculture associated with the accident scenarios under the no action alternative would be the same as those discussed under the proposed action alternatives (Section 6.23.3.3).

6.24 OTHER IMPACTS

6.24.1 Unavoidable Adverse Impacts

Most potential adverse impacts identified in this EIS would either be negligible or could be avoided through careful facility siting and adherence to best management practices during the construction and operation of industrial facilities. However, some minor unavoidable adverse impacts could result from implementation of an ACWA technology. These are described in this section.

ACWA facility construction activities, including land clearing and moving of personnel and equipment in the construction staging area(s), would require disturbance of as much as 25 acres (10 ha) and could result in unavoidable adverse impacts comparable to those that would occur at any construction site of similar size. An additional 60 acres could be disturbed by utility construction.

- As much as 85 acres (34 ha) of vegetative and terrestrial habitats could be disturbed. Most disturbances would be short-term (about 34 months) and would be mitigated through revegetation.

- Wildlife would be affected by loss of habitat, increased human activity in the construction area, increased traffic on local roads, and noise. Less mobile and burrowing species (such as amphibians, some reptiles, and small mammals) could be killed during vegetation clearing and other site preparation activities.

- The loggerhead shrike, a federal sensitive species, could be affected by loss of habitat.

- Although no cultural resources are known to exist in the construction areas, it is possible that archaeological resources could be encountered and destroyed during construction. However, since there was past disturbance in the construction areas, the likelihood of finding important cultural resources there is remote.

- Air quality would be affected during construction and operations as a result of increased fugitive dust and stack exhaust emissions. However, the concentration levels of these pollutants, when added to background air concentrations, would be below the applicable air quality standards.

- An estimated 44 (Neut/Bio) and 48 (Neut/SCWO) worker injuries could occur during ACWA facility construction. When workers follow established safety precautions, however, the risk of worker fatalities is very low.

The normal operations of an ACWA facility would have minor unavoidable adverse impacts. Facility workers would be subject to some risks from operations; consequently, an estimated 97 injuries are expected from occupational hazards. There would also be minor increases in emissions of air pollutants, but these emissions would be well below allowable levels and would not significantly affect human health, ecological resources, or wetlands. Impacts related to fluctuating operations are also expected to be minimal, given the safety features that would be built into the design of any of the ACWA facilities, which would prevent migration of contaminants to the environment in the event of a spill or other operational accident. While there would be significant unavoidable adverse impacts related to a catastrophic accident, the probability of this scenario is extremely low.

6.24.2 Irreversible and Irretrievable Commitment of Resources

Irreversible commitments are those that cannot be reversed (i.e., the resource is permanently lost or consumed). Irreversible commitments that would result from the construction and operation of a proposed ACWA pilot test facility would include the consumption of electricity and natural gas, as described in Section 6.3. Materials such as the concrete and steel used to construct the pilot test facility would also generally be irreversible commitments, since they would probably not be recyclable because of potential agent contamination. Data on the quantities of construction materials that would be required for an ACWA pilot facility are provided in Kimmell et al. (2001).

Irretrievable commitments are those that are lost for a period of time. Irretrievable commitments that would result from the construction and operation of a proposed ACWA pilot test facility would include water and habitat. Implementation of an ACWA technology would consume both process and potable water for the period of construction and operations (i.e., less than seven years total). (Amounts of water consumed are discussed in Section 6.3.) When operations would cease, water used by the ACWA technology would be available for other uses. Habitat lost because of the construction of an ACWA pilot test facility would also represent an irretrievable commitment. Habitat in the footprint of an ACWA pilot facility would be lost during the period of construction and operations (i.e., less than six years total). After decontamination and decommissioning, the land could be revegetated, and habitat could be restored. Depending on the methods chosen for decommissioning, habitat losses could also be considered irreversible.

6.24.3 Short-Term Uses of the Environment and Enhancement of Long-Term Productivity

Constructing and operating one or more pilot test facilities would be an action of limited duration — less than six years. Construction would disturb soils, wildlife, and other biota, and it would produce temporary air emissions. Operations would produce air emissions, liquid effluents, and liquid and solid wastes. Air emissions and liquid effluent releases would be temporary, ceasing at the end of project life. Disposal of wastes on post and off post would be a long-term commitment of land with restricted use. Construction and operation of one or more pilot test facilities would have short-term socioeconomic impacts for the duration of pilot testing by creating jobs, increasing tax revenues, and increasing demand for housing and public services.

After pilot testing, the ACWA facility might be used to destroy the remaining ACW stockpile. At the end of stockpile destruction, the facilities would be decontaminated and demolished, and the land would be returned to long-term productivity.

The pilot testing of an ACWA technology system would not substantially reduce or increase the risks to the general public from accidents involving chemical agents. This situation would occur because the accidents with the greatest consequences, although highly unlikely, are associated with ACW storage, and ACW storage would continue during pilot testing. The consequences from highly unlikely accidents involving agents at a pilot test facility would be less than the consequences from similar highly unlikely accidents involving ACW storage.

6.25 MITIGATION

For environmental resource areas where adverse impacts have been identified, mitigation measures have been developed to minimize or avoid potential impacts from constructing and operating an ACWA pilot facility. The mitigation measures are outlined below. Because no adverse impacts on land use, infrastructure, noise, visual resources, aquatic resources, socioeconomics, or environmental justice were identified, no mitigation would be required for these resource areas.

6.25.1 Waste Management

Adequate facilities exist to handle the hazardous and nonhazardous wastes that would be generated by construction activities. Large potentially hazardous waste streams would be produced from operating either of the neutralization pilot test facilities. The Army will work with regulators to develop procedures for handling potentially hazardous wastes resulting from ACW destruction. These procedures might include conducting tests to determine the toxicity of wastes, developing a process to stabilize salt wastes, sending wastes to a permitted hazardous waste disposal facility, or others.

6.25.2 Air Quality — Criteria Pollutants

Fugitive dust emissions would be generated during construction and operation of either ACWA pilot facility. To minimize dust emissions, access roads would be paved with asphaltic concrete, and standard dust suppression measures (i.e., watering) would be employed at the construction sites.

6.25.3 Air Quality — Toxic Air Pollutants

No significant emissions of hazardous air pollutants are expected during construction of either ACWA pilot facility. During operations, exhaust air released through filter farm stacks for both ACWA technologies would be purified through multiple carbon filter banks, and agent monitoring devices between filter banks would ensure that, in the unlikely event that some agent was not destroyed in the neutralization process and subsequent treatment, it would be detected, and the causes would be remedied immediately.

6.25.4 Human Health

Some risk to workers would be present as a result of constructing and operating either ACWA pilot facility. Workers would adhere to safety standards and use protective equipment as necessary to reduce these risks. Also, the ACWA facility would be designed and operated to contain potential agent emissions to air, water, or soils. Design components (e.g., recycling process effluents, surrounding the facility with a berm, installing automated agent detection devices) would be incorporated to minimize operational and accidental emissions. Emergency response procedures are in place to protect human health and safety, both on post and off post, in the unlikely event of a significant release to the environment from a catastrophic accident (see Section 6.7.1.4).

6.25.5 Geology and Soils

Best management practices (e.g., use of soil fences, berms, and liners; revegetation of disturbed land following construction) would be employed to minimize the potential for soil erosion that might be caused by construction of an ACWA pilot facility. A berm would surround the facilities to contain any potential releases from spills or fluctuating operations. In addition, the facilities would be designed to incorporate many safety features (e.g., detection devices, automatic shutoff) that would prevent migration of spills from an operational accident.

6.25.6 Groundwater, Surface Water, and Wetlands

Runoff created by construction would be contained or minimized by using standard erosion control measures. A berm would surround the facilities to contain any potential releases from spills or fluctuating operations. The facilities would be designed to incorporate many safety features (e.g., detection devices, automatic shutoff) that would prevent migration of spills from an operational accident.

6.25.7 Vegetation, Wildlife, and Protected Species

Construction could affect as much as 85 acres (34 ha) of vegetative and terrestrial habitat. The following mitigation measures would be implemented to reduce adverse impacts on ecological resources during construction.

- Facilities would be sited on previously disturbed vegetative areas, where possible.
- Disturbed areas along infrastructure rights-of-way and the construction site would be revegetated with native seed/shrub mixes recommended by the Natural Resources Conservation Service.
- Vehicle speed along site access roads would be low to reduce the incidence of roadkills.
- Periodic openings would be provided in all nonsecurity fencing being built to allow pronghorn antelope to pass.
- Before construction of either ACWA facility, the Army would conduct clearance surveys of construction areas for protected species.

- Construction activities would avoid protected species' habitats.

- Construction workers would be briefed on sensitive ecological resources and mitigation measures.

6.25.8 Cultural Resources

The Army would consult with the Colorado SHPO to confirm that an archaeological survey of the construction area was not warranted. Unexpected discoveries of archaeological artifacts in the construction area would be evaluated and reported in accordance with cultural resource laws and regulations.

6.26 REFERENCES FOR CHAPTER 6

Acoustical Society of America, 1983, *American National Standard Specification for Sound Level Meters, ANSI S1.4-1983*, New York, N.Y., Feb.

Acoustical Society of America, 1985, *American National Standard Specification for Sound Level Meters, ANSI S1.4A-1985, Amendment to ANSI S1.4-1983*, New York, N.Y., June.

Agency for Toxic Substances and Disease Registry, 1992, *Toxicological Profile for Mustard "Gas*," TP-91/92, prepared by Clement International Corp., for U.S. Department of Health and Human Services, Public Health Service, Washington, D.C., Sept.

Alley, P., 2000, record of telephone conversation on FTE employees between Alley (City of Pueblo, Pueblo, Colo.) and L. Nieves (Argonne National Laboratory, Argonne, Ill.), Oct.

Allison, T.A., 2001, *Forecasted Data for ACWA Socioeconomic Analyses*, intralaboratory memorandum from Allison to M. Goldberg (Argonne National Laboratory, Argonne, Ill.), Oct. 22.

Amador, S., 2000, record of telephone conversation on FTE employees between Amador (Pueblo County, Pueblo, Colo.) and L. Nieves (Argonne National Laboratory, Argonne, Ill.), Oct.

American Medical Association, 1999, *Physician Characteristics and Distribution in the U.S.*, Chicago, Ill.

Anderson, P., 2000, e-mail on noise associated with Tooele incinerator from Anderson (EG&G Inc., Tooele, Utah) to Y.-S. Chang (Argonne National Laboratory, Argonne, Ill.), Oct. 4.

ATSDR: see Agency for Toxic Substances and Disease Registry.

Avian Power Line Interaction Committee, 1996, *Suggested Practices for Raptor Protection on Power Lines: The State of the Art in 1996*, Edison Electric Institute/Raptor Research Foundation, Washington, D.C.

Benjamin and Geomatrix, 1996, *Probabilistic Seismic Hazard Assessment for the U.S. Army Chemical Disposal Facility, Pueblo Depot Activity, Colorado*, JBA 148-130-PU-002, Rev. 0, prepared by Jack R. Benjamin and Associates, Inc., Mountain View, Calif., and Geomatrix Consultants, Mountain View, Calif., March.

Brattstrom, B.H., and M.C. Bondello, 1983, "Effects of Off-Road Vehicles on Desert Vertebrates," pp. 167–206 in R.H. Webb and H.G. Wilshore (editors), *Environmental Effects of Off-Road Vehicles: Impacts and Management of Arid Regions*, Springer Verlag, New York, N.Y.

Burton, T.M., 2001, *Breathing Rates for Toxicity Data*, memorandum from Burton (U.S. Army Nuclear and Chemical Agency, Springfield, Va.) to Commander (Soldier and Biological Chemical Command, Aberdeen Proving Ground, Md.), May 24.

Cain, K., 1999, *Re-application for the National Pollutant Discharge Elimination Permit Number CO-0034673 for Pueblo Chemical Depot*, EPA ID FCO8213820725, U.S. Environmental Protection Agency, Region VIII, March 30.

Canestorp, K.M., 1999, notes from PCD site visit and meeting with Canestorp (U.S. Fish and Wildlife Service, Pueblo, Colo.) by E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), Dec. 7.

Canestorp, K.M., 2000, letter from Canestorp (U.S. Fish and Wildlife Service, Pueblo Chemical Depot, Pueblo, Colo.) to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), May 1.

Carlson, L.W., 2000, letter on federal threatened and endangered species from Carlson (Colorado Ecological Field Services Office, U.S. Fish and Wildlife Service, Lakewood, Colo.) to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), May 9.

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

CDC: see Centers for Disease Control and Prevention.

CDPHE: see Colorado Department of Public Health and Environment.

Centers for Disease Control and Prevention, 1988, "Final Recommendations for Protecting the Health and Safety against Potential Adverse Effects of Long-Term Exposure to Low Doses of Agents: GA, GB, VX, Mustard Agent (H, HD, T) and Lewisite (L)," U.S. Department of Health and Human Services, *Federal Register* 53(50)8504–8507, March 15.

CEQ: see Council on Environmental Quality.

Chafin, D.T., 1996, *Hydrogeology of the Alluvial Aquifers at the Pueblo Depot Activity Near Pueblo, Colorado*, Water-Resources Investigations Report 95-4137, U.S. Geological Survey, Denver, Colo.

Chick, N., 2001, fax on background concentrations from Chick (Colorado Department of Public Health and Environment, Denver, Colo.) to A. Smith (Argonne National Laboratory, Argonne, Ill.), March 1.

City of Pueblo, 1999, *1997–1998 City of Pueblo Comprehensive Annual Financial Report*, Pueblo, Colo.

CNHP: See Colorado Natural Heritage Program.

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

Colorado Department of Education, 2000, http://www.cde.state.co.us, accessed in 2000.

Colorado Department of Public Health and Environment, 1999, *Colorado Air Quality Commission Report to the Public, 1998–1999*, Air Pollution Control Division, Denver, Colo.

Colorado Department of Public Health and Environment, 2001, *Ambient Air Quality Standards: Colorado Air Quality Control Commission*, http://www.cdphe.state.co.us/op/airregs.asp.

Colorado Natural Heritage Program, 1999, *Conservation Status Handbook, Colorado's Animals, Plants, and Plant Communities of Special Concern*, Vol. 3, No. 2., Colorado State University, Fort Collins, Colo., and The Nature Conservancy.

Corbitt, R.A., 1990, *Standard Handbook of Environmental Engineering*, McGraw-Hill, Inc.

Council on Environmental Quality, 1997, *Environmental Justice Guidance under the National Environmental Policy Act*, CEQ, Executive Office of the President, Washington, D.C., Dec.

Dawson, S.V., and G.V. Alexeeff, 2001, "Multi-Stage Model Estimates of Lung Cancer Risk from Exposure to Diesel Exhaust, Based on a U.S. Railroad Worker Cohort," *Risk Analysis* 21(1):1–18.

DeMers, G. 1999, fax on munitions from DeMers (Pueblo Chemical Depot, Pueblo, Colo.) to H. Hartmann (Argonne National Laboratory, Argonne, Ill.), Dec. 14.

DOC: see U.S. Department of Commerce.

DOI: see U.S. Department of the Interior.

Ebasco Environmental, 1990, *Enhanced Preliminary Assessment Report: Pueblo Depot Activity Pueblo, Colorado*, prepared by Ebasco Environmental, Lakewood, Colo., under the supervision of Argonne National Laboratory, Argonne, Ill., for U.S. Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, Md., March.

EDAW et al., 1994, *Pueblo Depot Activity Reuse Development Plan*, prepared by EDAW, Inc., San Francisco, Calif., and Hammer, Siler, George Wilson & Co., Silver Spring, Md., for Pueblo Area Council of Governments and U.S. Department of Defense, Office of Economic Adjustment, Dec.

Emlen, J.T., 1971, "Population Densities of Birds Derived from Transect Counts," *The Auk* 88:323–342.

EPA: See U.S. Environmental Protection Agency.

Executive Order 13045, 1997, "Protection of Children from Environmental Health Risks and Safety Risks," *Federal Register* 62(78):19885-19888, Apr. 23.

FEC: See Foothill Engineering Consultants, Inc.

Folga, S.M., 2001, *Incinerator Utility Usage*, intraoffice e-mail from Folga to A.E. Smith and L.A. Nieves (Argonne National Laboratory, Argonne, Ill.), May 25.

Foothill Engineering Consultants, Inc., 1998, *Cultural Resources Survey of the Pueblo Chemical Depot, Pueblo County, Colorado,* Vols. I–III, prepared by T. Hoeffer et al., FEC, Golden, Colo., submitted to Rust Environmetnal and Infrastructure, Englewood, Colo., for U.S. Army Corps of Engineers, Omaha District, Omaha, Neb., May 26.

Freil, G.E., 1997, *Maximum Credible Events (MCE) for Daily Chemical Operations*, memorandum and attachments from Freil (U.S. Army Materiel Command, Alexandria, Va.) to various Army staff, AMCCB (385-61), Apr. 30.

GA Technologies, 1987, *Risk Analysis of the Continued Storage of Chemical Munitions, Chemical Stockpile Disposal Program*, SAPEO-CDE-IS-87009, prepared by GA Technologies, San Diego, Calif., for Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md., Aug.

General Atomics, 1999, *Assembled Chemical Weapons Assessment (ACWA) Draft Test*, Technical Report DAAM01-98-D-003 129300/0, San Diego, Calif., June 30.

Goodheer, I., 1994, *Dose Response Data for the Tooele Chemical Agent Disposal Facility Quantitative Risk Assessment (TOCDF QRA)*, memorandum from Goodheer (U.S. Army Nuclear and Chemical Agency, Springfield, Va.) to Commander (U.S. Army Chemical Material Destruction Agency, Aberdeen Proving Ground, Md.), June 13.

Hammerson, G.A., 1999, *Amphibians and Reptiles in Colorado*, Colorado Department of Natural Resources, Division of Wildlife, Denver, Colo.

Holland, M., 2000, *PCD Population Distribution*, e-mail from Holland (U.S. Army Corps of Engineers, Pueblo, Colo.) to H. Hartmann (Argonne National Laboratory, Argonne, Ill.), Apr. 26.

Kaczmarek, K., 2000, letter from Kaczmarek (Colorado Department of Natural Resources, Division of Wildlife, Pueblo, Colo.) to E. Pentecost (Argonne National Laboratory, Argonne, Ill.), May 26.

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

Kingery, H.E. (editor), 1998, *Colorado Breeding Bird Atlas*, Colorado Bird Atlas Partnership and Colorado Division of Wildlife, Denver, Colo.

Kirkham, R.M., and W.P. Rogers, 1981, *Earthquake Potential in Colorado, A Preliminary Evaluation*, Bulletin 43, Colorado Geological Survey, Department of Natural Resources, Denver, Colo.

Knopf, F.L., 1996, “Perspectives on Grazing Non-Game Bird Habitats,” in *Rangeland Wildlife*, R.R. Krausman (editor), Society for Range Management, Denver, Colo.

Kornelly and Associates and KPMG Inc., 1999, *Economic Impact Study for the Pueblo Chemical Depot Chemical Demilitarization Facility*, Pueblo, Colo., Oct.

Larson, T.K., and D.M. Penny (editors), 1995, *Results of a Class III Pedestrian Survey on Portions of the Pueblo Depot Activity Area, Pueblo County, Colorado*, Vol. I and II, prepared by Gulf Engineers & Consultants, Inc., Baton Rouge, La., and Larson-Tibesar Associates, Inc., Laramie, Wyo., for U.S. Army Corps of Engineers, Omaha District, Omaha, Neb., Jan.

Leach, B., 2000, record of telephone conversation between Leach (Pueblo County, Pueblo, Colo.) and L. Nieves (Argonne National Laboratory, Argonne, Ill.), Sept.

Liebich, R.E., and M.P. Cristoforo, 1988, "The Use of Audibility Analysis to Minimize Community Noise Impact of Today's Smaller Generation Facilities Located near Residential Areas," presented at American Power Conference 50th Annual Meeting, Chicago, Ill., Apr.

Light, S., 2000, *Draft Chemical Stockpile Demilitarization Program, Pueblo Pre-RCRA Construction*, Briefing, Pueblo Chemical Depot, U.S. Army Corps of Engineers, Engineering and Support Center, Pueblo, Colo., June 21.

Luz, G.A., and J.B. Smith, 1976, "Reactions of Pronghorn Antelope to Helicopter Overflight," *Journal of the Acoustical Society of America* 59:1514–1515.

MacDonald and Mack Partnership, 1984, *Historic Properties Report, Pueblo Depot Activity, Pueblo, Colorado,* Minneapolis, Minn., Aug.

Manci, K.M., et al., 1988, *Effects of Aircraft Noise and Sonic Booms on Domestic Animals and Wildlife*, AFESC TR 88-14, NERC-88/29, U.S. Air Force, Engineering and Service Center, and U.S. Fish and Wildlife Service, Fort Collins, Colo.

Marrero, P., 2000, record of telephone conversation between Marrero (Pueblo Chemical Depot, Pueblo, Colo.) and T. Allison (Argonne National Laboratory, Argonne, Ill.), Jan.

Mitretek, 2001a, *Estimates of Environmental Releases Associated with the Destruction of Assembled Chemical Weapons during Pilot Plant Testing of the Parsons Honeywell Neutralization/Biotreatment Process*, Mitretek Systems, Inc., McLean, Va., May.

Mitretek, 2001b, *Estimates of Environmental Releases Associated with the Destruction of Assembled Chemical Weapons during Pilot Plant Testing of the General Atomics Neutralization/Supercritical Water Oxidation Process*, Mitretek Systems, Inc., McLean, Va., May.

Munro, N.B., et al., 1999, "The Sources, Fate, and Toxicity of Chemical Warfare Agent Degradation Products," *Environmental Health Perspectives* 107(12):933–974, Dec.

National Oceanic and Atmospheric Administration, 1999, *Local Climatological Data: Annual Summary with Comparative Data for Pueblo, Colorado*, National Climatic Data Center, Asheville, N.C.

National Research Council, 1997a, *Risk Assessment and Management at Deseret Chemical Depot and the Tooele Chemical Agent Disposal Facility*, prepared by National Research Council, Washington, D.C., published by National Academy Press, Washington, D.C.

National Research Council, 1997b, *Review of Acute Human-Toxicity Estimates for Selected Chemical-Warfare Agents*, prepared by Subcommittee on Toxicity Values for Selected Nerve and Vesicant Agents, National Research Council, Washington, D.C., published by National Academy Press, Washington, D.C.

National Safety Council, 1999, *Injury Facts, 1999 Edition*, Itasca, Ill.

NOAA: see National Oceanic and Atmospheric Administration.

Oburn, D., 2000, record of telephone conversation between Oburn (Pueblo Chemical Depot, Pueblo, Colo.) and T. Allison (Argonne National Laboratory, Argonne, Ill.), Jan.

Opresko, D.M., et al., 1998, "Chemical Warfare Agents: Estimating Oral Reference Doses," in Ware, G.W. (editor), *Reviews of Environmental Contamination and Toxicology*, Vol. 156, Springer-Verlag, New York, N.Y.

Parker, P.L., 1995, *Guidelines for Evaluating and Documenting Traditional Cultural Properties*, National Register Bulletin 38, U.S. Department of the Interior, National Park Service., Washington, D.C.

Parsons and Allied Signal, 1999, *Assessment of Technologies for Assembled Chemical Weapon Demilitarization*, draft demonstration test final report, prepared by Parsons Infrastructure & Technology Group, Inc., and Allied Signal for U.S. Army Chemical and Biological Command, July.

PCD: see Pueblo Chemical Depot.

PDA: see Pueblo Depot Activity.

PDADA: see Pueblo Depot Activity Development Authority.

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

Pueblo Chemical Depot, 1997, *Pueblo Chemical Depot Chemical Accident/Incident Response and Assistance Plan (PCD-CAIRAP)*, U.S. Army, Pueblo, Colo.

Pueblo Chemical Depot, 1999, *Hazardous Waste Management Plan*, prepared by Harza Engineering Company, Chicago, Ill., for Pueblo Chemical Depot, Directorate of Environmental Management, Pueblo, Colo., and U.S. Army Corps of Engineers, Omaha District, Omaha, Neb., Dec.

Pueblo Chemical Depot, 2000a, *Pueblo Chemical Depot Recycling Plan*, U.S. Army, Pueblo, Colo., June.

Pueblo Chemical Depot, 2000b, *Installation Spill Contingency Plan*, draft final, U.S. Army, Pueblo, Colo.

Pueblo Chemical Depot, 2000c, *Oil and Hazardous Substance Spill Prevention, Control, and Countermeasures Plan*, draft final, U.S. Army, Pueblo, Colo.

Pueblo Chemical Depot, 2001, *Chemical Accident/Incident Response and Assistance Plan (PCD-CAIRAP)*, Apr.

Pueblo County, 1999, *1997–1998 Pueblo County Comprehensive Annual Financial Report*, Pueblo, Colo.

Pueblo Depot Activity, 1995, *Final Synthetic Minor Permit Application for Pueblo Depot Activity, Pueblo, Colorado*, prepared for L.M. Olson (Colorado Department of Public Health and Environment, Denver, Colo.), Oct.

Pueblo Depot Activity Development Authority, 1996, *Master Lease Interim Lease No. DACA45-1-96-6001 with Supplemental Agreements*, Pueblo, Colo., Feb.

Pueblo Depot Activity Development Authority, 2000, *Pueblo Chemical Depot Reuse Development Plan Update*, Pueblo, Colo., June.

Raytheon, 1996, *Johnston Atoll Chemical Agent Disposal System (JACADS) Human Health & Ecological Risk Assessment,* prepared by Raytheon Engineers & Constructors, Inc., Philadelphia, Penn., for U.S. Army Chemical Demilitarization and Remediation Activity, Aberdeen Proving Ground, Md., Dec. 30.

Rhoades, R., 2000, letter from Rhoades (Pueblo Field Office, Natural Resources Conservation Service, U.S. Department of Agriculture) to T. Allison (Argonne National Laboratory, Argonne, Ill.), July 26.

Rhodes, M., 2000, *Meteorological Data for PCD,* e-mail from Rhodes (University of Illinois, Urbana, Ill.) to Y.-S. Chang (Argonne National Laboratory, Argonne, Ill.), Jan. 5.

Rice, R.C., et al., 1989, "Ionic Composition of Vadose Zone Water in an Arid Region," *Groundwater* 27(6):813–822.

Rink, B., 2000, *Pueblo Data,* e-mail from Rink (Colorado Department of Public Health and Environment, Denver, Colo.) to Y.-S. Chang (Argonne National Laboratory, Argonne, Ill.), Feb. 3.

Robbins, C.S., et al., 1966, *Birds of North America,* Golden Press, New York, N.Y.

Ross, T., 2001, record of telephone conversation between Ross (Pueblo Chemical Depot, Pueblo, Colo.) and H. Hartmann (Argonne National Laboratory, Argonne, Ill.), Oct.

Runyan, J.L., 2000, *Profile of Hired Farmworkers, 1998 Annual Averages,* U.S. Department of Agriculture, Economic Research Service, Washington, D.C., http://www.ers.usda.gov/Publications/AER790/.

Rust, 1997, *Draft Final Preliminary Site-Wide Groundwater Evaluation Report, Pueblo Chemical Depot, Pueblo, Colorado,* prepared by Rust Environment & Infrastructure Inc., Englewood, Colo., for U.S. Army Corps of Engineers, Omaha District, Neb., Dec.

Rust and E-E Management, 1999, *Ecological Surveys at Pueblo Chemical Depot, Pueblo, Colorado,* prepared by Rust Environmental and Infrastructure Inc., Englewood, Colo., and Engineering-Environmental Management, Inc., Lakewood, Colo., for U.S. Army Corps of Engineers, Omaha District, Omaha, Neb., June.

SAIC: see Science Applications International Corporation.

School District 60, 1999, *FY 1997–1998 Annual Report for the Colorado Department of Education,* Pueblo, Colo.

School District 70, 1999, *FY 1997–1998 Annual Report for the Colorado Department of Education*, Pueblo, Colo.

Science Applications International Corporation, 1996, *Pueblo Chemical Agent Disposal Facility Phase 1 Quantitative Risk Assessment*, Report SAIC-96/2602, prepared by SAIC, Abingdon, Md., for U.S. Army Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Md, Nov.

Scott, G.R., et al., 1978, *Geologic Map of the Pueblo 1° × 2° Quadrangle, South-Central Colorado*, Miscellaneous Investigations Map I-1022, U.S. Geological Survey, Denver, Colo.

Shah, H.H., and J.W. Reed, 1996, *Seismic Fragilities of Structures and Equipment, U.S. Army Pueblo Chemical Agent Disposal Facility Pueblo, Colorado*, prepared by Jack R. Benjamin and Associates, Inc., Mountain View, Calif., for Science Applications International Corporation, March.

Simmons, T.H., and R.L. Simmons, 1998, *Historic Structures Survey, Pueblo Chemical Depot, Pueblo County, Colorado,* prepared by Front Range Research Associates, Inc., Denver, Colo., for Foothill Engineering Consultants, Inc., Golden, Colo.

SMG Marketing Group, Inc., 2001, data from Hospital Select web site, Chicago, Ill., http://www/hospitalselect.com.

Smith, A.E., 2001, record of telephone conversations on actions in Pueblo County in the vicinity of Pueblo Chemical Depot between Smith (Argonne National Laboratory, Argonne, Ill.) and various sources, Feb. 27.

Smith, K., 2000a, *Information about Stockpile Generated Wastes at Pueblo Chemical Depot*, record of telephone conversation between Smith (Argonne National Laboratory, Argonne, Ill.) and T. Ross (Pueblo Chemical Depot, Pueblo, Colo.), Oct. 24.

Smith, K., 2000b, record of telephone conversation between Smith (Pueblo County Department of Transportation, Pueblo, Colo.) and T. Allison (Argonne National Laboratory, Argonne, Ill.), Jan. 24.

Storm Prediction Center, 2000, *Historical Tornado Data Archive*, http://www.spc.noaa.gov/archive/tornadoes/index.html.

Tinney, R., 2000, record of telephone conversation between Tinney (Colorado Department of Transportation, Denver, Colo.) and T. Allison (Argonne National Laboratory, Argonne, Ill.), Jan. 24.

Transportation Research Board, 1985, *Highway Capacity Manual,* National Research Council, Washington, D.C.

Tsao, C.L., 2001a, *Ecological Risk Assessment of Chemical Emissions from an ACWA Pilot Facility during Normal Operation for Pueblo Chemical Depot (PCD)*, intraoffice memorandum from Tsao to E.D. Pentecost (Argonne National Laboratory, Argonne, Ill.), Nov. 30.

Tsao, C.L., 2001b, *Calculation of Inhalation HQ of HD (Mustard Gas) for Terrestrial Wildlife Ecological Risk Assessment at Pueblo Chemical Depot (PCD)*, intraoffice memorandum from Tsao to E.D. Pentecost (Argonne National Laboratory, Ill.).

USACHPPM: see U.S. Army Center for Health Promotion and Preventive Medicine.

USAEHA: see U.S. Army Environmental Hygiene Agency.

U.S. Army, 1982, *Installation Environmental Assessment*, draft, Headquarters, U.S. Army Depot System Command, Tooele, Utah, Dec.

U.S. Army, 1984, *Installation Environmental Assessment, Pueblo Depot Activity, Pueblo, Colorado,* Nov. 1984 revision of Dec. 1982 draft, Headquarters, U.S. Army Depot System Command, Tooele, Utah.

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

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

U.S. Army, 1997a, *Environmental Assessment: Reuse of a Portion of Pueblo Chemical Depot, Colorado,* U.S. Army Materiel Command, Alexandria, Va.

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

U.S. Army, 2000, *1999 Biennial Hazardous Waste Report for the Pueblo Chemical Depot (PCD),* attachment to letter from K. Cain (Department of the Army, Pueblo Chemical Depot, Pueblo, Colo.) to M. Neumiller (Colorado Department of Public Health and Environment, Hazardous Materials and Waste Management Division, Denver, Colo.), Feb. 22.

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

U.S. Army Center for Health Promotion and Preventive Medicine, 1999a, *Development and Derivation of Inhalation Benchmark Values for Wildlife: An Application to Identify Ecological Risk to Airborne Contaminants*, Study 87-1299-99, Health Effects Research Program, Toxicology Directorate, Aberdeen Proving Ground, Md., Dec.

U.S. Army Center for Health Promotion and Preventive Medicine, 1999b, *Derivation of Health-Based Environmental Screening Levels for Chemical Warfare Agents*, Aberdeen Proving Ground, Md.

U.S. Army Corps of Engineers, 1987, *Corps of Engineers Wetlands Delineation Manual*, Technical Report Y-87-1, Waterways Experiment Station, Vicksburg, Miss.

U.S. Army Environmental Hygiene Agency, 1990, *Environmental Noise Study No. 52-34-0490-90, Pueblo Army Depot Activity, Pueblo, Colorado, 11-15 September 1989*, Aberdeen Proving Ground, Md.

U.S. Army et al., 1987, *Geological-Seismological Investigation of Earthquake Hazards for a Chemical Stockpile Disposal Facility at the Pueblo Depot Activity, Colorado*, prepared by the U.S. Army Engineer Division, Huntsville, Ala.; Jacobs Engineering Group, Inc.; and URS/John A. Blume & Associates, Engineers, for the Office of the Program Manager for Chemical Munitions.

U.S. Army et al., 1992, *Seismic Design for Buildings*, Army Technical Memorandum 5-80-10, Headquarters, Departments of the Army, Navy, and Air Force, Washington, D.C.

U.S. Army et al., 1997, *Programmatic Agreement among United States Army, Colorado State Historic Preservation Officer, and Advisory Council on Historic Preservation for the Utilization and Eventual Disposal of Above Ground Facilities at Pueblo Chemical Depot, Colorado*.

U.S. Bureau of Labor Statistics, 2001, *Local Area Unemployment Statistics*, Washington, D.C., ftp://ftp.bls.gov/pub/time.series/la/, accessed in Feb. 2001.

U.S. Bureau of the Census, 1991, *1990 Census of Population and Housing, Summary of Population and Housing Characteristics, Colorado*, Washington, D.C.

U.S. Bureau of the Census, 1992a, *1990 Census of Population and Housing, Summary of Social, Economic, and Housing Characteristics, Colorado*, Washington, D.C.

U.S. Bureau of the Census, 1992b, *County Business Patterns, 1990*, Washington, D.C., http://www.census.gov/ftp/pub/epcd/cbp/view/cbpview.html, accessed in Sept. 2000.

U.S. Bureau of the Census, 1992c, *1990 Census of Population and Housing*, data including STF 1 and STF 3a, Washington, D.C., http://factfinder.census.gov., accessed in Feb. 2000.

U.S. Bureau of the Census, 1994, *City and County Data Book*, *1994,* Washington, D.C.

U.S. Bureau of the Census, 2000, *1997 Census of Governments*, Compendium of Public Employment, Washington, D.C., http://www.census.gov/ftp/pub/govs/www/cog.html.

U.S. Bureau of the Census, 2001a, *County Business Patterns*, *1999*, Washington, D.C., http://www.census.gov/ftp/pub/epcd/cbp/view/cbpview.html.

U.S. Bureau of the Census, 2001b, *American FactFinder,* Washington, D.C., http://factfinder.census.gov.

U.S. Bureau of the Census, 2001c, *State and County Quickfacts*, Washington, D.C., http://quickfacts.census.gov/qfd/states/08000.html, accessed in Sept. 2001.

U.S. Bureau of the Census, 2001d, *Census 2000 Redistricting Data (Public Law 94-171) Summary File*, Washington, D.C., http://www.census.gov/clo/www/redistricting.html, accessed in Aug. 2001.

USDA: see U.S. Department of Agriculture.

U.S. Department of Agriculture, 1979, *Soil Survey of Pueblo Area, Colorado, Parts of Pueblo and Custer Counties*, Soil Conservation Service in cooperation with Colorado Agricultural Experiment Station, June.

U.S. Department of Agriculture, 1994, *Census of Agriculture 1992*, National Agricultural Statistics Service, Washington, D.C., http://www.nass.usda.gov/census/census92/agrimenu.htm.

U.S. Department of Agriculture, 1999, *Census of Agriculture 1997*, National Agricultural Statistics Service, Washington, D.C., http://www.nass.usda.gov/census/census97/volume1/vol1pubs.htm, accessed in Feb. 2000.

U.S. Department of Commerce, 2001, *Local Area Personal Income,* Bureau of Economic Analysis, Washington, D.C., http://www.bea.doc.gov/bea/regional/reis/.

U.S. Department of the Interior, 1986a, *Visual Resource Inventory*, BLM Manual Handbook H-8410-1, Bureau of Land Management, Washington, D.C., Jan.

U.S. Department of the Interior, 1986b, *Visual Resource Contrast Rating*, BLM Manual Handbook H-8431-1, Bureau of Land Management, Washington, D.C., Jan.

U.S. Department of the Interior, 1999, *National Wetlands Inventory Map, North Avondale, Colorado Quadrangle*, U.S. Fish and Wildlife Service.

U.S. Environmental Protection Agency, 1974, *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, EPA-550/9-74-004, Washington, D.C.

U.S. Environmental Protection Agency, 1979, "Protective Noise Levels" (condensed version of *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, EPA/ONAC 550/9-74-004, March 1974), http://www.nonoise.org/library/levels/levels.htm.

U.S. Environmental Protection Agency, 1989, *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A)*, EPA/540/1-89/002, Interim Final, Office of Emergency and Remedial Response, Washington, D.C., Dec.

U.S. Environmental Protection Agency, 1994, *Exposure Assessment Guidance for RCRA Hazardous Waste Combustion Facilities (Draft)*, EPA 530/R-94/021, Office of Solid Waste, Washington, D.C.

U.S. Environmental Protection Agency, 1995, *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models*, EPA-454/B-95-003a and updated model (Version 00101), Office of Air Quality Planning and Standards, Research Triangle Park, N.C., Sept.

U.S. Environmental Protection Agency, 1997, *Exposure Factors Handbook*, EPA/600/P-95/002Fa, Office of Health and Environmental Assessment, Washington, D.C., Aug.

U.S. Environmental Protection Agency, 1998a, *Final Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses*, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency, 1998b, *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Peer Review Draft*, EPA/530/D-98/001A, July.

U.S. Environmental Protection Agency, 2000a, *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources*, Office of Air Quality Planning and Standards, Research Triangle Park, N.C., Clearinghouse for Inventories and Emission Factors (CHIEF), TTNWeb, http://www.epa.gov/ttn/chief/ap42/index.html.

U.S. Environmental Protection Agency, 2000b, *Documentation for the 1996 Base Year National Toxics Inventory for Nonroad Vehicle and Equipment Mobile Sources,* prepared by Eastern Research Group, Inc., Morrisville, N.C., for EPA, Emissions Monitoring and Analysis Division, Research Triangle Park, N.C., June 2.

U.S. Environmental Protection Agency, 2000c, *Technical Support Document: Control of Emissions of Hazardous Air Pollutants from Motor Vehicles and Motor Vehicle Fuels,* EPA-420-R-00-023, Office of Air and Radiation, Dec.

U.S. Environmental Protection Agency, 2001a, *National Emission Trends Inventory (NET 1996), County and Plant Emission Summaries,* Office of Air Quality Planning and Standards, Research Triangle Park, N.C., Regional Transport Office (RTO), TTNWeb, http://www.epa.gov/ttn/rto/areas/net.htm, accessed in March 2001.

U.S. Environmental Protection Agency, 2001b, *AIRSData, Monitor Values Report,* Office of Air Quality Planning and Standards, Research Triangle Park, N.C., http://www.epa.gov/air/data/monvals/html, accessed in Feb. 2001.

Watts, K.R., and R.F. Ortiz, 1990, *Geohydrology and Ground-Water Quality at the Pueblo Depot Activity Landfill near Pueblo, Colorado,* Water-Resources Investigations Report 89-4143, U.S. Geological Survey, Denver, Colo.

Whitacre, C.G., et al., 1987, *Personal Computer Program for Chemical Hazard Prediction (D2PC),* CRDEC-TR-87021, U.S. Army, Armament Munitions Chemical Command, Chemical Research, Development, and Engineering Center, Aberdeen Proving Ground, Md., Jan.

White, M.A., 2000, *Background Noise Levels at the Transportation Technology Center for Pueblo Chemical Depot Environmental Study,* letter from White (Transportation Technology Center, Inc., Pueblo, Colo.) to K. Smith (Argonne National Laboratory, Argonne, Ill.), Feb. 28.

Whorton, M., 2000a, record of telephone conversation on synthetic minor permit for PCD between Whorton (Argonne National Laboratory, Argonne, Ill.) and T. Ross (Pueblo Chemical Depot, Pueblo, Colo.), Nov.

Whorton, M., 2000b, personal communication on PCD civilian personnel from Wharry (Pueblo Chemical Depot, Pueblo, Colo.) to Whorton (Argonne National Laboratory, Argonne, Ill.), Oct. 18.