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| | |
|---|---|
| AST | aboveground storage tank |
| bgs | below ground surface |
| BCP | BRAC Cleanup Plan |
| BCT | BRAC Cleanup Team |
| BEC | BRAC Environmental Coordinator |
| BHC | 1,2,3,4,5,6-hexachlorocyclohexane |
| BRAC | Base Realignment and Closure |
| BTEX | benzene, toluene, ethylbenzene, and total xylenes |
| CAP | Cleanup Action Plan |
| CCC | Civilian Conservation Corps |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act of 1980 |
| CERFA | Community Environmental Response Facilitation Act |
| CRP | community relations plan |
| CS | 2-chlorobenzalmalononitrile (tear gas) |
| CSM | conceptual site model |
| CWM | Chemical Waste Management |
| 2,4-D | 2,4-dichlorophenoxy acetic acid |
| 4,4'-DDD | dichlorodiphenyldichlorethane |
| 4,4'-DDE | dichlorodiphenyldichloroethylene |
| DDT | dichloro-diphenyl-trichloroethane |
| DNR | Department of Natural Resources (Washington) |
| DOD | Department of Defense |
| EBS | environmental baseline survey |
| Ecology | Washington Department of Ecology |
| EM | electromagnetic |
| EPA | U.S. Environmental Protection Agency |
| FBI | Federal Bureau of Investigation |
| FR-80 | forest zoning with an 80-acre minimum lot size |
| FR-40 | forest zoning with a 40-acre minimum lot size |
| GPR | ground-penetrating radar |
| IRP | Installation Restoration Program |
| LAW | light anti-tank weapon |
| MCPP | (2-methyl-4-chlorophenoxy)2-proprionic acid |
| mg/kg | milligram per kilogram |
| mg/L | milligram per liter |
| MTCA | Model Toxics Control Act |
| NFA | No Further Action |

| | |
|---|---|
| NGVD | National Geodetic Vertical Datum |
| PA | picric acid |
| PCB | polychlorinated biphenyl |
| PETN | pentaerythritol tetranitrate |
| PID | photoionization detector |
| PPL | Priority Pollutant List |
| ppm | part per million |
| Pt | Troutdale formation |
| Qa | Quaternary alluvium |
| Qls | Quaternary landslide deposit |
| R-5 | rural estate zoning with a minimum 5-acre lot size |
| R-10 | rural estate zoning with a minimum 10-acre lot size |
| RAB | Restoration Advisory Board |
| RAU 1 | Remedial Action Unit 1 |
| RCRA | Resource Conservation and Recovery Act |
| RDX | hexahydro-1,3,5-trinitro-1,3,5-triazine |
| SPT | standard penetration test |
| SSI | supplemental site investigation |
| SVOC | semivolatile organic compound |
| 2,4,5-T | 2,4,5-trichlorophenoxy acetic acid |
| TOC | total organic carbon |
| TPH | total petroleum hydrocarbons |
| TPH-DRO | total petroleum hydrocarbons in the diesel range |
| TPH-GRO | total petroleum hydrocarbons in the gasoline range |
| Tv | Tertiary volcanics |
| USACE | U.S. Army Corps of Engineers |
| UST | underground storage tank |
| UXO | unexploded ordnance |
| VOC | volatile organic compound |
| WAC | Washington Administration Code |

## 1.1 SITE NAME, LOCATION, AND DESCRIPTION

Camp Bonneville is located in Clark County, Washington, near the town of Proebstel, approximately 10 miles east of the city of Vancouver (Figure 1-1). It is situated on the western slopes of the Cascade Mountains. The western portion of the installation consists of low hills and the low plain of the Lacamas Creek valley whereas the remainder of the installation comprises well-dissected hills of the westernmost Cascade Mountain foothills. Elevations range from approximately 290 feet in Lacamas Creek at the southwest corner of the installation to 1,000 feet in the northwest, 1,350 feet in the southeast, and approximately 1,450 feet at the center of the installation.

The area surrounding Camp Bonneville has historically been sparsely populated with scattered residences and is used primarily for agriculture and livestock grazing. The zoning at Camp Bonneville is FR-80, i.e., forest zoning with an 80-acre minimum lot size (Otak Inc. 1998). Neighboring properties are zoned FR-80, FR-40 (forest zoning with a 40-acre minimum lot size), R-5 (rural estate zoning with a minimum 5-acre lot size), and R-10 (rural estate zoning with a 10-acre minimum lot size). Although current zoning permits nothing smaller than a 5-acre lot size, many residences on much smaller lots were approved prior to the adoption of the current standards. The nearest town is Proebstel, an unincorporated community about 2.5 miles to the southwest of the western entrance to the camp. However, increased residential development and population has occurred in the past few years in eastern Clark County. Clark County has been the fastest growing county in Washington, with an estimated 2000 population of 345,000 (WOFM 2000).

Camp Bonneville was selected for transfer and reuse by the Base Realignment and Closure (BRAC) ‘95 Commission. When Vancouver Barracks was decommissioned in 2001, Camp Bonneville became a sub-installation of Fort Lewis, Washington. Camp Bonneville encompasses approximately 3,840 acres, which have been identified as BRAC property subject to lease or transfer. Two areas within Camp Bonneville, totaling 820 acres (part of the 3,840-acre total), are currently leased from the Washington Department of Natural Resources.

The Department of the Army (Army), with support from the U.S. Army Corps of Engineers (USACE), is the lead agency for site activities at Camp Bonneville. The Washington State Department of Ecology (Ecology) is the lead regulatory agency, with the U.S. Environmental Protection Agency (EPA) Region 10 serving in an advisory capacity.

The individual sites within Camp Bonneville that are covered by this Cleanup Action Plan (CAP) are collectively referred to as Remedial Action Unit 1 (RAU 1) and include (Figure 1-2):

- Landfill 1
- Landfill 2
- Landfill 3
- Former Burn Area
- Buildings 1962 and 1983
- Grease Pits
- Former Sewage Pond
- Hazardous Materials Accumulation Point
- Drum Disposal Area

- Paint and Solvent Disposal Area
- Washrack 1
- Maintenance Pit
- Washrack 2
- Pesticide Storage/Mixing Building (Building 1864)
- Aboveground Storage Tanks
- CS Gas Training Building
- Pesticide Storage Building (Building 4126)
- Ammunition Storage Bunkers
- CS Gas Chamber Building (Building 1834)
- Underground Storage Tank (formerly associated with Building 4475)

These sites are described in Section 2.

## 1.2 GEOLOGY AND HYDROGEOLOGY

### 1.2.1 Regional Geology and Physiography

Camp Bonneville is situated in the foothills of the middle Cascade Mountains in the transition zone between the Puget Trough and the Willamette Trough Provinces. The geology of this area generally consists of Eocene and Miocene volcanic and sedimentary rock types overlain by unconsolidated clays, silts, sands, and gravels of the Troutdale Formation (Phillips 1987).

The Camp Killpack and Camp Bonneville cantonments are located on the valley floor. The remainder of Camp Bonneville consists of moderately steep, heavily vegetated slopes that have been used primarily as firing ranges. The valley floor is a relatively narrow floodplain, which ranges from an elevation of about 290 feet national geodetic vertical datum (NGVD) on the western end of Camp Bonneville to about 360 feet NGVD on the east. The adjoining slopes rise moderately steeply to elevations of between 1,000 and 1,500 feet NGVD along ridge tops within the property boundaries. The entire installation is heavily vegetated.

### 1.2.2 Geology and Soils

Camp Bonneville is situated along the structural and physiographic boundary between the western flank of the middle Cascade Mountains and the Portland-Vancouver Basin. The geology of the Camp Bonneville vicinity is known primarily from geologic mapping by Mundorff (1964) and Phillips (1987), a limited number of well logs available from the general area, and a multi-sites investigation conducted by Shannon & Wilson (1999).

Shannon & Wilson (1999) described the four distinctive stratigraphic units that underlie Camp Bonneville:

- Quaternary floodplain and stream channel alluvium and lacustrine deposits (Qa), which mantle the Lacamas Creek valley floor
- A Quaternary landslide deposit (Qls) of surface soils and bedrock displaced from the steep slope along David Creek

- A thick sequence of Quaternary to Pliocene-age gravel, fine-grained sand, and cobbly and bouldery sand known as the Troutdale formation (Pt), which underlies areas to the west of the Bonneville cantonment
- Tertiary volcanic bedrock (Tv), which is exposed at the surface in the eastern part of Camp Bonneville

These units are presented in a geologic map (Figure 1-3).

The Quaternary alluvium deposits that compose the shallow surface soils of the Lacamas Creek valley floor comprise stream channel, floodplain, and alluvial fan sediments. These deposits consist of a thin layer of clay and silt, underlain by silty sand and some gravel. During drilling and excavation activities associated with the removal of a UST in Camp Killpack (Hart Crowser 1996), at least 25 feet of silty clay was encountered and interpreted to be older alluvium. Borings from the multi-sites investigation (Shannon & Wilson 1999) also encountered alluvial clays and silts overlying a relatively thick, silty clay deposit in the Camp Bonneville cantonment. These clayey soils probably originated as water deposits that were deposited on the valley floor in Quaternary time as a result of catastrophic flooding along the Columbia River (Shannon & Wilson 1999).

Phillips (1987) mapped a large landslide deposit on the steep northwest-facing slope of Lacamas Creek above the Camp Bonneville cantonment. The age of the landslide is unknown; however, the topographic expression suggests that it is not recent as noted by the re-growth of vegetation. The slide displaced surface soils and bedrock over about 100 acres of land adjacent to David Creek to the northeast. The landslide deposits extended from an elevation of about 1,000 feet at the headwall of the slide to an elevation of about 500 feet at its toe along David Creek.

The Troutdale formation, which reportedly underlies a portion of the western part of the camp, ranges from a poorly consolidated sand and gravel to a well-indurated conglomerate in its upper part. Based on regional boring logs, the upper Troutdale formation is locally about 150 feet thick and consists of cemented sand, gravel, sandy clay, and boulders. It is underlain by up to 150 feet of the lower Troutdale formation, which contains considerably more clay interspersed with sandy and gravelly layers. There is considerable variation in the lithology and thickness of the Troutdale formation. In general, the formation thins eastward against the underlying bedrock, and the lower part of the formation reportedly is typically coarser grained toward the east (Mundorff 1964).

The bedrock that underlies the alluvial deposits and Troutdale formation is exposed at the surface in the eastern part of Camp Bonneville. This bedrock consists of Oligocene-age andesite and basaltic andesite flows, minor flow breccias, tuffs, and volcaniclastic sandstones. According to the logs of borings from the multi-sites investigation (Shannon & Wilson 1999), the uppermost bedrock is severely weathered. This weathered bedrock tends to form surface soils that contain gravel of basalt lithology. During drilling for the multi-sites investigation, bedrock was encountered in 10 soil borings, at depths ranging from approximately 6 to 37 feet below ground surface (bgs).

### 1.2.3 Surface Hydrology

The principal surface water feature in the vicinity of Landfill 4 is Lacamas Creek, which flows southward from the coalescence of two branch streams in the north-central part of Camp

Bonneville, exiting the installation at its southwest corner. From the southwestern property boundary, Lacamas Creek flows southwestward and discharges into Lacamas Lake. Lacamas Lake discharges in to the Columbia River near the town of Camas, Washington. Numerous minor tributaries draining adjacent uplands flow into Lacamas Creek. Buck Creek and David Creek, the largest of these streams, drain the southeastern hills of Camp Bonneville.

### 1.2.4 Hydrogeology

Little information is available about the hydrogeology of Camp Bonneville, despite Mundorff's (1964) study of groundwater resources in Clark County. There are two drinking water wells at Camp Bonneville: a 364-foot-deep well at the Camp Bonneville cantonment and a 516-foot-deep well at the Camp Killpack cantonment. In addition, a well was drilled at the FBI range during 1998 that extends to a depth of 105 feet bgs (Shannon & Wilson 1999). Several groundwater monitoring wells associated with the multi-sites investigation (Shannon & Wilson 1999) are located primarily near the two cantonments. Based on regional information from Mundorff (1964) and the reported depths of the wells at the camp, water supply wells in the area generally extend into the Troutdale formation or underlying bedrock. Most of the nearby wells apparently obtain groundwater from depths of 150 to as much as 500 feet bgs. Wells drilled into volcanic bedrock typically yield only enough water for limited domestic use (Shannon & Wilson 1999).

The water table is typically within a few feet of the surface in areas underlain by alluvium and appears to fluctuate seasonally several feet. A rising water table occurs in the early fall through spring during the rainy season, and a declining water table occurs throughout the summer. The localized groundwater flow generally follows local topography toward tributaries and creeks. Generally, groundwater flows from the uplands west toward Lacamas Creek and east toward the creek from the cantonments. The elevation of the water table at upland areas of Camp Bonneville has not been established. However, it may be fairly shallow (less than 50 feet bgs) on the eastern valley walls, which are marked by shallow bedrock, multiple creeks, and tributaries.

## 1.3 ECOLOGY

Most of Camp Bonneville is forested undeveloped land that provides habitat for many plant and animal species, including some special status species (USACE 2001). Wetlands and riparian forests are primarily associated with Lacamas Creek at Camp Bonneville. Vegetation and wildlife are described in terms of their association with five plant communities:

- Coniferous forest
- Mixed forest
- Scrub-shrub
- Meadows
- Open-water wetlands

### 1.3.1 Vegetation

Diverse plant communities surround the Lacamas Creek drainage at Camp Bonneville, whereas most of the rest of the installation consists of coniferous forest.

### *Coniferous Forest*

Most of Camp Bonneville is covered with coniferous forest. The dominant species is Douglas fir, typically less than 100 years old. Past fires have shifted the forest from a western hemlock forest to predominantly even-aged Douglas fir stands (USACE 2001). Remnant western hemlock and western red cedar are found primarily along drainages in some areas. Several areas have dense Douglas fir forest with little or no understory due to the close spacing of the trees and reduced light penetration. Other Douglas fir forest areas, where thinning had been conducted in previous years, contain a shrub layer and a ground layer. Common understory species include vine maple, salmonberry, red elderberry, hazelnut, salal, and sword fern. Common ground cover species include Vancouveria, Oregon grape, and piggy-back plant. Snags and old growth stumps are most common along the East Fork of Lacamas Creek.

### *Mixed Coniferous and Deciduous Forest*

The mixed coniferous and deciduous forests are found primarily along Lacamas Creek and other drainages and wetland areas. Red alder is typically the dominant tree species in the riparian and wetland areas. Other tree species include Oregon ash, Douglas fir, big leaf maple, black cottonwood, crabapple, and willow. Patches of Garry oak are found in this community. Common understory species are similar to those in the coniferous forest and include vine maple, salmonberry, Indian plum, and snowberry. Most of the trees in this habitat are young, and snags are small in diameter and uncommon.

### *Scrub-Shrub*

Scrub-shrub is found primarily along drainages and wetland depressions and adjacent to and within the wetter areas of Camp Bonneville. Dominant species include red alder, hardhack, willows, red osier dogwood, softstem bulrush, and slough sedge. Himalayan blackberry and scotch broom are invasive exotic species that have begun to appear in recently disturbed uplands. Scrub-shrub typically has dense vegetation, providing valuable habitat and cover for prey species, nesting for birds, and food sources for some of the more common larger mammals.

### *Meadows*

Most of the meadows were probably created by forest clearing. Meadows include upland and wetland areas and in scattered openings in the coniferous forest and associated with rock outcrops at the top of Little Baldy. Because of previous military activities and land uses, meadows are dominated by nonnative herbaceous species. Grasses include bentgrass, silver hairgrass, cheat grass, fescue, tufted hairgrass, and bluegrass. Forbs include Canadian thistle, snowberry, and Canada goldenrod. Wetter areas are dominated by sedges and rushes. Invasive exotic species of particular concern are meadow knapweed and tansy ragwort.

### *Wetlands*

Wetlands and riparian areas include forested, scrub-shrub, and herbaceous communities. Most of the open-water wetlands were created by beaver dams along Lacamas Creek and its tributaries. Ponds are considered to be permanently inundated wetland depressions. Snags are

present in some of the wetlands and provide breeding habitat for nesters. Dominant plant species include red alders and willows in the overstory with slough sedge, skunk cabbage, soft rush, and small-fruited bulrush in the understory. Reed canary grass appears to have invaded some of the wetlands.

### 1.3.2 Wildlife

Many of the most common species of wildlife found at Camp Bonneville exist in the coniferous forest and the mixed coniferous and deciduous forest areas. Dense stands of Douglas fir are not as valuable to wildlife because they lack an understory. Past timber thinning practices have allowed a shrub layer, an herbaceous layer, and an overstory layer of Douglas fir to develop, resulting in an increase in available habitat types that benefit wildlife species. Meadows provide open area habitat for a variety of species. Meadows also offer food and nesting for ground-nesting birds, as well as good hunting for raptors. Riparian vegetation is adjacent to water sources and as such is an excellent habitat for many species. Riparian areas provide dense cover and habitat for both terrestrial and aquatic species.

Wildlife at Camp Bonneville includes many common species of invertebrates, fish, amphibians, reptiles, birds, and mammals. Coastal cutthroat trout are found in Lacamas and David Creeks. Other observed fish species include sculpin, chiselmouth, redside shiner, and western brook lamprey. Brown trout have been observed in Lacamas Creek downstream of Camp Bonneville. Rough-skinned newts, tree frogs, ensatina, northwestern salamander, western red-backed salamander, and Cascade torrent salamander typically are found in meadows and wetlands. Porcupine, deer, elk, coyote, and black bear typically are found in the coniferous forest and mixed coniferous and deciduous forests.

### 1.3.3 Federal Threatened and Endangered Species

The U.S. Fish and Wildlife Service has indicated that no listed animal species and one proposed animal species (coastal cutthroat trout) were within Camp Bonneville (USACE 2001). The National Marine Fisheries Service stated that the Lower Columbia River steelhead, Lower Columbia River chinook salmon, and Columbia River chum may be present at Camp Bonneville.

On April 5, 1999, the coastal cutthroat trout was proposed as a threatened species for the Southwest Washington/Columbia River Ecologically Sensitive Unit and may be present at Camp Bonneville. Coastal cutthroat trout require relatively cold water for spawning, and continuous forest canopy is important in maintaining cold temperatures. Lacamas Dam blocks upstream fish passage on Lacamas Creek approximately 10 miles downstream from the Camp Bonneville western boundary. As a result, Lower Columbia River steelhead, Lower Columbia River chinook salmon, and Columbia River chum are not found above Lacamas Dam. However, coastal cutthroat trout can become resident above a dam and have been found in surveys of Lacamas Creek. It is assumed that the now-resident population of coastal cutthroat trout above the dam still has downstream access over Lacamas Dam and provides flow of genetic material to downstream populations.

### 1.3.4 State Threatened and Endangered Species

The 1995 endangered species survey identified certain Washington State special status target species at Camp Bonneville (USACE 2001). The species that were found during the survey were small-flowered trillium (*Trillium parviflorum*), hairy-stemmed checker-mallow (*Sidalcea*

*hirtipes*), red-legged frog (*Rana aurora*), Vaux's swift (*Chaetura vauxi*), pileated woodpecker (*Drycopus pileatus*), and the brush prairie or northern pocket gopher (*Thomomys talpoides douglasi*).

Two state-listed plant species were found at Camp Bonneville. Two populations of small-flowered trillium (state-listed as sensitive) were found within mixed woodland communities. This species likes moist, shady woods. Numerous individuals were found within these populations. Only one population of hairy-stemmed checker-mallow (state-listed as endangered) was found, and included approximately 25 individuals. While this plant is often found along streams and in open fields, it was located at Camp Bonneville along a road in association with a ditch.

Two state-listed candidate bird species have been observed at Camp Bonneville. Both Vaux's swifts and pileated woodpeckers are found throughout the installation. Vaux's swifts occur in coniferous forested areas. No nesting or roosting sites for Vaux's swifts were found during the survey, but four individuals were sighted. These may not have been residents and may have only been passing through. No nesting sites were found for the pileated woodpecker, but suitable nesting areas exist within the installation, so nesting is possible. This species typically is found in mixed coniferous and deciduous forests. However, resources within the installation are unlikely to support more than two pairs. No spotted owns (*Strix occidentalis caurina*), a federally-threatened and state-listed endangered species, were observed during the spotted owl survey.

Signs of a mammal species that is a federal- and state-listed candidate were observed during the surveys at Camp Bonneville. Fresh brush prairie pocket gopher burrows were sighted during the surveys, indicating that the burrows were active and that the species exists on the installation. These pocket gophers are commonly found in meadows.

A general history of Camp Bonneville is presented below, followed by specific descriptive information about the sites that comprise RAU 1. The discussion below is based on data from Shannon & Wilson (1999), URS (2000a and 2000b), Hart Crowser (1997), and CEcon (1997). Data generated during various investigation and remediation activities at each of the sites are presented in Section 5. Figures and tables from the investigation and remediation activities are presented in Appendices A and B.

## 2.1 GENERAL HISTORY OF CAMP BONNEVILLE

Camp Bonneville was established in 1909 as a drill field and rifle range. Troops from Vancouver Barracks began to use part of the facility for a target range in 1910. Installation use grew to include a range for assault weapons, artillery, and field and air defense artillery between 1910 and 1995. The original reservation, consisting of approximately 3,020 acres, was acquired by the federal government in 1918. It was officially named Camp Bonneville in 1926. The Camp Bonneville cantonment area was built in the late 1920s. The Camp Killpack cantonment area was built and occupied by the Civilian Conservation Corps (CCC) in 1935. The facilities were used for several military training programs, in addition to being used by Vancouver Barracks. During World War II, the facility was also used to house Italian prisoners of war.

In 1950, many of the buildings and systems at the facility were rehabilitated to use for training Army Reserve units. In the early 1950s, an additional 840 acres of land were leased from the State of Washington. Vancouver Barracks, which included Camp Bonneville, became a sub-installation of Fort Lewis, Washington, in 1959. Since World War II, Camp Bonneville has been used as a training camp for active Army, Army Reserve, National Guard, Marine Corps Reserve, Navy Reserve, and Coast Guard Reserve units, as well as other Department of Defense (DOD) and government personnel. When not required for military training exercises, Camp Bonneville was made available until the late 1980s to local equestrians and hunters, as well as for overnight use of the cantonment areas by 4-H groups and school districts for outdoor schools (Otak Inc. 1998). Camp Bonneville is currently used by federal, state, and local law enforcement agencies for firearms training and practice and general training purposes. The Federal Bureau of Investigation (FBI) makes frequent use of one of the firing ranges.

In 1996, following the selection of Camp Bonneville for closure by the BRAC Commission, all active military training units ceased operations at the camp. All out-grants for using the facilities were cancelled, with the exception of the FBI range. The FBI currently plans to maintain a firing range on Camp Bonneville property after the base has been officially released by the DOD.

## 2.2 CHARACTERISTICS OF SITES COMPRISING REMEDIAL ACTION UNIT 1

Brief descriptions of the sites included in RAU 1 are provided below, including their location within Camp Bonneville. Most of the sites were largely identified during the environmental baseline survey (EBS) (Woodward-Clyde 1997) conducted after the installation was selected for closure by the BRAC Commission.

### 2.2.1 Landfill 1

Landfill 1 was reportedly located east of the Camp Bonneville cantonment area and just north of the existing sewage lagoon. It was identified as having potential historic significance based on a

1980 cultural resources survey (Larson 1980), which stated that bottle fragments dating from the early 1900s were found in the area. There is no record of when the site was used or what other types of materials it may contain. In the 1980 archaeological survey, the site was described as a small (approximately 12 by 15 feet) shallow depression.

### 2.2.2 Landfill 2

Landfill 2 was discovered in about 1978, during excavation for construction of the current sewage lagoon. According to an interview performed during the EBS, landfill material was unearthed at the eastern and northern borders of the sewage lagoon (Woodward-Clyde 1997). No description of the materials encountered during construction of the sewage lagoon was found. No additional records of the type or quantity of material that was placed in this landfill were located, and the exact dates of use are unknown. Although the EBS suggested that the landfill may have been operated from 1940 to 1950, its use apparently preceded the mid-1970s, based on the fact that base personnel working at Camp Bonneville at that time and interviewed for the EBS were unaware of the landfill's existence.

The general Landfill 2 area is bounded by the existing sewage lagoon to the west and north and wooded areas to the south and east. The landfill area slopes gently southward toward Lacamas Creek. Although most of the site area is fairly flat, portions of the area are bumpy and uneven. The area between the sewage lagoon and the gravel road to the south is covered with native grasses.

### 2.2.3 Landfill 3

Landfill 3 is located southeast of the existing sewage lagoon, near Lacamas Creek, and approximately 300 feet southeast of Landfill 2. According to the EBS, the site was described by the previous Camp Bonneville Facility Manager as having been dug out as a trench and then used as a trash burial area from the mid to late-1970s to the early to mid-1980s (Woodward-Clyde 1997). The landfill trench reportedly was approximately 40 feet long by 12 feet wide by 8 feet deep, and ran north to south. Objects such as a refrigerator, a locker, wallboard, and paint cans were reportedly buried here. Soil was scraped from nearby and pushed onto the landfill, creating a broad mound that currently marks the location of the landfill.

The location of Landfill 3 is noticeable as a mound of soil in an otherwise fairly flat area on the Lacamas Creek floodplain. Lacamas Creek flows along the eastern and southern sides of Landfill 3. At its closest point, Lacamas Creek is approximately 20 feet east of the landfill area. The creek banks are nearly vertical with the top of the bank about 4 feet above stream level.

### 2.2.4 Former Burn Area

The Former Burn Area is located immediately north of Landfill 3, to the southeast of the existing sewage lagoon. A pile of wooden debris approximately 20 feet long by 15 feet wide marking the site was removed in June 1997. The area reportedly was used infrequently to burn wood and debris, although there is no record of the length of use or list of materials burned (Woodward-Clyde 1997). This area has apparently not been used for burning material since the mid-1980s. According to the Camp Bonneville Facility Manager, debris had been piled on the site for 3 to 4 years before its removal in June 1997.

### 2.2.5 Buildings 1962 and 1983

Buildings 1962 and 1983 were located near the southeastern corner of the Camp Bonneville cantonment area. The buildings were burned in place, and the burned debris was removed to an unknown location, leaving no visible trace of the footprints of the buildings. Building 1962 was a 9-foot-wide by 12-foot-long storage shed used to store fire hoses, and Building 1983 was a 10-foot-wide by 40-foot-long structure used as a stage and outdoor theater. Both buildings were constructed in the 1930s with wooden frame walls, wooden floors, wooden post/concrete pillar foundations, and rolled composition roofs. Based on their age and type of construction, it is reasonable to suspect that lead-based paint may have been used in the buildings. Lead from the paint could have been released to the soils over the life of the buildings and when they were burned. Asbestos and semivolatile organic compounds may also have been present in the composition roofing materials and other building materials.

### 2.2.6 Grease Pits

Three grease pits were identified at Camp Bonneville: two were located in the Camp Bonneville cantonment north of Building 1828, and one was located in the Camp Killpack cantonment east of Building 4389. Each of the grease pits consists of a gravel-filled excavation with a corrugated metal pipe extending vertically down into the gravel. The grease pits were used for disposal of waste cooking greases and oils from nearby mess halls. Use of the pits reportedly began around 1935. During an interview performed as part of the EBS, the potential for the disposal of unauthorized materials in the pits was suggested.

The two grease pits in the Camp Bonneville cantonment are located north of the mess hall and associated structures. They occupy a flat, elevated area north of the gravel road. The ground surface is covered with grass and slopes steeply down to a ditch and the gravel road, approximately 10 feet south of the grease pits. Several rows of concrete tent pads remain immediately north of the pits. Each of these grease pits consists of a single corrugated metal pipe approximately 18 inches in diameter. The pipes are approximately 1.5 feet apart. There were no lids on these grease pits, and trash was observed in both.

The grease pit at the Camp Killpack cantonment is located approximately 10 feet east of the gravel road that runs north to south, on the east side of the former mess hall building (Building 4389). Small ditches run along both sides of the gravel road. The grease pit is located just inside a heavily wooded area; access is somewhat limited by the trees. The visible portion of the grease pit consists of two corrugated metal pipes, one inside the other. The outer pipe is approximately 16 inches in diameter, and the inner pipe is approximately 10 inches in diameter. The pipes are covered with a metal lid.

### 2.2.7 Former Sewage Pond

The Former Sewage Pond site is located south of the Camp Bonneville cantonment area. The exact location and dimensions of the pond were not documented in the records reviewed for the EBS. According to the former Facility Caretaker, the pond was an unlined lagoon that was pumped out and filled with clean soil derived from a local source when it was abandoned. The pond reportedly was used for sewage disposal until 1978, when the existing sewage lagoon was constructed. The years of pond usage are not known; however, according to the Facility Caretaker, it may have been used for only a short period of time (Woodward-Clyde 1997).

Although there are no records of hazardous materials disposal in the sewage pond and no evidence of contamination has been observed in the area, the potential for contamination could not be discounted given the nature and purpose of the facility. There was also a potential for unexploded ordnance (UXO) at the site because of munitions misfires impacting outside of established range fans, unauthorized munitions disposal, or other activities. The general site area is on the floodplain of Lacamas Creek, and the terrain is low-lying and flat. Water tends to pond in much of this area during the wet season. Lacamas Creek is approximately 200 feet southeast of the site at the closest point.

### 2.2.8 Hazardous Materials Accumulation Point

The Hazardous Materials Accumulation Point (Building 4476) is located in the northeast corner of the Camp Bonneville shop area, in the Camp Killpack cantonment. The building is a three-walled structure, built in 1990, with concrete masonry block walls and a concrete slab floor. The open front of the structure is secured with locking metal gates. The structure, also referred to as the Covered Vehicle Maintenance Storage, has been used for the storage of drums of liquids such as antifreeze and used oil. It may have been used for temporary accumulation of drums of other hazardous materials. The concrete floor of the building is sloped toward a sump in the middle of the floor. The sump measures approximately 2 feet square and is approximately 2 feet deep. No drains are present in the sump. No evidence or reports of spills at this site were found.

The Hazardous Materials Accumulation Point is bounded by a gravel driving surface to the south and east, small storage buildings and equipment to the west, and woods to the north. A vehicle fuel aboveground storage tank (AST), covered and within a concrete containment structure, is immediately west of the building. The chain-link fence that surrounds the shop office area runs along the north and east sides of the building. The site area is fairly flat; drainage from the area likely flows to the ditch running parallel to the main access road, south of the fenced shop area.

### 2.2.9 Drum Disposal Area

An anonymous caller identifying himself as a former Camp Bonneville employee reported the existence of an area of buried drums, south of the Camp Killpack cantonment and east of the gravel road that runs south from the main east-west roadway through the facility. The caller reported that pesticides, paints, and solvents were disposed of at this location. As a result of the call, a program was established to characterize the site from such allegations. The summary of all investigative work is presented in Section 6.

### 2.2.10 Paint and Solvent Disposal Area

The existence of the Paint and Solvent Disposal Area was reported by the same anonymous caller who reported on the Drum Disposal Area. The Paint and Solvent Disposal Area was reported to be south of the Camp Killpack cantonment, in an open area where a tractor shed currently exists. The caller stated that paints, solvents, and pesticides were disposed of in this location. As a result of the call, a program was established to characterize the site from such allegations. The summary of all investigative work is presented in Section 6.

### 2.2.11 Washrack 1

Located immediately west of the shop office (Building 4475) in the Camp Killpack cantonment, Washrack 1 was used to clean vehicles from approximately 1978 to 1994. A wooden two-track vehicle ramp remains at the site. Wastewater from the washing operations was reportedly

discharged directly to ground via overland flow to a nearby ditch. Potential contaminants include vehicle fluids such as gasoline, used oil, lubricants, antifreeze, and solvents used for cleaning.

The site is largely covered with grass, with asphalt pavement present only at the extreme north end. A gravel road is located to the north and west. Building 4475 and a culvert containing a small stream are located east of the site. The washrack slopes downward to the east and south, toward the stream and ditch, respectively. The washrack structure abuts the chain-link fence that surrounds the shop area.

### 2.2.12 Maintenance Pit

The Maintenance Pit is located underneath a concrete slab within the west end of Building 4475 in the Camp Killpack cantonment. It was formerly an area where mechanics repaired and maintained vehicles. Based on this use, it is possible that vehicle fluids such as gasoline, used oil, lubricants, antifreeze, and solvents were released to the ground. The pit was reported to be an unlined excavation, and no documentation exists concerning its depth or how long the pit was used.

Building 4475 and the Maintenance Pit are bounded by Washrack 1 and a small stream to the west, a gravel drive and storage buildings to the north, and a ditch and the main road to the south. A chain-link fence surrounds the entire shop office area, including the washrack, the former Hazardous Materials Accumulation Point, and a number of smaller buildings.

### 2.2.13 Washrack 2

The Washrack 2 site (former maintenance rack site) is located in the Camp Killpack cantonment at the northeast corner of the shop office area, near Building 4476, on the hillside in a small, relatively level clearing. The washrack was used for vehicle cleaning, and a rack for performing vehicle maintenance, including the draining of engine fluids, was present. The rack, reportedly demolished in the 1980s, was originally constructed of two parallel timber ramps with gravel in between them. If vehicles were washed at the site, wash water would have discharged, by uncontrolled overland flow, onto the surrounding area. According to the EBS, the washrack was demolished in the early 1980s and an adjacent underground storage tank (UST) was removed in 1978 (Woodward-Clyde 1997).

### 2.2.14 Pesticide Storage/Mixing Building (Building 1864)

Built in 1955, the Pesticide Storage/Mixing Building (Building 1864), a wood-frame building with a concrete slab-on-grade floor, was originally used as a fire station. Much later (1977 through 1980), it was used as an area where pesticides were stored and mixed. Fifty-five gallon drums of 2,4,5-trichlorophenoxy acetic acid (2,4,5-T); 2,4-dicholorophenoxy acetic acid (2,4-D); and dichloro-diphenyl-trichloroethane (DDT) were reportedly stored here. A sink was used for pesticide mixing and pesticide container and applicator cleaning. This sink was discovered to discharge via a pipe to a dry well containing large drain rock to a depth of 3 feet. More recently, the building has been used as the grounds shop where equipment, vehicles, small gasoline containers, and car batteries are stored.

The building is located approximately 70 feet north of the main access road. The grounds around the building are covered with grass, and the topography slopes downward to the south-southeast. A small south-flowing creek is present approximately 130 feet east of the building.

### 2.2.15 Aboveground Storage Tanks

Of the 26 ASTs currently at Camp Bonneville, 23 are located in the Camp Bonneville cantonment and the remaining 3 in the Camp Killpack cantonment. Each of these ASTs has a 275-gallon capacity and has been used since the 1920s and 1930s to store diesel fuel for heating. In July 1999, ASTs were reportedly still being used at the Camp Killpack shop office, the fire station, and the laundry.

### 2.2.16 Former CS Gas Training Building Site

The former CS Gas Training Building was located south of the Camp Bonneville cantonment, between Lacamas Creek on the north and the 50-caliber firing range (Firing Range 7) on the south. The exact location and dimensions of the building are unknown as is its period of use. This former structure was used to train troops in the use of protective equipment for chemical warfare. The primary substance reported to have been released during training exercises was CS gas (tear gas). CS is the common name for 2-chlorobenzalmalononitrile and is a military or police riot-control agent. It is also often used for training exercises. The dates of use for the building are not documented, but the building is observed in aerial photographs from the years 1950, 1960, and 1970. The building was destroyed by fire in the late 1970s.

### 2.2.17 Pesticide Storage Building (Building 4126)

Building 4126, the Pesticide Storage Building, was located on the edge of a small, flat, grassy field approximately 75 feet south of the gravel road in front of the Camp Killpack cantonment. The building was constructed in approximately 1958 and was composed of a wood frame and wood floor. This building was used to store 55-gallon drums of 2,4,5-T; 2,4-D; and an unknown amount of DDT until 1977 when these materials were moved to Building 1864.

Overall, the ground surface in this area slopes very gently to the south, away from the road. Building 4126 rests directly on the ground surface, without foundational support. It contains a doorway, with the door removed, and two large windows without panes. The walls and roof were moderately weathered but the 2-inch by 12-inch fir boards that compose the floor were sound and showed no signs of rot.

The building was approximately 4 feet west of an approximately 8-foot by 8-foot concrete pad. There is a small grassy area 20 feet to the east and a covered storage area approximately 30 feet to the northeast. A few pieces of wood and sheet metal were scattered on the ground surface.

According to USACE and Camp Bonneville personnel, (Woodward-Clyde 1997), previous uses of the Pesticide Storage Building included towing it to various locations throughout the cantonment. Wooden skids attached to the underside of the floor further suggest this type of use. Vines and bushes growing up against the building walls suggest that the building has not been moved and has been in its current location for a considerable amount of time.

### 2.2.18 Ammunition Storage Magazines (#2953, #2951, #2950)

Ammunition Storage Magazines #2953, #2951, and #2950 are located approximately 2,000 feet northeast of the Pesticide Storage Area on the south side of the road leading into the facility from the Camp Killpack cantonment. They were constructed in 1976 and used to store munitions of various types that were brought to Camp Bonneville for training purposes. They are positioned on a flat, graded terrace approximately 10 feet below the elevation of the road. An

approximately 10-foot-wide by 50-foot-long access road descends from the main gravel road on the west side of the largest magazine (#2953) and ends in front of the bunker entrance on the south side. Overall, the ground surface in this area slopes away from the road and continues to descend toward the south away from the terrace.

The westernmost ammunition storage bunker (#2953) has an interior floor space measuring roughly 10 feet by 10 feet. The entrance to this structure faces southward. The center magazine (#2951) is the smallest, with an interior floor space measuring only about 2 feet by 2 feet, and a door also facing southward. The interior floor space of the easternmost bunker (#2950) measures roughly 4 feet by 4 feet. The entrance to this medium-sized structure faces southeastward. The largest storage bunker is surrounded by a chain-link fence, topped with barbed wire, and has a gate northwest of the bunker. The two smaller bunkers are fenced separately from the larger bunker (with one common fence side). The entrance to the larger fenced area is north of the two structures.

The access road and portions of the area around the bunker are covered with coarse, basaltic gravel. Most of the area, including the access road, is overgrown with Himalayan blackberry vines, Scotch Broom, small red alder trees, and grass.

### 2.2.19 CS Gas Chamber Building (Building 1834)

The CS Gas Chamber Building (Building 1834) is located in the Camp Bonneville cantonment and was used historically to train troops in chemical warfare agents. The wood frame structure is a one-story, post-on-pier converted troops barracks. The chemical warfare training conducted in this building was restricted to CS gas. CS gas is a solid particulate that is typically heated to the vapor phase, introduced into the area to be controlled, where it recondenses into a solid particulate. Chemical warfare training was conducted inside while troops wore chemical warfare protective gear. The CS gas was generated inside by heating a CS capsule with a candle in a metal container. When the training exercise ended, the doors were opened and the CS gas dissipated into the ambient air.

### 2.2.20 Underground Storage Tank (associated with Building 4475)

The underground storage tank was formerly located approximately 10 feet east of Building 4475. This UST was part of a refueling system connecting one 275-gallon diesel AST with the 300-gallon diesel UST. The UST was thought to be leaking because the fuel consumption and tank filling records did not coincide. Additionally, petroleum stains were prevalent on the ground surface around the fueling site. As a result, the 300-gallon diesel UST was removed in 1995. Contaminated soil was discovered during the UST removal. This is discussed in more detail in Section 5.20.

Community participation is being carried out under a Community Relations Plan (CRP) implemented by the Army pursuant to Section 117 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

In 1995, a Restoration Advisory Board (RAB) was established to increase community participation and awareness of the activities being conducted in preparation of property transfer to Clark County. The RAB consists of members of the local community and generally meets monthly to discuss progress of work at Camp Bonneville and any concerns of the RAB members. The RAB meetings are chaired by the BRAC Environmental Coordinator (BEC) and are attended by the other members of the BRAC Cleanup Team (BCT) including representatives from Ecology, EPA Region 10 (acting in an advisory role), and Clark County.

Documents associated with the sites covered by this decision document, including investigation and remediation activities, were made available to the public in the Administrative Record maintained by Fort Lewis. The documents are available at:

- Vancouver Mall Public Library (5001 NE Thurston Way, Suite 185, Vancouver, Washington 98662)
- Clark County Public Works office (500 W. 8th Street, Vancouver, Washington 98666)
- Range Control at Camp Bonneville (23201 NE Pluss Road, Vancouver, Washington 98682)

The availability of these documents was made known to members of the RAB.

This CAP will be made available for public comment by publishing an advertisement in *Columbian* and *Oregonian* newspapers. Copies will be maintained at the same repositories listed above. A 30-day public comment period will be observed after which a public meeting will be held where comments on the CAP will be discussed. The CAP will be presented to a broader community audience than those that have already been involved with Camp Bonneville. At this public meeting, representatives from Fort Lewis, the USACE, Ecology, and EPA will be available to answer questions regarding the No Further Action decision. Responses to the public comments will be made part of the final CAP in a Responsiveness Summary (included as Appendix C to this report).

## 4.1 ENVIRONMENTAL BASELINE SURVEY

Camp Bonneville Military Reservation was selected for closure in 1995 under the BRAC process. An Environmental Baseline Survey (EBS) was prepared in 1997 (Woodward-Clyde 1997) to classify discrete areas of real property associated with Camp Bonneville, subject to transfer or lease into one of seven standard environmental condition of property area types as defined by the Community Environmental Response Facilitation Act (CERFA) guidance and the DOD BRAC Cleanup Plan (BCP) Guidebook.

The BRAC environmental restoration program is similar to the DOD Installation Restoration Program (IRP). However, the BRAC program was expanded to include non-CERCLA substances not normally addressed under the IRP, such as asbestos, lead-based paint, polychlorinated biphenyls (PCBs), radon, UXO, radionuclides, and pesticides. CERFA was enacted in 1992 and amended Section 120 of CERCLA. CERFA directs federal agencies to evaluate all BRAC property to identify contaminated parcels and allows for transfer of or lease of remediated parcels.

Classification was performed by identifying, characterizing, and documenting the presence or likely presence of a release of hazardous substances or petroleum products associated with the historical use of Camp Bonneville. Releases at properties adjacent to Camp Bonneville that could affect the environmental condition of property were also identified, characterized, and documented. Areas containing or suspected of containing non-CERCLA contamination substances (i.e., asbestos, lead-based paint) that might limit or preclude the transfer or lease of the property for unrestricted use were delineated separately as being qualified.

Areas that were designated as Category 1, 2, 3, or 4 are suitable for transfer or lease, subject to the consideration of qualifiers. Areas that were designated as Category 5, 6, or 7 are not suitable for transfer, but may be suitable for lease.

Based on review of installation-related documents, government records, aerial photographs, visual property inspection, and interviews, CERFA categories were identified at the 3,840-acre property. Of the 3,840 acres, approximately 3,826 acres were designated as Categories 1 and 2. The remaining 14 acres were designated as Categories 5 and 7. Additionally, 1.3 acres of the 3,840 acres were designated qualified for asbestos-containing materials and lead-based paint. The entire installation was qualified for UXO and/or ordnance fragments.

## 4.2 SCREENING LEVELS AND CLEANUP STANDARDS

Screening criteria for RAU 1 sites consist of regulatory and risk-based limits for soil and groundwater, as well as background levels established for metals in soils. Sample results are compared with these criteria to determine which constituents may present a concern at each site in Section 5.5.

### 4.2.1 Screening Criteria

The following regulations and guidance provide cleanup-level and risk-based concentrations for chemicals in soil and groundwater.

***Ecology's Model Toxics Control Act (MTCA).*** The MTCA regulations (Chapter 173-340 WAC) set forth cleanup levels for environmental media for sites within Washington state.

Revised regulations became effective in August 2001. The revised MTCA values have been included in the tables in this report.

*MTCA Method A*: MTCA Method A cleanup level values for soil and groundwater are applicable to sites undergoing routine cleanup actions as defined in MTCA and are not site specific. Establishment of actual MTCA Method A cleanup levels requires meeting requirements for use of Method A and consideration of applicable laws, achievable quantitation limits, background concentrations, and other factors in addition to the values listed in the Method A tables.

*MTCA Method B for Protection from Direct Contact*: Method B standard cleanup levels may be used at any site. They are based on protection from human exposure to contaminants via direct contact and are determined through equations using default exposure assumptions (which are the same equations as those used in the original regulation). MTCA Method B risk-based concentrations for soil and groundwater were obtained from the MTCA Cleanup Levels and Risk Calculations (CLARC) 3.1 database (based on a $10^{-6}$ cancer risk or a hazard quotient of 1) (Ecology 2003). These are formula values obtained from the February 1996 CLARC 3.1 Update (Ecology 2003). Establishment of actual MTCA Method B cleanup levels requires considering applicable laws, site-specific information, cross-media impacts, and other factors in addition to formula risk-based calculations. Method B cleanup levels were not calculated for chemicals that are not listed in the CLARC 3.1 database. Method B groundwater cleanup levels were also used in instances where groundwater was encountered during remedial actions.

A summary of the potential contaminants and their respective screening and cleanup levels is shown in Table 4-1.

### 4.2.2 Background Concentrations for Soils

Natural background concentrations of metals in soil were obtained from two sources. Ecology (1994) has reported on background metals concentrations for soil within the state of Washington. However, some of the metals analyzed during the multi-sites investigation were not covered by the Ecology report. In addition, copper was typically detected during the multi-sites investigation at concentrations exceeding the Ecology background concentrations. Therefore, background soil samples were collected at Camp Bonneville and were statistically evaluated to establish concentrations representative of area background (Shannon & Wilson, 1999).

#### *Statewide Background*

Ecology conducted a study to measure the natural background concentrations of metals in soil throughout Washington State. The report, titled *Natural Background Soil Metals Concentrations in Washington State*, provides background data for selected regions, as well as statewide (Ecology 1994). One of the regions investigated was the Clark County area. Soil samples used in the study were collected from the ground surface to a depth of 3 feet bgs.

Under MTCA, natural background soil metals concentrations can be used to establish a cleanup standard for a hazardous substance for which no applicable or relevant and appropriate requirement (ARAR) exists (Chapter 173-340-700(5)(4)(a) WAC). Natural background concentrations can also be used to replace existing Method A or Method B cleanup standards that are below the natural background level or the practical quantitation limit, whichever is highest. Numbers typically used for comparison are the 90$^{th}$ percentile values for the data.

Statewide and Clark County 90th percentile natural background values are shown in Table 4-2. According to the Ecology report, use of the statewide 90th percentile values is unrestricted (i.e., they can be compared with data from anywhere within the state). The regional (for example, Clark County) 90th percentile numbers are to be compared only with data from that region.

The Ecology 90th percentile numbers ideally are compared with the 95 percent upper confidence limit (UCL) of a given data set when comparing site data with background values. However, because of the limited number of data points collected from most of the investigation sites, such statistical comparison is not practical. When comparing individual data points with the 90th percentile values, there is a 10 percent chance that an individual data point from an unaffected site will exceed the 90th percentile value. Therefore, no single sample concentration can be greater than two times the soil cleanup level, and less than 10 percent of the sample concentrations can exceed the soil cleanup level (WAC 173-340-740(7)(e)).

### *Site Background*

Surface and near-surface soil samples were collected to determine background concentrations of metals in soil at Camp Bonneville (Shannon & Wilson, 1999). Ten background locations were sampled. Two soil samples were collected from each location: one from 0 to 1 foot bgs and one from 1 to 2 feet bgs. The sample locations were distributed around the facility, generally near the perimeter on the west, northwest, and southwest sides. An attempt was made to locate relatively undisturbed areas for sampling. Two locations were selected near Lacamas Creek, close to the point were it exits the site to the west. These locations were selected in an attempt to evaluate the chemical composition of floodplain soils. Most of the samples were collected from densely wooded areas. Sample depths were influenced, in some cases, by the presence of roots, very dense clay, gravel, or cobbles.

The metals data were analyzed to establish concentrations representative of area background. Background values were calculated only for metals that tended to exceed both the risk-based or regulatory criteria and the Ecology background values in on-site soils. Background values could not be calculated for antimony or thallium because the majority of the concentrations detected were reported as estimated (detected at a concentration between the method detection limit [MDL] and the method reporting limit [MRL]).

Summary statistics were calculated using concentrations for barium and copper. Before summary statistics were calculated, field duplicates were compared with field samples to determine which samples would be included in the data set, and statistical tests were applied to determine what types of distributions were present. Twenty field samples and two field duplicates were collected. A duplicate was compared with its corresponding field sample, and the lowest concentration was included in the data set. Distributions were tested for normality and lognormality using the Shapiro-Wilk test (SPSS 1997). None of the data set fits a normal distribution. One data set, for barium, fit a lognormal distribution. The distribution for copper was assumed to be nonparametric.

The summary statistic calculated for barium was the 90th percentile of the lognormal distribution (Ecology 1992). This statistic was calculated using the following formula:

$$Y = \exp(X + Z_{90}\,SD)$$

where:

$Y$ = 90th percentile of the lognormal distribution

$X$ = mean of the $\log_e$-transformed data

$Z_{90}$ = value from the normal distribution corresponding to the 90th percentile.

$SD$ = standard deviation of the $\log_e$-transformed data.

The summary statistic used for copper was the 90th percentile calculated using the nonparametric (distribution-free) method (Ecology 1992). This method ranks the data in ascending order and uses the value with the rank corresponding to the desired percentile and given by the following formula:

$$V = p/100\,(n+1)$$

where:

$V$ = rank of the $p^{th}$ percentile data.

$p$ = percentile (i.e., 90).

$n$ = number of samples (i.e., 20).

In cases where V was not an integer, linear extrapolation between two data points was used.

### 4.2.3 Background Concentrations Used for Screening Criteria

Many of the statewide natural background numbers are the same as or similar to the Clark County numbers; however, the statewide background numbers for chromium and mercury are more similar than the Clark County numbers for concentrations detected in background soil samples from Camp Bonneville. As a result, the statewide background numbers were selected for comparison, rather than the Clark County numbers. Camp Bonneville-specific background numbers were calculated only for metals that exceeded the default Ecology background values, or for which no Ecology values were available.

Table 4-2 includes a summary of available background numbers (90th percentile) for metals in soils for statewide, Clark County, and Camp Bonneville-specific samples. The shaded numbers are those selected for use as screening criteria.

## 4.3 PREVIOUS INVESTIGATIONS AND REMEDIATION

This section addresses each of the sites in RAU 1, including a summary of investigation and remediation (where necessary) performed. The no action alternative was not considered for sites within RAU 1 with identified contamination due to the generally limited extent of contamination detected. Excavation of soil was performed to remove identified contaminants and protect human health and the environment. Figures and tables of chemical data generated during investigation and remediation activities of these sites are presented in Appendices A and B. The

list of analytes at each separate site was based on the suspected COPCs. Therefore, the analytes varied from site to site.

### 4.3.1 Landfill 1

UXO avoidance/screening surveys were performed on December 9, 1997, in the general area where Landfill 1 was reportedly located. The precise location of the landfill was unknown. UXO specialists swept a large area generally north and northwest of the existing sewage lagoon, but no evidence of the landfill area was found. On December 12, 1997, a second search of the area was made using three Fisher and Garrett metal locator meters and a Schonstedt flux-gate gradiometer. The area surveyed was covered with dense vegetation, including trees and thick underbrush. No evidence of a landfill was found using the gradiometer or magnetometers. Also, there was no visual evidence of the landfill, either in the way of a depression or of debris at the ground surface.

Attempts to locate Landfill 1 were ended after these efforts. Based on this survey work, it is likely that the term “landfill” may not be appropriate for this site. Rather, it may have been a former homestead area where disposal of household debris (such as old bottle fragments) occurred. No soil or groundwater sampling has been conducted at this site.

### 4.3.2 Landfill 2

UXO avoidance/screening and electromagnetic (EM) surveys were performed in December 1997 in the Landfill 2 area. A large area was initially surveyed and additional areas were surveyed, as needed, as the fieldwork progressed. Two ground-penetrating radar (GPR) surveys were conducted on the site, but because of high natural ground conductivity, uneven terrain, and the presence of ponded water, GPR was not used as the primary geophysical method. Based on the results obtained in the field, the EM survey was extended into the trees on the east side of the suspected landfill area and across to the south of the gravel road.

Metallic debris (including pipes, vehicle parts, and wiring) was detected at and near the land surface during the UXO avoidance survey. No UXO-related debris were observed during the field investigation with the exception of one undetonated 2.76-inch light anti-tank weapon (LAW) round located during early scoping surveys of the Landfill 2 area. The Explosive Ordnance Detachment from Fort Lewis managed disposal of the LAW round.

#### *Soil Gas Survey*

A soil gas survey was performed during December 1997. There were 64 soil gas samples collected in the Landfill 2 area and analyzed for halogenated hydrocarbons (those captured by analytical method 8010) and benzene, toluene, ethylbenzene, and xylenes (BTEX). These data were used as a screening tool to evaluate whether volatile constituents were present in and escaping from the landfill. No target analytes were detected above the reporting limits in any soil gas sample, with the exception of chloroform. Trace concentrations of chloroform were detected in two samples, possibly due to contamination from sampling or analytical procedures. The chloroform is not likely to be associated with volatile organic compounds (VOCs) emanating from the landfill. Laboratory analysis of the soil gas samples was performed by a mobile laboratory. The QA/QC procedures employed can be found in the Shannon & Wilson Multi-Sites Report (Shannon & Wilson 1999).

### *Soil Sampling*

Three soil borings were drilled in July 1998 outside the estimated perimeter of Landfill 2. No sheen or odor was observed and no VOCs were detected by the photoionization detector (PID) during field screening of soil samples from the borings, with one exception. Relatively low PID readings, detected at or below the water table in one boring, were concluded to be related to the high moisture content of the soil samples.

One soil sample was collected from each of the three soil borings in July 1998. The samples were analyzed for total petroleum hydrocarbons (TPH), VOCs, semivolatile organic compounds (SVOCs), PCBs/pesticides, nitroaromatic and nitramine explosives, pentaerythritol tetranitrate (PETN), picric acid (PA), cyanide, total organic carbon (TOC), and priority pollutant metals. No target analytes were detected above the reporting limits with the exception of PETN and Priority Pollutant List (PPL) metals. PETN was detected at an estimated concentration below the reporting limit in one sample. No regulatory cleanup levels are available for PETN in soil.

Antimony, barium, beryllium, cadmium, chromium, copper, lead, nickel, silver, thallium, and zinc were detected in all of the Landfill 2 soil samples, but at concentrations below the regulatory cleanup levels. Selenium and mercury were not detected above the reporting limits. Arsenic and chromium were detected in all soil samples at concentrations exceeding the regulatory cleanup level for soils, but not exceeding background levels. Copper was detected in one upgradient soil boring and zinc was detected in one downgradient soil boring at concentrations that slightly exceeded the background levels.

### *Groundwater Sampling*

Monitoring wells were installed during July 1998 in all three borings drilled outside of the estimated perimeter of Landfill 2. The monitoring wells were installed in locations assumed to be upgradient (one well) and downgradient (two wells) of the landfill, based on area topography and surface drainage. The water table was encountered at depths of 2.6 to 2.9 feet bgs during drilling of two downgradient soil borings. No groundwater was encountered in the upgradient boring during or immediately after installation; however, evidence of a wet season water table (iron staining) was seen at about 3 feet bgs.

One groundwater sample was collected in August 1998 from each of the two downgradient monitoring wells. The upgradient well was dry in August 1998 and had insufficient water for sampling in December 1998. Both samples were analyzed for TPH, VOCs, SVOCs, explosive compounds (including PETN and PA), PCBs/pesticides, cyanide, and total/dissolved priority pollutant metals. With the exception of one VOC and PPL metals, no target analytes were detected above the reporting limits. One VOC, naphthalene, was detected in one groundwater sample at an estimated concentration below the regulatory cleanup levels.

Arsenic, barium, chromium, copper, lead, nickel, selenium, thallium, and zinc all were detected in one or both of the groundwater samples. However, the metals detected were below regulatory cleanup levels.

## 4.3.3 Landfill 3

UXO avoidance/screening and EM surveys were performed in December 1997 in the Landfill 3 area. A considerable amount of metallic debris (including corrugated metal sheets, pipes, drums, and wiring) was detected at and near the land surface; no UXO-related debris was observed. The

landfill area, measuring about 50 feet wide by 70 feet long, was found to generally coincide with the elevated mound of dirt at the site.

### *Soil Gas Survey*

There were 11 soil gas samplers planted on December 16, 1997, and retrieved on December 30, 1997. The samples were collected to screen for halogenated hydrocarbons (those captured by analytical method 8010) and BTEX compounds. Analytical results for the soil gas samples were below the reporting limits for all target analytes in every sample. Laboratory analysis of the soil gas samples was performed by a mobile laboratory. The QA/QC procedures employed can be found in the Shannon & Wilson Multi-Sites Report (Shannon & Wilson 1999).

### *Soil Sampling*

There were five soil borings drilled outside of the estimated perimeter of Landfill 3 during July 1998. The borings were drilled to characterize the shallow subsurface conditions and to evaluate potential pathways for contaminant migration from the landfill. One soil sample was collected for chemical analysis at or immediately above the water table (capillary fringe) in each soil boring. No sheen or odor were detected during field screening of soil samples from the borings. Detectable PID measurements in two samples from one boring might have been related to the high moisture content of the soil samples.

A total of five soil samples were analyzed for TPH, VOCs, SVOCs, PCBs/pesticides, nitroaromatic and nitramine explosives, PETN, PA, cyanide, TOC, and PPL metals. With the exception of PPL metals, no target analyte concentrations in any sample were above the reporting limits. Antimony, barium, beryllium, cadmium, chromium, copper, lead, nickel, selenium, silver, thallium, and zinc were detected in some or all of the samples, but at concentrations below regulatory cleanup levels. Mercury was not detected. Arsenic and chromium were detected at a concentration exceeding the regulatory cleanup level, but not exceeding background levels.

### *Groundwater Sampling*

Four monitoring wells were installed during July 1998 in locations assumed to be upgradient (one well) and downgradient (three wells) of the Landfill 3. The assumed gradient was inferred from topography and the proximity to Lacamas Creek. One groundwater sample was collected from each well in August 1998. All samples were analyzed for TPH, VOCs, SVOCs, nitroaromatic and nitramine explosives, PETN, PA, PCBs/pesticides, cyanide, and total/dissolved PPL metals. Methylene chloride, a common laboratory contaminant, was detected in the method blank for this analysis. Naphthalene was detected in one sample at an estimated concentration below the regulatory cleanup levels.

Beryllium, cadmium, silver, and mercury were undetected. Antimony, arsenic, barium, chromium, copper, lead, nickel, selenium, thallium, and zinc were detected in some or all of the groundwater samples. These metals were detected at concentrations below regulatory cleanup levels.

### 4.3.4 Former Burn Area

Surface debris was removed at the Former Burn Area prior to initiation of the field investigation in December 1997, leaving the area accessible for soil sampling. A UXO avoidance/screening

survey was performed across the area during the debris removal. PID readings were less than 1 part per million (ppm) for all samples.

Surface and near-surface soil samples were collected from five locations in and adjacent to the Former Burn Area in December 1997. The samples were collected to evaluate the potential for contamination resulting from past disposal and burning activities. There were three sampling locations within the Former Burn Area; the other two locations were upslope and downslope of the area. Two samples were collected from each location to assess the vertical extent of contamination: one from the 0- to 1-foot bgs interval, and one from the 1- to 2-foot bgs interval. The upslope sample location filled with water at a depth of about 1.2 feet bgs, and the deeper of the two samples from this location was saturated.

Each of the samples was analyzed for TPH, VOCs, SVOCs, PCBs/pesticides, nitroaromatic and nitramine explosives, PETN, PA, and PPL metals. With the exception of VOCs and PPL metals, target analytes were not detected above the reporting limits in any of the samples. VOCs were detected (all at estimated concentrations) in three of the samples at concentrations below regulatory cleanup levels. The VOCs included xylenes, toluene, and acetone.

Antimony, beryllium, cadmium, copper, lead, nickel, selenium, silver, zinc, and mercury were detected at concentrations below regulatory cleanup levels in the samples. Arsenic and chromium were detected in all samples at concentrations exceeding the regulatory cleanup levels. However, none of these concentrations exceeded the background levels. Thallium and zinc were detected above background levels but not above MTCA levels.

### 4.3.5 Burned Buildings 1962 and 1983

A magnetometer was used in an attempt to locate the footprints of former Buildings 1962 and 1983. The area where Buildings 1962 and 1983 were located is a grassy field with no obvious evidence of the former buildings. Using available maps, the UXO specialists conducted a magnetometer survey of the area and were able to identify evidence of what may be the former building areas. This evidence included nails and pieces of wood in areas that corresponded to the mapped locations of the former buildings. PID measurements for all surface samples were less than 1 ppm.

There were 15 surface soil samples collected in February 1998. The soil samples were collected to determine whether soil contamination resulted from the building use or destruction. A total of 10 samples was collected from five locations within the suspected footprints of the former buildings at a depth of 0 to 2 feet bgs. The other five samples were collected from locations within 50 feet of the suspected footprint of the former buildings at a depth of 0 to 1 foot bgs. Each sample was analyzed for SVOCs, asbestos, and lead. SVOCs and asbestos were not detected in any of the samples at concentrations above the reporting limits. Lead was detected in all 15 samples; however, none of the concentrations detected exceed the regulatory cleanup levels for lead.

### 4.3.6 Grease Pits

The site inspection at the Camp Bonneville Grease Pits occurred in July 1998. Debris (trash, including paper and food cans) was present on the surface of the drain rock inside the grease pit pipes. An attempt was made to drill down through center of the grease pit; however, the presence of large rocks (up to about 1 foot in diameter) prevented penetration. Several attempts were made to drill through the drain rock. Ultimately, it was necessary to drill adjacent to the

rock-filled area. PID measurements for all sample locations were less than 1 ppm, and no sheen, staining, or odor was noted during drilling and sampling. Groundwater was not encountered in the subsurface soils. However, occasional wet seams were present between 5 and 10 feet deep, and iron staining (indicative of wet season water levels) was observed below about 3.5 feet bgs.

Two soil borings were drilled (using a hollow-stem auger) and logged adjacent to the rock-filled drain area surrounding the corrugated metal pipes in the Camp Bonneville Grease Pit area. One soil sample was collected from each boring for chemical analysis; however, the samples were improperly handled by the shipping company and were discarded. On August 4, 1998, a soil boring was advanced immediately adjacent to one of the previous boring locations. The samples were collected from the 3- to 5-foot and 5- to 7-foot bgs intervals. The deeper sample was assumed to be deeper than the pit containing the drain rock based on the length of the removed corrugated pipe (approximately four feet long).

Access to the Camp Killpack Grease Pit area was blocked by a ditch and nearby trees. In August 1998, a soil boring was drilled and sampled adjacent to the Camp Killpack Grease Pit. No staining, odors, sheen, or PID readings above 0 ppm were noted during drilling and sampling. No groundwater was encountered. Two soil samples were collected starting at the assumed depth of the bottom of the pit drain rock, based on the construction of a similar pit at the Camp Bonneville cantonment. The samples were collected from the 3- to 5-foot and 5- to 7-foot intervals.

The four soil samples collected from the two grease pits were analyzed for TPH, SVOCs, PCBs/pesticides, VOCs, and PPL metals. VOCs and PCBs were not detected above the reporting limits in any sample. TPH was detected in one sample at the Camp Killpack grease pit; however, the laboratory noted that the chromatographic profile was not consistent with the reference fuel standards. One sample collected at each grease pit area contained diethyl phthalate at concentrations below regulatory cleanup levels. Diethyl phthalate is a common laboratory contaminant. One sample collected at the Camp Bonneville grease pit contained the pesticide gamma-BHC (lindane) at a concentration above the regulatory cleanup levels. However, it is unlikely that the grease pits are a source of lindane as they were used for disposal of cooking grease from nearby mess halls and have not been historically linked to pesticide storage, use, or disposal.

Antimony, beryllium, cadmium, lead, nickel, selenium, silver, and zinc were detected in most or all of the samples, but at concentrations below the regulatory cleanup levels. Arsenic and chromium were detected at concentrations exceeding the regulatory cleanup levels. However, arsenic concentrations were less than background values in all but the sample (that sample was 7.5 mg/kg versus 7.0 mg/kg for background) and chromium concentrations were less than background for all soil samples.

There was one sample collected at the Camp Bonneville Grease Pit area that contained copper at a concentration exceeding the background level, but was less than the regulatory cleanup level. One sample at the Camp Killpack Grease Pit area contained arsenic at a concentration that slightly exceeded the background level (7.9 mg/kg vs. 7 mg/kg) and the MTCA Method B cleanup level. One sample from the Camp Killpack Grease Pit area contained thallium and at lead concentrations above the background levels, but less than the regulatory cleanup level. Both samples from the Camp Bonneville Grease Pit area contained barium at concentrations that exceeded the background concentration, but were less than regulatory cleanup levels.

### 4.3.7 Former Sewage Pond

UXO avoidance/screening and EM surveys were performed in the Former Sewage Pond area in July 1998. A large area (including access to the site) was initially surveyed and additional areas were added, as needed, as the fieldwork progressed. GPR equipment was not used because of the suspected high natural ground conductivity and uneven terrain at the site. A roughly circular area of magnetic anomalies was detected, and several fence posts were identified in this area of anomalies, lying horizontally, just under the ground surface. The pattern of anomalies also coincided with a slight elevation rise near the center of the old parade grounds. Efforts were concentrated in this slightly mounded area.

Soil borings were drilled at five locations in the Former Sewage Pond area in July 1998. The borings were drilled to characterize subsurface conditions and to collect samples for chemical analyses. Three borings were drilled into volcanic rock within the estimated former pond area. The two other soil borings were drilled to collect soil samples for chemical analysis and for the installation of monitoring wells. The wells were installed in locations assumed to be upgradient and downgradient of the Former Sewage Pond, based on site topography and the proximity to Lacamas Creek.

Three samples were collected from each boring. The uppermost sample was collected from the apparent pond bottom (approximately 4 to 5 feet bgs) depth or the approximate water table interface, whichever came first. There were two additional samples collected at each location at greater depths. No sheen, odor, or elevated PID readings were observed during field screening of soil samples from the borings.

The 15 soil samples were analyzed for TPH, SVOCs, VOCs, PCBs/pesticides, and PPL metals. No TPH, SVOCs, PCBs, or pesticides were detected in the Former Sewage Pond samples. Two VOCs (acetone and carbon disulfide) were detected at concentrations below the regulatory cleanup levels. Both are common laboratory contaminants.

Antimony, beryllium, cadmium, copper, lead, nickel, silver, thallium, and zinc were detected in all soil samples at concentrations below regulatory cleanup levels. Mercury was detected in two samples at concentrations below regulatory cleanup levels; and selenium was detected in one sample at a concentration below the regulatory cleanup level. Arsenic and chromium were detected at concentrations above the regulatory cleanup levels. All chromium concentrations were below background values. Arsenic was detected in all samples, but only one sample contained arsenic a concentration above the cleanup levels and background, although the concentration was close to the background value (7.2 mg/kg vs. 7.0 mg/kg).

Groundwater was encountered in most of the Former Sewage Pond borings at approximately 4 to 5.5 feet bgs. The silt below this depth was moist, with scattered wet zones at some locations. The sand/gravel unit was saturated, and the underlying rock was moist. Groundwater levels were measured twice in the wells in August 1998. These groundwater levels were similar to those measured during drilling. No sheen, odor, or PID readings above 1 ppm were noted in groundwater during well development or sampling.

One groundwater sample collected from each of the two monitoring wells at the Former Sewage Pond site was analyzed for TPH, VOCs, SVOCs, PPL metals (total and dissolved), and water quality parameters.

No TPH, VOCs, or SVOCs were detected in any of the groundwater samples. Both total and dissolved arsenic were detected in the upgradient well sample at concentrations below regulatory cleanup levels. Arsenic was not detected in the downgradient well. Barium, chromium, copper, nickel, selenium, and zinc were detected in both monitoring wells at concentrations below regulatory cleanup levels. Lead was detected in the upgradient well at concentrations below the regulatory cleanup levels.

Water quality results were similar in both the upgradient and downgradient wells. Alkalinity was detected at 112 milligrams per liter (mg/L) in the downgradient well and 94.3 mg/L in the upgradient well. Cyanide, nitrates, and orthophosphates were not detected in either well.

### 4.3.8 Hazardous Materials Accumulation Point

One surface soil sample (approximately 0 to 6 inches bgs) was collected in February 1998 from each of two locations directly in front of the Hazardous Materials Accumulation Point building. The samples were collected to evaluate possible soil contamination resulting from building use. PID results were 13.2 ppm and 23 ppm. No odor or staining was observed in the samples.

The soil samples were analyzed for TPH, SVOCs, PCBs/pesticides, and PPL metals. Pesticides and PCBs were not detected above the reporting limits for the samples. Two samples contained TPH (identified as unknown hydrocarbons and quantitated in the diesel range) at concentrations below regulatory cleanup levels. One SVOC, bis-(2-ethylhexyl)phthalate, was detected in the duplicate sample at a concentration below the regulatory cleanup levels. Phthalates are common laboratory and field sampling contaminants.

Metals detected in the soil samples included antimony, barium, beryllium, cadmium, chromium, copper, lead, nickel, silver, and zinc, all at concentrations below regulatory cleanup levels. Arsenic was detected at a concentration exceeding the regulatory cleanup level but below the background level.

A sample of the liquid and sludge in the sump was collected for analysis (TPH, SVOCs, VOCs, PCBs/pesticides, and metals) to determine the appropriate means of disposal. Unknown hydrocarbons were detected at an estimated concentration of 51 mg/L. A review of the chromatogram for this sample indicated that the substance appeared to be a weathered oil-based product or weathered diesel-oil mixture. Bis(2-ethylhexyl) phthalate, the only other organic analyte detected, was initially measured at a concentration of 52 mg/L, and upon reextraction and reanalysis, was reported at 10 mg/L. Arsenic, lead, and thallium were detected at concentrations above the groundwater screening criteria. The contents of the sump were pumped into a 55-gallon drum, after which the sump was visually inspected for any evidence of cracks or outlets where leaking or discharges from the sump could occur. The concrete was observed to be in good condition, with no pipes or outlets evident. The contents of the drum were disposed of as non-Resource Conservation and Recovery Act waste (RCRA).

### 4.3.9 Drum Disposal Area

An EM study was conducted in 1998 at the Drum Disposal Area to delineate the extent of the buried drums and potential soil and/or groundwater contamination. Following the EM study, two borings were advanced immediately north and south of the disposal area. One sample was collected from each boring at 4 to 5 feet bgs, approximately 1 foot below the estimated depth of the buried drums. The contents of the buried drums were unknown; therefore, the samples were analyzed for a wide range of analytes. No SVOCs, PCBs/pesticides, or explosive compounds

were detected in either of the samples and no evidence of the presence of explosives was found. The samples contained unidentified hydrocarbons at concentrations below the MTCA Method A regulatory cleanup level of 2,000 milligrams per kilogram (mg/kg) for TPH in the diesel range (TPH-DRO). One sample contained several VOC constituents at concentrations below regulatory cleanup levels. Although several metals exceeded regulatory cleanup levels in one or more samples, the metals did not exceed their respective background concentrations. In addition, several metals exceeded background values but were less than regulatory cleanup levels.

Excavation activities at the Drum Disposal Area were conducted in June 2000 to remove surface and subsurface debris, excavate soil, conduct confirmation sampling, and perform site restoration (Garry Struthers Associates, Inc. 2002). While excavating the metal debris, a solvent-like odor was noted and fieldwork was discontinued. To evaluate the extent of potential contamination, 26 test pits were excavated south and east of the Drum Disposal Area. Two soil samples were collected from the test pit that recorded the highest PID concentrations (Test Pit 25). Laboratory analyses of these soil samples indicated that toluene, arsenic, barium, chromium, and methoxychlor exceeded cleanup levels. Rainwater flowed into the excavation of Test Pit 25 from the surrounding area during excavation activities. Samples collected from Test Pit 25 rainwater contained naphthalene, ethylbenzene, toluene, and lead above cleanup levels. A second EM survey, in October 2000, was conducted to identify additional areas that might have contained buried drums or other debris capable of contributing to soil and/or groundwater contamination. There were 13 anomalies identified and investigated by trenching with a backhoe. One of the excavations (Area G) contained construction debris, paint cans and paint, a sink, wall lockers, and corrugated metal. The remaining 12 excavations contained scrap metal, reinforcement bar, barbed wire, and firing point survey markers.

Approximately 110 tons of soil, metallic debris, and non-metallic debris (including scrap metal, piping, paint cans and construction debris) were removed from Area G. After excavation of the debris and soil, four confirmation samples were collected. Laboratory data indicated that the analytes of concern (TPH, metals, VOCs, SVOCs, PCBs, PAHs, and pesticides) were either not detected or below regulatory cleanup levels. In addition, groundwater was not present during confirmation soil sampling. Soil removed from the Drum Disposal Area was designated as hazardous waste because of lead concentrations and disposed of at the Chemical Waste Management (CWM) facility in Arlington, Oregon. Metal debris removed from the site was designated as non-hazardous and disposed of at the CWM facility in Hillsboro, Oregon.

### 4.3.10 Paint and Solvent Disposal Area

An EM survey was conducted in July 1998 at the Paint and Solvent Disposal Area to delineate the extent of the buried drums and metal debris. Based on the findings of the EM survey, two soil borings were advanced adjacent to each of two identified disposal areas for a total of four borings. Two subsurface soil samples were collected from each boring, at a depth estimated to be below the base of the debris. Because debris was only located below the ground surface and surface soil contamination was not suspected surface soil samples were not collected. Data from the analyses of these samples indicated that VOCs, SVOCs, PCBs/pesticides, and explosive compounds were not detected above the laboratory reporting limits. Unidentified hydrocarbons, resembling weathered diesel or possibly a diesel-oil mixture, were detected at concentrations below the MTCA Method A cleanup levels of 2,000 mg/kg for TPH-DRO and 4,000 mg/kg for motor oil. Metals were detected in the samples at levels below the regulatory cleanup levels with

the exception of arsenic and chromium. However, these two metals were detected below background levels.

Cleanup activity in the area was conducted in June 2000 and consisted of removing debris from the site, including an empty paint can, paint chips, pipes, and wiring discovered in the near surface soil (Garry Struthers Associates, Inc. 2001b). The paint chips were determined to be hazardous and were added to a compatible waste stream from Vancouver Barracks for disposal at the CWM facility in Arlington, Oregon. The remaining debris removed from the Paint and Solvent Disposal Area was designed as non-hazardous and disposed of at the CWM facility in Hillsboro, Oregon. Confirmation soil sampling was not conducted because data collected prior to excavation did not indicate the presence of target analytes exceeding cleanup levels or background levels (metals).

### 4.3.11 Washrack 1 Area

Two surface soil samples were collected in February 1998 to evaluate potential contamination from the Washrack 1 area. Three subsurface samples were collected in July 1998 from one soil boring drilled to a depth of 11.5 feet bgs. All samples were analyzed for TPH, SVOC, and PPL metals. In addition, the surface soil samples were analyzed for pesticides/PCBs and the subsurface samples were analyzed for VOCs. TPH, reported as unidentified hydrocarbons (quantitated as TPH-DRO), was detected in four of the five samples. One of the surface soil samples contained TPH, identified as a weathered oil-based product or a weathered diesel-oil mixture, at a concentration just above the MTCA Method A cleanup level of 2,000 mg/kg. In addition, lead was detected in one surface sample at concentrations that exceeded the background and regulatory cleanup levels. Arsenic and chromium were detected in all samples at concentrations above the MTCA cleanup levels but below background levels. No other organic compounds were detected above regulatory cleanup levels and no other metals were detected above both cleanup levels and background levels.

Cleanup activities at the Washrack 1 Area in June 2000 included dismantling of the washrack timbers and soil excavation to a depth of 3.5 feet bgs over the footprint of the building (Garry Struthers Associates, Inc. 2001b). Confirmation testing for TPH-DRO, heavy oil-range TPH, cadmium, and lead indicated that additional excavation was required due to the continued presence of hydrocarbons and lead above regulatory cleanup levels. An additional 3 feet of soil were removed from the faces of the sidewalls and subsequent confirmation soil sampling indicated lead and hydrocarbon concentrations below cleanup levels. Wood debris generated during dismantling of the washrack was managed as special waste in accordance with WAC 173-303 and disposed of at the CWM facility in Hillsboro, Oregon. Excavated soil was characterized as non-regulated waste and was also disposed of at the Hillsboro, Oregon, facility.

### 4.3.12 Maintenance Pit

A total of six soil samples was collected from two soil borings at the Maintenance Pit from July through November 1998. Unidentified hydrocarbons, VOCs, SVOCs, and chlorinated pesticides were detected in the samples at concentrations below cleanup levels. No PCBs were detected in any of the soil samples. Most of the priority pollutant metals were detected below their respective background levels. Arsenic, chromium, and lead were detected above cleanup levels but below background levels with the exception of lead, which was detected in one sample at a concentration above both the regulatory cleanup level and the background level.

Cleanup activities in June 2000 included soil excavation to a depth of 0.8 foot bgs along the northern border of the Maintenance Pit Building (Garry Struthers Associates, Inc. 2001b). Two confirmation soil samples were collected. The samples were analyzed for TPH-DRO, heavy oil-range TPH, vinyl chloride, PCBs, 4, 4'-dichlorodiphenyldichloroethane (4,4'-DDD), 4,4'-dichlorodiphenyldichloroethylene (4,4'-DDE), 4,4'-DDT, and lead. The resulting data indicated that additional excavation was required due to the presence of TPH-DRO, heavy oil-range TPH, and lead in concentrations that exceeded cleanup levels. Additional soil removal was performed that increased the area and depth of the excavation to 2.7 feet bgs. Subsequent confirmation soil sampling indicated that concentrations of target analytes were below cleanup levels. Soil removed from the Maintenance Pit was characterized as non-regulated waste and disposed of at the CWM facility in Hillsboro, Oregon.

Although data have not been obtained beneath the building, contaminants are suspected of being present in soils beneath the building since the Maintenance Pit is now located beneath an existing structure. Potential contaminants may include petroleum hydrocarbons, VOCs, SVOCs, and metals; however, the concentration of these potential contaminants is unknown. Reuse plans currently include use of this building. Institutional controls, such as deed restrictions, will be prepared for the property transfer to account for the potential for a change in the reuse plan that would not include use of the building. Additional details regarding the institutional controls will be presented in the Institutional Control Plan to be prepared by Fort Lewis for all of Camp Bonneville for the property transfer.

### 4.3.13 Washrack 2 Area

Two surface (0 to 6 inches bgs) and two near-surface (2 to 3 feet bgs) soil samples were collected for analysis from each of two locations in the Washrack 2 area. The samples were analyzed for TPH, SVOCs, and priority pollutant metals. Unidentified hydrocarbons were detected at an estimated concentration below MTCA Method A cleanup levels in all four samples. No target analytes were detected at concentrations above both cleanup levels and background levels (for metals); therefore, remediation activities were unnecessary.

### 4.3.14 Pesticide Storage/Mixing Building (Building 1864)

Prior to cleanup activities at the Pesticide Storage/Mixing Building, samples were collected to evaluate possible pesticide spillage in front of the building. Surface soil samples were collected from two locations (0 to 6 inches bgs); subsurface soil samples were collected at three intervals in each of three soil borings; and two groundwater samples were collected at monitoring wells installed at assumed upgradient and downgradient locations based on topography.

Surface soil, subsurface soil and groundwater samples were analyzed for TPH, VOCs (on subsurface samples), SVOCs, chlorinated pesticides, PCBs, organophosphorus pesticides, chlorinated herbicides, and PPL metals. Unidentified hydrocarbons, possibly a weathered diesel or diesel-oil mixture, were detected at concentrations below cleanup levels in both surface soil and subsurface soil samples. With the exception of a few metals, target analytes were either not detected in the samples or were detected at concentrations below cleanup levels. However, cadmium, chromium (subsurface only), and lead (surface only) were detected in the surface and soil boring samples above one or more of the regulatory cleanup levels. Cadmium and lead also exceeded background levels in the surface soil samples but only cadmium exceeded both the

cleanup and background levels in the subsurface samples. Groundwater samples collected from two wells at the site contained no target analytes at concentrations exceeding cleanup levels.

Cleanup activities at the Pesticide Storage/Mixing Building began in June 2000 and included soil excavation to 2.5 feet bgs followed by collection of five confirmation soil samples (Garry Struthers Associates, Inc. 2001b). The confirmation samples were analyzed for lead, arsenic, cadmium, hexachlorobenzene, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, 2,4-D, and 2,4-T. The analytical data from the confirmation samples indicated that additional excavation was required due to the continued presence of elevated lead concentrations. Additional excavation was performed in August 2000. Following the additional excavation, confirmation soil samples indicated that concentrations of all target analytes were below cleanup levels. Soil removed from the Pesticide Storage/Mixing Building area was characterized as non-regulated waste and disposed of at the CWM facility in Hillsboro, Oregon.

### 4.3.15 Aboveground Storage Tanks

Each of the 26 ASTs was inspected for evidence of leaks or spills. Stained soil, odors and/or elevated PID measurements were observed in the near-surface soil beneath eight ASTs. Review of available information did not suggest a history of leaks or spills and the visual and olfactory evidence at the AST sites suggested near-surface localized soil impacts only. In March 1998, soil samples were collected from these eight AST locations at a maximum depth of 6 inches bgs. Laboratory analyses detected TPH in seven of the samples at concentrations above the MTCA Method A cleanup level of 2,000 mg/kg. Diesel No. 2 fuel was identified in four samples. The unidentified hydrocarbons detected in three samples appeared to be weathered to highly weathered diesel.

Cleanup at the AST sites consisted of soil excavation in the eight AST locations identified in 1998, collection of confirmation soil samples, and site restoration (Garry Struthers Associates, Inc. 2001b). Initially, soil was excavated to depths ranging from approximately 2 feet bgs to 5 feet bgs, and one composite confirmation soil sample was collected from the base and sidewalls of each excavation. Laboratory analyses detected elevated concentrations of hydrocarbons in three of the eight samples.

Additional excavation and confirmation sampling were conducted at the two locations where target analytes exceeded cleanup levels. Hydrocarbons were not present above the MTCA cleanup levels in confirmation samples collected following the additional excavations.

No additional excavation occurred at one location (Building T-1932) because further soil removal would likely have undermined the adjacent building. One soil sample contained 2,690 mg/kg adjacent to Building T-1932. Although it is unlikely that this level of hydrocarbon contamination would underlie the entire building, extending this concentration over the footprint of the building, and assuming a depth of 6 inches, a maximum of approximately 33 cubic yards of petroleum-contaminated soil may exist beneath Building T-1932. Ecology concurred that leaving petroleum in place beneath Building T-1932 was acceptable. In addition, institutional controls, such as deed restrictions, will be prepared for the property transfer. Additional details regarding the institutional controls will be presented in the Institutional Control Plan to be prepared by Fort Lewis for all of Camp Bonneville for the property transfer.

All soil removed from the AST locations was characterized as non-regulated waste and disposed of at the CWM facility in Hillsboro, Oregon.

### 4.3.16 CS Gas Training Building Site

One surface soil sample and one subsurface soil sample were collected from each of five borings at the CS Gas Training Building Site. The samples were analyzed for CS gas and cyanide. In addition, four surface soil samples and one subsurface soil sample were analyzed for SVOCs and lead. CS gas and cyanide were not detected in any of the surface or subsurface samples. SVOCs were detected in four of the five soil samples, although the detected SVOCs were below regulatory cleanup levels. Lead was detected at concentrations exceeding the MTCA Method A cleanup level and the background level in two samples.

Cleanup activities at the CS Gas Training Building began in June 2000 and included soil excavation to a depth of one foot bgs, confirmation sampling, and site restoration (Garry Struthers Associates, Inc. 2001b). After completing the initial excavation, five confirmation samples were collected and analyzed for lead and benzo(a)fluoranthene. Prior to receiving analytical data from the laboratory, the excavation was extended to two feet bgs and two additional confirmation samples were collected. Lead was detected in both the first and second sets of confirmation samples at concentrations above the MTCA cleanup level; benzo(a)fluoranthene was undetected in the samples. The excavation was extended to 3 feet bgs and one additional sample was collected. The concentration of lead in the confirmation sample was below the MTCA cleanup level. All soil removed at the CS Gas Training Building site was characterized as non-regulated waste and disposed of at the CWM facility in Hillsboro, Oregon.

### 4.3.17 Pesticide Storage Building (Building 4126)

A supplemental site investigation (SSI) was conducted at the former Pesticide Storage Building (Building 4126) in June 2000. Two soil samples and one flooring material sample were collected and analyzed for chlorinated pesticides and herbicides, PCBs, priority pollutant metals (plus barium), TPH in the gasoline range (TPH-GRO), and TPH-DRO.

4,4-DDT; 4,4-DDD; 4,4-DDE; beta-1,2,3,4,5,6-hexachlorocyclohexane (beta-BHC); lindane; 2,4-D; 2,4-DB;, 2,4,5-T; and (2-methyl-4-chlorophenoxy)2-proprionic acid (MCPP) were detected in some or all of the samples at concentrations below the regulatory cleanup levels. PCBs were not detected at concentrations exceeding the laboratory reporting limits in any of the samples. TPH-GRO was not detected in the soil samples. TPH-DRO and motor oil-range hydrocarbons were detected at concentrations below the MTCA Method A cleanup levels in the soil samples and above MTCA Method A in the flooring material sample. Arsenic and chromium were detected above cleanup levels but below background levels. Lead was detected in the surface soil samples at concentrations that exceeded the MTCA Method A cleanup level and the background level. Other metals detected in the surface soil samples were below their respective cleanup levels.

Based on the results of the soil and floor samples, site cleanup begun in May 2001 and included dismantling the building, collecting confirmation soil samples, and restoring the site (Garry Struthers Associates, Inc. 2001a and 2001c). The building was dismantled and samples of the building material were analyzed to enable proper waste disposal. In addition, soil was excavated over the footprint of the building to a depth of 1 foot bgs. Five confirmation samples were analyzed for TPH-DRO; antimony; lead; 2,4,5-T; 4,4'-DDT; and MCPP. Antimony and MCPP were undetected in the samples. TPH-DRO; lead; 2,4,5-T; and 4,4'-DDT were detected in some or all of the samples at concentrations less than the MTCA cleanup levels. Based on the results

of the confirmation sampling, it was concluded that additional soil excavation was unnecessary. Soil removed from the Pesticide Storage Building was managed as Discarded Chemical Products (U060, U061) and disposed of at the CWM facility in Arlington, Oregon. Wood from the dismantled Pesticide Storage Building was managed as Listed Waste (D008) and also disposed of at the CWM facility in Arlington, Oregon.

### 4.3.18 Ammunition Storage Magazines

Surface soil, subsurface soil, and wipe samples were collected during March and August 1998 at three ammunition storage magazines (#2953, #2951, #2950) to evaluate possible contamination caused by activities occurring in the area.

Nine sampling locations were selected in front of the largest magazine, and three samples were collected in front of each of the smaller magazines. Surface soil samples were collected at these locations from a depth of 0 to 6 inches bgs. Wipe samples were collected from the concrete floors of the three magazines and a sample of the soil from each magazine was collected for analysis. In August 1998, one soil boring was drilled and sampled in the location that had the highest metals concentrations detected in the surface soil at the site. Two subsurface soil samples were collected from the boring at depths of 2.5 and 6 feet bgs. No odor, staining, or elevated PID measurements were identified during surface soil sampling or borehole drilling. Groundwater was not encountered in the boring.

In June 2000, URS performed an SSI at Ammunition Storage Bunker #2953, the largest of the three bunkers. The purpose of the SSI was to evaluate potential surface soil contamination associated with black powder that had been recently removed from the building.

Three discrete grab soil samples and one subsurface soil sample were collected. The sample locations were along the short footpath leading away from the door. The subsurface sample was composited from two standard penetration test (SPT) samplers driven between 4 and 7 feet bgs. Groundwater was not encountered during drilling. Soil collected in the split spoon sampler was dry to moist. Visual or olfactory evidence of contamination was not observed in the soil samples collected. Results of PID screening also indicated an absence of volatile organic compounds.

#### *Results of 1998 Site Investigation*

A total of 17 surface soil samples, 2 subsurface soil samples, 2 soil samples from inside the magazines, and 4 wipe samples was analyzed for PPL metals, nitroaromatic and nitramine explosives, PETN, and PA. Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) and all PPL metals (except selenium and thallium) were detected in the wipe samples. These same constituents were detected in soil samples collected from the floors of the magazines. Arsenic, beryllium, and cadmium were detected at concentrations that exceeded MTCA cleanup levels and/or background levels. Chromium, lead, and mercury concentrations in the magazine soil samples exceeded the MTCA cleanup levels. Explosives compounds were not detected above the reporting limits in the floor soil and wipe samples, with the exception of RDX, which was detected in both samples collected from the mid-sized magazine (#2950). PETN was detected in one magazine soil sample; however, no cleanup levels are available for PETN.

No organic compounds were detected above reporting limits in the surface soil samples collected outside of the bunkers. All PPL metals were detected with the exception of selenium. Arsenic, cadmium, chromium, and lead were detected at concentrations exceeding both background and MTCA cleanup levels.

### *Results of 2001 SSI*

Surface and subsurface soil samples from Ammunition Storage Bunker #2953 were analyzed for priority pollutant list metals, plus barium, SVOCs, ordnance compounds, and picric acid. In addition to the above analyses, the subsurface soil sample was analyzed for TPH.

The subsurface soil sample did not contain detectable concentrations of gasoline-range, diesel-range, or motor-oil range petroleum hydrocarbons. One SVOC, bis(2-ethylhexyl)phthalate, was detected in one sample at a concentration below cleanup levels. PETN and PA were detected in one surface soil sample and 2,4-dinitrotoluene was detected in all three surface soil samples at concentrations less than MTCA cleanup levels. No ordnance compounds or propellants were detected in the subsurface soil sample.

Analyses for 13 PPL metals plus barium were conducted for all three surface samples and the subsurface sample collected from the soil boring. All PPL metals except mercury, thallium and selenium were detected above the reporting limits in one or more of the surface soil samples. Arsenic and chromium exceeded the MTCA cleanup levels but not background levels. The lead concentration in one soil sample exceeded background and the MTCA cleanup level.

### *Cleanup Activities at the Ammunition Storage Magazines (#2953, #2951, and #2950)*

Based on the results of the soil sampling, cleanup at the three Ammunition Storage Magazines was performed in May 2001 (Garry Struthers Associates, Inc. 2001c). Cleanup activities consisted of excavating soil, performing confirmation sampling, disinfecting the magazines, and conducting site restoration. Disinfection was performed for worker safety to prevent potential exposure to hanta virus.

Soil was excavated to a depth of one foot bgs at all three ammunition storage magazines. One confirmation soil sample was collected from the floor and one sample was collected from each of the four walls in all three excavations. All of the samples were submitted for metals analyses. In addition, the samples collected from magazine #2953 were submitted for 2,4-dinitrotoluene, PETN, and PA analyses and samples collected from magazine #2950 were submitted for RDX analysis.

Several metals were detected in the soil samples collected from the excavations at all of the magazines, although the concentrations were either less than background values and/or cleanup levels. In addition, 2,4-dinitrotoluene, PETN, and PA were not detected above the reporting limits in the soil samples associated with the excavation of magazine #2953, and RDX was not detected in the soil samples associated with the excavation of magazine #2950. Based on the results of the confirmation samples, it was concluded that additional soil excavation was unnecessary.

Following receipt of the confirmation sampling analyses, the excavations were backfilled with imported fill, compacted, and graded on September 17, 2001. Disinfection of the magazines was performed on May 8, 2001. Soil removed from the Ammunition Storage Magazine area was characterized as non-hazardous contaminated soil and disposed of at the CWM facility in Hillsboro, Oregon. Wood from pallets removed from the Ammunition Storage Magazines was characterized as listed waste and disposed of at the CWM facility in Arlington, Oregon.

### 4.3.19 CS Gas Chamber Building (Building 1834)

In preparation for demolition of Building 1834, a pre-demolition survey was conducted that included sampling surface soil for CS gas (2-chlorobenzalmalononitrile) and its breakdown products, field-screening (plus one laboratory sample) the near surface soil for lead, and sampling building materials for asbestos (Hart Crowser 1997). Sample maps and laboratory data tables were not included in the report and are therefore not presented in Appendices A and B.

One surface soil sample was collected from beneath Building 1834 and one surface soil sample was collected from approximately 10 feet in the prevailing downwind direction from Building 1834. Both samples were laboratory analyzed for CS gas and its breakdown products. Neither sample contained detectable concentrations of CS gas or its breakdown products.

An x-ray fluorescence (XRF) spectrometer was used to field screen for lead in the near surface samples. The report stated that samples were collected from surrounding Building 1834; however, the number of samples and their locations were not provided. All samples were reported to have lead concentrations of less than 93 mg/kg, the detection limit of the hand-held XRF instrument. One confirmation soil sample was submitted for laboratory analysis, which was determined to have a total lead concentration of 17 mg/kg. The XRF instrument was also used to sample building material surfaces for the presence of lead. The surfaces sampled that were found to contain lead-based paint included corner boards, exterior siding, and stairway risers. Regulatory guidelines indicate that painted materials with elevated concentrations of lead (4 $mg/cm^2$ or greater) may be a potentially dangerous waste if separately removed during demolition activities (Hart Crowser 1997). None of the building materials tested contained more than 2.9 $mg/cm^2$ of lead.

Building materials were also sampled during the pre-demolition survey for the presence of asbestos. Thirty-two samples were collected in accordance with the Asbestos Hazard Emergency Response Act (AHERA) regulations although the materials sampled and their locations were not noted in the report. None of the materials tested contained asbestos.

### 4.3.20 Underground Storage Tank (associated with Building 4475)

In 1995, a 300-gallon diesel UST and associated dispensing unit and piping were removed from the east side of Building 4475 (CEcon 1997). Small holes were observed in the UST upon removal and hydrocarbon contamination was noted in the surrounding soils. Overburden soils were stockpiled near the excavation. Soil samples collected from the stockpile and excavation indicated diesel-range organics (DRO) in concentrations greater than the regulatory cleanup level of 200 mg/kg (the cleanup level has since been changed to 2,000 mg/kg for DRO) in the stockpiles soils and the excavation. Additional soil removal was not performed at the time of the UST removal and the excavation was backfilled.

As a result of the initial data obtained during the UST removal, a subsurface investigation was performed to assess the vertical and horizontal extent of soil contamination (Hart Crowser 1996). Four soil borings were drilled within and around the former UST location to depths ranging up to 25 feet bgs. Two soil samples were submitted from each soil boring, except for one boring which was terminated at 1.5 feet bgs as field observations suggested that the boring location was within a former drainage ditch. The soil samples from the borings were selected for laboratory analysis based on hydrocarbon concentrations obtained from a field test kit. One sample collected from a depth of 5 to 7 feet bgs contained DRO concentrations of 1,300 mg/kg, which exceeded the

former regulatory cleanup level of 200 mg/kg. The remaining soil samples did not contain detectable concentrations of DRO. BTEX was not detected in any of the subsurface soil samples. In addition, a near surface soil sample collected from a drainage ditch approximately 20 feet south of the former UST location contained 9,600 mg/kg hydrocarbons quantified as DRO. BTEX and PCBs were not detected in this soil sample.

During an 11-month from period November 1996 to October 1997, approximately 375 cubic yards of petroleum-contaminated soil were removed from the former UST location and transported to TPST Soil Recyclers in Portland, Oregon for thermal desorption treatment (CEcon 1997). An additional 250 gallons of diesel-contaminated water was transported to Northwest Enviroservice, Inc. in Seattle, Washington for treatment and disposal. Confirmation soil samples indicated that petroleum-contaminated soil was removed from the former UST location. All of the confirmation soil samples contained concentrations of DRO below the current cleanup level of 2,000 mg/kg (maximum concentration – 860 mg/kg). Contaminated soil was removed up to the edge of the gravel road.

Table 4-1
**SCREENING VALUES**
**REMEDIAL ACTION UNIT 1**

| | MTCA 2001[a] | | | |
|---|---|---|---|---|
| | MTCA Method A cleanup Levels | | MTCA Method B Cleanup Levels | |
| | Soil (ug/kg) | Groundwater (ug/L) | Soil (ug/kg) | Groundwater (ug/L) |
| ***Volatile Organic Compounds*** | | | | |
| Acetone | | | | |
| Benzene | 30 | 5 | 18,200 ca | 0.795 ca |
| Bromobenzene | NE | NE | NE | NE |
| Bromochloromethane | NE | NE | NE | NE |
| Bromodichloromethane | NE | NE | 16,100 ca | 0.706 ca |
| Bromoform | NE | NE | 127,000 ca | 5.54 ca |
| Bromomethane | NE | NE | 112,000 | 11.2 |
| 2-Butanone (methyl ethyl ketone) | NE | NE | 48,000,000 | 4,800 |
| n-Butylbenzene | NE | NE | NE | NE |
| sec-Butylbenzene | NE | NE | NE | NE |
| tert-Butylbenzene | NE | NE | NE | NE |
| Carbon Disulfide | NE | NE | 8,000,000 | 800 |
| Carbon Tetrachloride | NE | NE | 7,690 ca | 0.337 ca |
| Chlorobenzene | NE | NE | 1,600,000 | 160 |
| Chloroethane (ethyl chloride) | NE | NE | NE | NE |
| Chloroform | NE | NE | 164,000 ca | 7.17 ca |
| Chloromethane | NE | NE | 76,900 ca | 3.37 ca |
| 2-Chlorotoluene | NE | NE | 1,600,000 | 160 |
| 4-Chlorotoluene | NE | NE | NE | NE |
| Dibromochloromethane (chlorodibromomethane) | NE | NE | 11,900 ca | 0.521 ca |
| 1,2-Dibromo-3-chloropropane | NE | NE | 714 ca | 0.0313 ca |
| 1,2-Dibromoethane (EDB, ethylene dibromide) | 5 | 0.01 | 1.8 ca | 0.000515 ca |
| Dibromomethane (methylene bromide) | NE | NE | 800,000 | 80 |
| 1,2-Dichlorobenzene | NE | NE | 7,200,000 | 720 |
| 1,3-Dichlorobenzene | NE | NE | NE | NE |
| 1,4-Dichlorobenzene | NE | NE | 41,700 ca | 1.82 ca |
| Dichlorodifluoromethane | NE | NE | 16,000,000 | 1,600 |
| 1,1-Dichloroethane | NE | NE | 8,000,000 | 800 |
| 1,2-Dichloroethane (EDC) | NE | 5 | 11,000 ca | 0.481 ca |
| 1,1-Dichloroethene | NE | NE | 1,670 ca | 0.0729 ca |
| cis-1,2-Dichloroethene | NE | NE | 800,000 | 80 |
| trans-1,2-Dichloroethene | NE | NE | 1,600,000 | 160 |
| 1,2-Dichloropropane | NE | NE | 14,700 ca | 0.643 ca |
| 1,3-Dichloropropane | NE | NE | NE | NE |
| 2,2-Dichloropropane | NE | NE | NE | NE |
| 1,1-Dichloropropene | NE | NE | NE | NE |
| cis-1,3-Dichloropropene | NE | NE | 5,560 ca | 0.243 ca |
| trans-1,3-Dichloropropene | NE | NE | 5,560 ca | 0.243 ca |
| Ethylbenzene | 6,000 | 700 | 8,000,000 | 800 |
| Ethyl methacrylate | NE | NE | 7,200,000 | 720 |

Table 4-1 (Continued)
**SCREENING VALUES**
**REMEDIAL ACTION UNIT 1**

| | MTCA 2001[a] | | | |
|---|---|---|---|---|
| | MTCA Method A cleanup Levels | | MTCA Method B Cleanup Levels | |
| | Soil (ug/kg) | Groundwater (ug/L) | Soil (ug/kg) | Groundwater (ug/L) |
| Hexachlorobutadiene | NE | NE | 12,800 ca | 0.56 ca |
| 2-Hexanone (butyl methyl ketone) | NE | NE | NE | NE |
| Iodomethane (methyl iodide) | NE | NE | NE | NE |
| Isopropylbenzene (cumene) | NE | NE | 8,000,000 | 1,600 |
| p-Isopropyltoluene (p-cymene) | NE | NE | NE | NE |
| Methylene chloride | 20 | 5 | 133,000 ca | 5.83 ca |
| Naphthalene | 100 | 160 | 1,600,000 | 160 |
| n-Propylbenzene | NE | NE | NE | NE |
| Styrene | NE | NE | 33,300 ca | 1.46 ca |
| 1,1,2,2-Tetrachloroethane | NE | NE | 5,000 ca | 0.219 ca |
| 1,1,1,2-Tetrachloroethane | NE | NE | 38,500 ca | 1.68 ca |
| Tetrachloroethene | 50 | 5 | 19,600 ca | 0.858 ca |
| Toluene | 7,000 | 1,000 | 16,000,000 | 1,600 |
| 1,2,3-Trichlorobenzene | NE | NE | NE | NE |
| 1,2,4-Trichlorobenzene | NE | NE | 800,000 | 80 |
| 1,1,2-Trichloroethane | NE | NE | 17,500 ca | 0.768 ca |
| 1,1,1-Trichloroethane | 2,000 | 200 | 72,000,000 | 7,200 |
| Trichloroethene | 30 | 5 | 90,900 ca | 3.98 ca |
| Trichlorofluoromethane | NE | NE | 24,000,000 | 2,400 |
| 1,2,3-Trichloropropane | NE | NE | 143 ca | 0.00625 ca |
| 1,3,5-Trimethylbenzene | NE | NE | NE | NE |
| 1,2,4-Trimethlybenzene | NE | NE | NE | NE |
| Vinyl Chloride | NE | 0.2 | 667 | 0.0292 ca |
| m,p-xylene | 9,000 | 1,000 | 160,000,000 | 16,000 |
| o-xylene | 9,000 | 1,000 | 160,000,000 | 16,000 |
| ***Semivolatile Organic Compound (SVOCs)*** | | | | |
| Acenaphthene | NE | NE | 4,800,000 | 960 |
| Acenaphthylene | NE | NE | NE | NE |
| Anthracene | NE | NE | 24,000,000 | 2,400 |
| Benzoic Acid | NE | NE | 320,000,000 | 64,000 |
| Benzo(a)pyrene [†] | 100 (See note b) | 0.1 (See note b) | 137 ca | 0.012 ca |
| Benzo(b+k)fluoranthene (total)[†] | See note b | See note b | 137 ca | 0.012 ca |
| Benzo(g,h,i)perylene | NE | NE | NE | NE |
| Benzyl Alcohol | NE | NE | 24,000,000 | 4,800 |
| bis(2-Chloroethoxy)methane | NE | NE | NE | NE |
| bis-(2-Chloroethyl)ether | NE | NE | 909 ca | 0.0398 ca |
| bis(2-Chloroisopropyl)ether | NE | NE | 3,200,000 | 320 |
| bis(2-Ethylhexyl)phthalate | NE | NE | 71,400 ca | 6.25 ca |
| 4-Bromophenyl phenyl ether | NE | NE | NE | NE |
| Butyl benzyl phthalate | NE | NE | 16,000,000 | 3,200 |
| Carbazole | NE | NE | 50,000 ca | 4.38 ca |
| 4-Chloroaniline | NE | NE | 320,000 | 64 |
| 4-Chloro-3-methylphenol | NE | NE | NE | NE |

Table 4-1 (Continued)
**SCREENING VALUES**
**REMEDIAL ACTION UNIT 1**

| | MTCA 2001[a] | | | |
|---|---|---|---|---|
| | MTCA Method A cleanup Levels | | MTCA Method B Cleanup Levels | |
| | Soil (ug/kg) | Groundwater (ug/L) | Soil (ug/kg) | Groundwater (ug/L) |
| 2-Chloronaphthalene | NE | NE | 6,400,000 | 1,280 |
| 2-Chlorophenol | NE | NE | 400,000 | 80 |
| 4-Chlorophenyl-phenylether | NE | NE | NE | NE |
| Chrysene[f] | See note b | See note b | 137 ca | 0.012 ca |
| Dibenz(a,h)anthracene [f] | See note b | See note b | 137 ca | 0.012 ca |
| Dibenzofuran | NE | NE | NE | NE |
| di-n-Butylphthalate | NE | NE | 8,000,000 | 1,600 |
| 1,2-Dichlorobenzene | NE | NE | 7,200,000 | 720 |
| 1,3-Dichlorobenzene | NE | NE | NE | NE |
| 1,4-Dichlorobenzene | NE | NE | 41,700 ca | 1.82 ca |
| 3,3'-Dichlorobenzidine | NE | NE | 2,220 ca | 0.194 ca |
| 2,4-Dichlorophenol | NE | NE | 240,000 | 48 |
| Diethyl phthalate | NE | NE | 64,000,000 | 12,800 |
| 2,4-Dimethylphenol | NE | NE | 1,600,000 | 320 |
| Dimethyl phthalate | NE | NE | 80,000,000 | 16,000 |
| 4,6-Dinitro-2-methylphenol | NE | NE | NE | NE |
| 2,4-Dinitrophenol | NE | NE | 160,000 | 32 |
| 2,4-Dinitrotoluene | NE | NE | 160,000 | 32 |
| 2,6-Dinitrotoluene | NE | NE | 80,000 | 16 |
| 2,4-/2,6-Dinitrotoluene | NE | NE | 1,470 ca | 0.129 ca |
| Di-n-octyl phthalate | NE | NE | 1,600,000 | 320 |
| Diphenylamine | NE | NE | 2,000,000 | 400 |
| Fluoranthene | NE | NE | 3,200,000 | 640 |
| Fluorene | NE | NE | 3,200,000 | 640 |
| Hexachlorobenzene | NE | NE | 625 ca | 0.0547 ca |
| Hexachlorobutadiene | NE | NE | 12,800 ca | 0.561 ca |
| Hexachlorocyclopentadiene | NE | NE | 480,000 | 96 |
| Hexachloroethane | NE | NE | 71,400 ca | 6.25 ca |
| Indeno(1,2,3-cd)pyrene [f] | See note b | See note b | 137 ca | 0.012 ca |
| Isophorone | NE | NE | 1,050,000 ca | 92.1 ca |
| 2-Methylnaphthalene | 5,000 [c] | 160 [c] | NE | NE |
| 2-Methylphenol (o-cresol) | NE | NE | 4,000,000 | 800 |
| 4-Methylphenol (p-cresol) | NE | NE | 400,000 | 80 |
| Naphthalene | 5,000 [c] | 160 [c] | 1,600,000 | 160 |
| 2-Nitroaniline | NE | NE | NE | NE |
| 3-Nitroaniline | NE | NE | NE | NE |
| 4-Nitroaniline | NE | NE | NE | NE |
| Nitrobenzene | NE | NE | 40,000 | 8.0 |
| 2-Nitrophenol | NE | NE | NE | NE |

Table 4-1 (Continued)
**SCREENING VALUES**
**REMEDIAL ACTION UNIT 1**

| | MTCA 2001[a] | | | |
|---|---|---|---|---|
| | MTCA Method A cleanup Levels | | MTCA Method B Cleanup Levels | |
| | Soil (ug/kg) | Groundwater (ug/L) | Soil (ug/kg) | Groundwater (ug/L) |
| 4-Nitrophenol | NE | NE | NE | NE |
| N-Nitrosodiphenylamine | NE | NE | 204,000 ca | 17.9 ca |
| N-Nitroso-di-n-propylamine | NE | NE | 143 ca | 0.0125 ca |
| Pentachlorophenol | NE | NE | 8,330 ca | 0.729 ca |
| Phenanthrene | NE | NE | NE | NE |
| Phenol | NE | NE | 48,000,000 | 9,600 |
| Pyrene | NE | NE | 2,400,000 | 480 |
| 1,2,4-Trichlorobenzene | NE | NE | 800,000 | 80 |
| 2,4,5-Trichlorphenol | NE | NE | 8,000,000 | 1,600 |
| 2,4,6-Trichlorophenol | NE | NE | 90,900 ca | 7.95 ca |
| 1,3,5-Trinitrobenzene | NE | NE | 214,000,000 | 42,900 |
| ***Polychlorinated Biphenyls (PCBs)*** | | | | |
| Aroclor 1016 | NE | NE | 5,600 | 1.12 |
| Aroclor 1221 | NE | NE | NE | NE |
| Aroclor 1232 | NE | NE | NE | NE |
| Aroclor 1242 | NE | NE | NE | NE |
| Aroclor 1248 | NE | NE | NE | NE |
| Aroclor 1254 | NE | NE | 1,600 | 0.16 |
| Aroclor 1260 | NE | NE | NE | NE |
| Total PCBs [d] | 1,000 | 0.1 | NE | NE |
| ***Organochlorine Pesticides*** | | | | |
| Aldrin | NE | NE | 58.8 ca | 0.00515 ca |
| alpha-BHC (benzene hexachloride, BHC) | NE | NE | NE | NE |
| beta-BHC | NE | NE | NE | NE |
| delta-BHC | NE | NE | NE | NE |
| gamma-BHC (Lindane) | 10 | 0.2 | 769 ca | 0.0673 ca |
| gamma-Chlordane | NE | NE | NE | NE |
| alpha-Chlordane | NE | NE | NE | NE |
| Chlordane (tech) | 1,000 | 0.1 | 2,860 ca | 0.25 ca |
| 4,4'-DDD | NE | NE | 4,170 ca | 0.365 ca |
| 4,4'-DDE | NE | NE | 2,940 ca | 0.257 ca |
| 4,4'-DDT | 3,000 | 0.3 | 2,940 ca | 0.257 ca |
| Dieldrin | NE | NE | 62.5 ca | 0.00547 ca |
| Endosulfan | NE | NE | 480,000 | 96 |
| Endosulfan I | NE | NE | NE | NE |
| Endosulfan II | NE | NE | NE | NE |
| Endosulfan Sulfate | NE | NE | NE | NE |
| Endrin | NE | NE | 24,000 | 4.8 |
| Endrin aldehyde | NE | NE | NE | NE |
| Endrin ketone | NE | NE | NE | NE |
| Heptachlor | NE | NE | 222 ca | 0.0194 ca |
| Heptachlor epoxide | NE | NE | 110 ca | 0.00962 ca |
| Methoxychlor | NE | NE | 400,000 | 80 |

Table 4-1 (Continued)
**SCREENING VALUES**
**REMEDIAL ACTION UNIT 1**

| | MTCA 2001[a] | | | |
|---|---|---|---|---|
| | MTCA Method A cleanup Levels | | MTCA Method B Cleanup Levels | |
| | Soil (ug/kg) | Groundwater (ug/L) | Soil (ug/kg) | Groundwater (ug/L) |
| Toxaphene | NE | NE | 909 ca | 0.0795 ca |
| ***Organophosphorous Pesticides*** | | | | |
| Azinphos methyl | NE | NE | NE | NE |
| Bolstar | NE | NE | NE | NE |
| Chlorpyrifos | NE | NE | 240,000 | 48 |
| Coumaphos | NE | NE | NE | NE |
| Demeton | NE | NE | 3,200 | 0.64 |
| Diazinon | NE | NE | 72,000 | 14.4 |
| Dichlorovos | NE | NE | 3,440 ca | 0.301 ca |
| Dimethoate | NE | NE | 16,000 | 3.2 |
| Disulfoton | NE | NE | 3,200 | 0.64 |
| EPN (ethyl p-nitrophenyl phenylphosphorothioate) | NE | NE | 800 | 0.16 |
| Ethoprop | NE | NE | NE | NE |
| Fensulfothion | NE | NE | 20,000 | 4 |
| Fenthion | NE | NE | NE | NE |
| Malathion | NE | NE | 1,600,000 | 320 |
| Merphos | NE | NE | 2,400 | 0.48 |
| Mevinphos | NE | NE | 20,000 | 4 |
| Naled | NE | NE | 160,000 | 32 |
| Methyl parathion | NE | NE | 20,000 | 4 |
| Ethyl parathion | NE | NE | 480,000 | 96 |
| Phorate | NE | NE | 16,000 | 1.6 |
| Ronnel | NE | NE | 4,000,000 | 800 |
| Sulfotep | NE | NE | NE | NE |
| TEPP | NE | NE | NE | NE |
| Tertrachlorvinphos | NE | NE | 41,700 ca | 3.65 ca |
| Tokuthion (Profthiofos) | NE | NE | NE | NE |
| Trichloronate | NE | NE | NE | NE |
| ***Chlorophenoxy Herbicides*** | | | | |
| 2,4-D (2,4-Dichlorophenoxy acetic acid) | NE | NE | 800,000 | 160 |
| 2,4-DB | NE | NE | 640,000 | 128 |
| 2,4,5-T (2,4,5-Trichlorophenoxy acetic acid) | NE | NE | 800,000 | 160 |
| 2,4,5-TP (Silvex) | NE | NE | 640,000 | 128 |
| Dalapon | NE | NE | 2,400,000 | 480 |
| Dicamba | NE | NE | 2,400,000 | 480 |
| Dichoroprop | NE | NE | NE | NE |
| Dinoseb | NE | NE | 80,000 | 16 |
| MCPA | NE | NE | 40,000 | 8 |
| MCPP | NE | NE | NE | NE |

Table 4-1 (Continued)
**SCREENING VALUES**
**REMEDIAL ACTION UNIT 1**

| | MTCA 2001[a] | | | |
|---|---|---|---|---|
| | MTCA Method A cleanup Levels | | MTCA Method B Cleanup Levels | |
| | Soil (ug/kg) | Groundwater (ug/L) | Soil (ug/kg) | Groundwater (ug/L) |
| ***Total Petroleum Hydrocarbons*** | | | | |
| Gasoline Range | 100,000 | 800 / 1,000 [e] | NE | NE |
| Diesel Range | 2,000,000 | 500 | NE | NE |
| Oil Range | 2,000,000 | 500 | NE | NE |
| ***Metals (Dissolved and Total*** | | | | |
| Antimony | NE | NE | 32,000 | 6.4 |
| Arsenic | 20,000 | 5 [f] | 667 ca | 0.058 ca |
| Barium | NE | NE | 5,600,000 | 1,120 |
| Beryllium | NE | NE | 160,000 | 32 |
| Cadmium | 2,000 | 5 | 80,000 | 8 |
| Calcium | NE | NE | NE | NE |
| Chromium | 2,000,000 ($Cr^{+3}$), 19,000 ($Cr^{+6}$) | 50 | 120,000,000 ($Cr^{+3}$), 240,000 ($Cr^{+6}$) | 24,000 ($Cr^{+3}$), 48 ($Cr^{+6}$) |
| Cobalt | NE | NE | NE | NE |
| Copper | NE | NE | 2,960,000 | 592 |
| Iron | NE | NE | NE | NE |
| Lead | 250,000 | 15 | NE | NE |
| Magnesium | NE | NE | NE | NE |
| Manganese | NE | NE | 11,200,000 | 2240 |
| Mercury | 2,000 | 2 | 24,000 | 4.8 |
| Nickel | NE | NE | 1,600,000 | 320 |
| Potassium | NE | NE | NE | NE |
| Selenium | NE | NE | 400,000 | 80 |
| Silver | NE | NE | 400,000 | 80 |
| Sodium | NE | NE | NE | NE |
| Thallium | NE | NE | 56,000 | 1.12 |
| Tin | NE | NE | 48,000,000 | 9,600 |
| Vanadium | NE | NE | 560,000 | 112 |
| Zinc | NE | NE | 24,000,000 | 4,800 |
| Cyanide | NE | NE | 1,600,000 | 320 |
| **Explosives** | | | | |
| Nitrobenzene | NE | NE | 40,000 | 8 |
| 1,3-Dinitrobenzene | NE | NE | 8,000 | 1.6 |
| 1,3,5-Trinitrobenzene | NE | NE | 214,000,000 | 42,900 |
| 2-Nitrotoluene | NE | NE | 800,000 | 80 |
| 3-Nitrotoluene | NE | NE | 800,000 | 80 |
| 4-Nitrotoluene | NE | NE | 800,000 | 80 |
| 2,4-Dinitrotoluene | NE | NE | 160,000 | 32 |
| 2,6-Dinitrotoluene | NE | NE | 80,000 | 16 |
| 2,4/2,6-Dinitrotoluene | NE | NE | 1,470 ca | 0.129 ca |
| 2,4,6-Trinitrotoluene (TNT) | NE | NE | 33,300 ca | 2.92 ca |
| 2-Amino-4,6-dinitrotoluene | NE | NE | NE | NE |
| 2-Amino-2,6-dinitrotoluene | NE | NE | NE | NE |

Table 4-1 (Continued)
**SCREENING VALUES**
**REMEDIAL ACTION UNIT 1**

| | MTCA 2001[a] | | | |
|---|---|---|---|---|
| | MTCA Method A cleanup Levels | | MTCA Method B Cleanup Levels | |
| | Soil (ug/kg) | Groundwater (ug/L) | Soil (ug/kg) | Groundwater (ug/L) |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) | NE | NE | 4,000,000 | 800 |
| Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX) | NE | NE | 9,090 ca | 0.795 ca |
| PETN | NE | NE | NE | NE |
| Picric Acid | NE | NE | NE | NE |
| Tetryl (trinitrophenylmethylnitramine) | NE | NE | 800,000 | 160 |
| Perchlorate ion | NE | NE | NE | NE |
| Nitroglycerin | NE | NE | NE | NE |
| Nitroguanidine | NE | NE | 8,000,000 | 1,600 |

Notes:
[a] Model Toxics Control Act Cleanup Regulation, WAC 173-340 Method A values are from Ecology Publication 94-06 amended February 12, 2001. Method B values are from MTCA Cleanup Levels and Risk Calculations (CLARC) version 3.1, Ecology publication 94-145 updated November 2001. Soil values are for direct contact (ingestion only).
[b] PAHs other than benzo(a)pyrene are detected, use the value listed for benzo(a)pyrene as the total concentration that all carcinogenic PAHs must meet using the toxicity equivalency method in WAC 173-340-70.
[c] Cleanup level based on total of naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene.
[d] Cleanup level if for total PCBs.
[e] If benzene is present, cleanup level is 800 ug/L. If benzene is not present, cleanup level is 1,000 ug/L.
f The MTCA Method A cleanup level for arsenic was used as it is the default background value. Application of the Maximum Contaminant Level in combination with the Method B value resulted in unacceptable risk to human health (Ecology 2003).

NE - Not established.

Table 4-2
**90TH PERCENTILE NATURAL BACKGROUND VALUES FOR METALS IN SOILS (IN MG/KG)**

| METAL | STATEWIDE[a] | CLARK COUNTY[a] | CAMP BONNEVILLE |
|---|---|---|---|
| Antimony | NA | NA | 0.12 [b] |
| Arsenic | 7 | 6 | NC |
| Barium | NA | NA | 257 |
| Beryllium | 2 | 2 | NC |
| Cadmium | 1 | 1 | NC |
| Chromium | 42 | 27 | NC |
| Copper | 36 | 34 | 114 |
| Lead | 17 | 17 | NC |
| Nickel | 38 | 21 | NC |
| Selenium | NA | NA | NC[c] |
| Silver | NA | NA | NC[c] |
| Thallium | NA | NA | 0.27[b] |
| Zinc | 86 | 96 | NC |
| Mercury | 0.07 | 0.04 | NC |

**Notes:**
[a] Ecology (1994).
[b]The value indicated is the maximum value detected.
[c]No value was calculated for this metal because the regulatory screening criteria were above concentrations detected in background samples.
mg/kg - milligrams per kilogram
NA - not available
NC - not calculated
Shading indicates that the concentration was selected for use as background.

As mentioned above, Camp Bonneville was identified for closure under the BRAC 95 program, with the associated real property being destined for transfer to Clark County. Clark County has developed a Reuse Plan (Otak Inc. 1998) that includes public recreational, educational and law enforcement activities. Specifically, the reuse plan encompasses the following elements:

- Regional Park
- Law Enforcement Training Center
- Rustic Retreat Center/Outdoor School
- Native American Cultural Center
- Clark County Environmental Education
- Trails and Nature Area
- FBI Firing Range
- Law Enforcement and Public Firing Ranges
- Timber Resource Management Area

The Reuse Plan is illustrated in Figure 6-1. The majority of the activities and areas for public access will be in the western one-third of the installation whereas the eastern one-third of the installation will be restricted to hiking, mountain biking and equestrian trails, and timber resource management. A brief description of the Reuse Plan elements is discussed below.

## 5.1 REGIONAL PARK

A regional park approximately 1,000 acres would be created along the western portion of Camp Bonneville. This would provide the public an opportunity to participate in passive and active recreation. The facilities and services to be available include the following:

- Trails for hiking, mountain biking, and equestrian use
- Group picnic areas
- Amphitheater and stage
- Meadow area for group picnicking and recreation
- Tent camping facilities
- Recreational vehicle camping
- Archery practice range
- Ponds for recreational use and environmental education
- Orienteering

## 5.2 LAW ENFORCEMENT TRAINING AREA

A law enforcement training center is proposed to serve the regional needs of the law enforcement agencies of southwest Washington. At this facility, police officers would receive basic training, learn new skills, and receive firearms training. The law enforcement training academy would be one of the user groups for classrooms and offices at the Camp Killpack cantonment area. A physical fitness and canine training area would be provided in this area. The canine training would be used for training search and rescue dogs.

## 5.3 RUSTIC RETREAT CENTER/OUTDOOR SCHOOL

A rustic retreat center and outdoor school is proposed as the primary reuse of the barracks area. New buildings, such as a meeting hall, would be located within the existing Camp Bonneville cantonment area.

## 5.4 NATIVE AMERICAN CULTURAL CENTER

A nonprofit Native American cultural group representing area tribes would provide training to Native American youth and assist in coordinating tribal activities. The Native American Cultural Center would also be open to the general public.

## 5.5 CLARK COUNTY ENVIRONMENTAL EDUCATION

Approximately 50 acres would be designated for environmental studies in the southwest corner of Camp Bonneville. The area was selected based on the ecosystems in the Lacamas Creek watershed and its suitability for water quality research.

## 5.6 TRAILS AND NATURE AREA

Approximately 2,000 acres would be maintained for trails and nature areas in the central and eastern portions of Camp Bonneville. The public would access these areas through hiking, mountain bike, and equestrian riding trails. The majority of the trails would use gravel and unpaved roads and cart tracks that already exist throughout the facility.

## 5.7 FBI FIRING RANGE

An area immediately adjacent to the law enforcement firing ranges has been identified for lease by the FBI. Their current range is located less than 1/10 of a mile from the meadow area. Noise studies indicate that firing ranges must be located no closer than 2,000 feet from neighborhoods and public use areas. The FBI has agreed to move its range to the area that will meet these criteria.

## 5.8 TIMBER RESOURCE MANAGEMENT AREA

Timber thinning is recommended as part of the management plan to maintain the health of the forest environment, reduce potential forest fire hazards, and provide revenue from timber sales. Forest management goals would include stimulating an old-growth timber stand structure and optimizing growth, yield, and forest health.

As indicated in Section 2 and shown in Figure 1-2, the sites included in RAU 1 are Landfills 1, 2, and 3; the Former Burn Area; Buildings 1962 and 1983; the Grease Pits; the Former Sewage Pond; the Hazardous Materials Accumulation Point; the Drum Disposal Area; the Paint and Solvent Disposal Area; Washracks 1 and 2; the Maintenance Pit; the Pesticide Storage/Mixing Building (Building 1864); the ASTs; the CS Gas Training Building Site; the Pesticide Storage Building (Building 4126); the Ammunition Storage Bunkers, the CS Gas Chamber Building (Building 1834), and the underground storage tank formerly associated with Building 4475.

The majority of these sites were investigated as part of the multi-sites investigation conducted by Shannon & Wilson (1999). However, additional investigations were also performed that focused on the Pesticide Storage Building (Building 4126) and the Ammunition Storage Bunkers (URS 2000b). Hart Crowser conducted investigations regarding the UST associated with Building 4475 and the CS Gas Chamber Building (Building 1834) (Hart Crowser 1996 and 1997). CEcon performed an investigation associated with the UST at Building 4475 (CEcon 1997). These sites were investigated using various methods including geophysics, soil gas sampling, wipe sampling, surface soil sampling, subsurface soil sampling obtained from drilling soil borings, and groundwater sampling. The investigative sampling activities associated with each site are summarized in Tables 6-1 through 6-3.

Based on the analyses obtained from the investigations, some of the sites did not contain chemicals of potential concern (COPCs) because chemicals were either not detected or were detected below regulatory cleanup levels. No further action was performed at these sites. The data for these sites are summarized in Table 6-4. The remaining sites evaluated during the investigations revealed selected chemicals above regulatory cleanup levels (Table 6-4). At these sites, No Action was not considered as an alternative because it was not judged to be protective of human health and the environment. It was concluded by the BCT and the Army that because of the relatively limited amount of soil contamination detected during the investigations, removal of impacted soil and potential contaminant sources, would enable more rapid site closure and transfer of property. Subsequent confirmation sampling, discussed in more detail in Section 5, documented chemicals that were not detected, were below regulatory cleanup levels, or were present at locations and concentration that do not pose a risk to human health or the environment.

Since contaminated soil has been removed at the required sites, such that COPs are either not present or are present at concentrations below regulatory cleanup levels, No Further Action is required at the site based on the information presented in Table 6-4. Because contamination either was not present or has been removed, there is no risk to human health or the environment posed by these sites. For the two sites with remaining contamination, the location and concentration of contaminants are such that a risk to human health or the environment is not present (i.e., there is not a complete exposure pathway). Therefore, No Further Action is proposed.

No risk assessments were conducted for any of the sites addressed in this document. Rather, risks were evaluated by comparing chemical concentrations detected at each location to regulatory cleanup levels protective of human health and the environment. A more in-depth evaluation of risks was not required because chemicals were either below their regulatory level and thus did not represent a level of concern, or, if above the regulatory level, were removed from the site during cleanup activities. Therefore, no concentrations of chemicals are present that present a human health or environmental concern under the anticipated current and future

land uses of the property. However, some localized contaminants may remain below the surface (where there would be no human or environmental contact) at the Maintenance Pit, one AST location, and potentially beneath a roadway.

Institutional controls appropriate for the reuse of Camp Bonneville will be implemented to protect human health and the environment after transfer of the property. These controls may include physical, legal, and/or administrative mechanisms that restrict the use of, or limit access to, real property. In addition, deed restrictions will be applied at the time of property transfer. The restrictions will include a provision that additional investigation and possibly remediation will be conducted if the Maintenance Buildings or Building T-1932 (AST location) are demolished and not included in the reuse plan. The institutional controls are discussed in more detail in Section 7.

## 6.1 CONCEPTUAL SITE MODEL

To ensure that human and ecological health risks were adequately addressed, a conceptual site model (CSM) was developed for the site (Figure 7-1). The CSM provides a schematic showing potential human and environmental exposure to chemicals at RAU 1. The CSM identifies the populations potentially exposed to chemicals and the means by which exposure may occur. Only complete exposure pathways require quantitative evaluation in a risk assessment. Complete pathways contain four elements:

- A source and mechanism of chemical release
- A retention or transport medium (e.g., groundwater)
- A point of potential contact with the affected medium
- A means of entry into the body at the contact point.

The potential pathways at RAU 1 are either incomplete or not applicable. Thus, there are no health risks that need to be addressed under the current reuse scenario.

Figure 7-1 identifies soils as a potential direct exposure medium; soils are also a secondary source from which chemicals may potentially be released to other environmental media, such as groundwater. Groundwater may also serve as a secondary source from which chemicals may be released to other media such as surface water. At this time, air (volatilization) is not included as a migration pathway in Figure 7-1 because most of the contaminants of concern are nonvolatile compounds, and many of the chemical releases occurred below ground. In addition, the releases occurred many years ago, so volatile constituents at or near the surface are likely to have volatilized since their release.

Exposure to surface soils is not considered as a complete or viable exposure pathway or release mechanism. Remediation efforts have been documented in several reports and the BCT, which includes representatives from Ecology and EPA Region 10, has concurred that no further action is necessary at any of the sites comprising RAU 1. The agreement is contingent on the provision that future users would not build on or excavate the area underlain by landfill debris and that the Maintenance Building and Building T-1932 (AST location) would not be demolished. Institutional controls will be implemented for reuse that will focus on protection of human health and the environment after transfer of the property. In addition, under the current reuse plan for Camp Bonneville by Clark County, the eastern portion of the site, would encompass timber

management and hiking and equestrian trails. Reuse activities with more potential for human exposure, such as camping and outdoor instructional areas, are planned for the western portion of the site, near the Camp Bonneville and Camp Killpack cantonments. Therefore, the potential exposure to surface soil from Landfills 2 and 3 was considered to be incomplete or nonviable. In addition, Landfill 1 was not located, and the information cited regarding its existence is consistent with a small debris pile associated with a former residence.

Normal background concentrations of several metals in soil exceeded regulatory cleanup levels, including arsenic, barium, beryllium, chromium, copper, and thallium. At some of the sites, one or more of these metals were detected at concentrations only slightly exceeding the background level in a minimal number of samples. These slightly elevated concentrations may be representative of the normal variability of metals concentrations in soil. Although they may exceed cleanup levels, these constituents are extremely localized and do not appear to pose a risk to human health or the environment because there is no complete exposure pathway.

No analyte concentrations of concern were noted in groundwater. Therefore, no remedial actions were necessary for groundwater. Because contaminated soil has been removed from those sites where required and contaminated groundwater is not present, the surface water pathway is considered incomplete.

## 6.2 SUMMARY OF HUMAN AND ECOLOGICAL RISK

The predominant contaminants detected at RAU 1 sites were various petroleum hydrocarbons and related compounds and metals. VOCs, SVOCs, PCBs, pesticides, herbicides, and explosives compounds were either not detected or detected at concentrations below their respective cleanup levels where evaluated.

Because the contaminants of concern were either not present in concentrations above regulatory cleanup levels or have been removed and reduced to concentrations below regulatory cleanup levels (i.e., nonexistent source or removal of contaminant source), exposure pathways for human and/or ecological receptors are considered incomplete at the sites.

Table 6-1
**INVESTIGATION SUMMARY**
**REMEDIAL ACTION UNIT 1 SITES**
**CAMP BONNEVILLE, WASHINGTON**

| Site Name | UXO Survey | Geophysical Survey | Soil Gas Survey | Surface Soil Samples | Soil Borings/ Samples | Wipe Samples | Wells/Water Samples |
|---|---|---|---|---|---|---|---|
| Landfill 1 | X | X | | | | | |
| Landfill 2 | X | X | X | | X | | X |
| Landfill 3 | X | X | X | | X | | X |
| Former Burn Area | X | | | X | | | |
| Buildings 1962 and 1983 | | | | X | | | |
| Drum Disposal Area | X | X | | | X | | |
| Paint and Solvent Disposal Area | X | X | | | X | | |
| Maintenance Pit | | | | | X | | |
| Washrack 1 | | | | X | X | | |
| Grease Pits | | | | | X | | |
| Pesticide Mixing/Storage Building (1864) | | | | X | X | | X |
| Aboveground Storage Tanks | | | | X | | | |
| Former Sewage Pond | X | X | | | X | | X |
| Ammunition Storage Bunkers | X | | | X | X | X | |
| Hazardous Materials Accumulation Point | | | | X | | | |
| Former CS Gas Training Building | X | | | | X | | |
| Washrack 2 | | | | | X | | |
| Pesticide Storage Building (4126) | X | | | X | | | |
| CS Gas Chamber Building (Building 1834) | | | | X | | | |
| UST (associated with Building 4475) | | | | X | X | | |

Note:

UXO - unexploded ordnance
Sources: Shannon & Wilson (1999), URS (2000b), Hart Crowser (1996), Hart Crowser (1997), CEcon (1997)

Table 6-2
**SOIL SAMPLE ANALYSES AND QUANTITIES**
**REMEDIAL ACTION UNIT 1 SITES**
**CAMP BONNEVILLE, WASHINGTON**

| | Number of Environmental Samples | | | | | | | | | | | | Number of QA/QC Samples | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sampling Location/Activity | VOCs | SVOCs | PCB/ Pest. | Organo-phosphorous Pesticides | Chlorinated Herbicides | Lead | PPL Metals | CS | Cyanide | TPH | Explosives[a] | Asbestos | Replicate/ Split (Q/CMQAL) | MS/ MSD |
| Landfill 2/Landfill 3 | | | | | | | | | | | | | | |
| Soil Borings | 8 | 8 | 8 | | | | 8 | | 8 | 8 | 8 | | 1/1 | 1 |
| Burn Area | | | | | | | | | | | | | | |
| Surface Soil Samples | 10 | 10 | 10 | | | | 10 | | | 10 | 10 | | 1/1 | 1 |
| Former Buildings 1962 and 1983 | | | | | | | | | | | | | | |
| Surface Soil Samples | | 15 | | | | 15 | | | | | | 15 | 1/1 | 1 |
| Drum Disposal Area | | | | | | | | | | | | | | |
| Soil Borings | 2 | 2 | 2 | | | | 2 | | | 2 | 2 | | | |
| Paint/Solvent Disposal Area | | | | | | | | | | | | | | |
| Soil Borings | 4 | 4 | 4 | | | | 4 | | | 4 | 4 | | 1/0 | |
| Maintenance Pit | | | | | | | | | | | | | | |
| Soil Borings | 5 | 6 | 6 | | | | 6 | | | 6 | | | | |
| Wash Rack No. 1 | | | | | | | | | | | | | | |
| Surface Soil Samples | | 2 | 2 | | | | 2 | | | 2 | | | | |
| Soil Borings | 2 | 3 | | | | | 3 | | | 3 | | | | |
| Grease Pits | | | | | | | | | | | | | | |
| Soil Borings | 4 | 4 | 4 | | | | 4 | | | 4 | | | 1/0 | |
| Pesticide Mixing/Storage Building (Bldg. 1864) | | | | | | | | | | | | | | |
| Surface Soil Samples | | 2 | 2 | 2 | 2 | | 2 | | | 2 | | | | |
| Soil Borings | 7 | 9 | 9 | 9 | 9 | | 9 | | | 9 | | | 1/1 | 1 |
| Aboveground Storage Tanks | | | | | | | | | | | | | | |
| Surface Soil Samples | | | | | | | | | | 8 | | | 1/0 | |
| Former Sewage Pond | | | | | | | | | | | | | | |
| Soil Borings | 13 | 15 | 15 | | | | 15 | | | 15 | | | 2/1 | 1 |
| Ammunition Storage Magazines | | | | | | | | | | | | | | |
| Surface Soil Samples | | 1 | 1 | 1 | 1 | | 21 | | | 4 | 21 | | 1/1 | 1 |
| Soil Borings | | | | | | | 2 | | | | 2 | | | |
| Wipe Samples | | | | | | | 3 | | | | 3 | | 1/0 | |

Table 6-2 (Continued)

**SOIL SAMPLE ANALYSES AND QUANTITIES**
**REMEDIAL ACTION UNIT 1 SITES**
**CAMP BONNEVILLE, WASHINGTON**

| | Number of Environmental Samples | | | | | | | | | | | | Number of QA/QC Samples | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sampling Location/Activity | VOCs | SVOCs | PCB/ Pest. | Organo-phosphorous Pesticides | Chlorinated Herbicides | Lead | PPL Metals | CS | Cyanide | TPH | Explosives[a] | Asbestos | Replicate/ Split (Q/CMQAL) | MS/ MSD |
| Hazardous Material Accumulation Point | | | | | | | | | | | | | | |
| Surface Soil Samples | | 2 | 2 | | | | 2 | | | 2 | | | 1/1 | 1 |
| Former CS Training Building | | | | | | | | | | | | | | |
| Surface Soil Samples | | 4 | | | | 4 | | 5 | 5 | | | | | |
| Subsurface Soil Samples | | 1 | | | | 1 | | 5 | 5 | | | | 1/1 | 1 |
| Wash Rack No. 2 | | | | | | | | | | | | | | |
| Surface Soil Samples | | 2 | | | | | 2 | | | 2 | | | 1/0 | |
| Subsurface Soil Samples | | 2 | | | | | 2 | | | 2 | | | | |
| Pesticide Storage Building (Bldg. 4126) | | | | | | | | | | | | | | |
| Surface Soil Samples | | | 2 | 3 | 3 | | 2 | | | 4 | | | 2/2 | 1 |
| CS Gas Chamber Building (Bldg. 1834) | | | | | | | | | | | | | | |
| Surface Soil Samples | | | | | | 1 | | 2 | | | | | | 1 |
| UST (associated with Bldg. 4475) | | | | | | | | | | | | | | |
| Surface Soil Samples | 1 | | | | | | | | | 1 | | | | |
| Subsurface Soil Samples | 6 | | | | | | | | | 6 | | | 3 | 3 |

[a]Includes nitroaromatics and nitramines by EPA Method SW8330, PETN by EPA Method SW8321, and Picric Acid by EPA Method SW8321 modified.

Note: Replicate/split samples not indicated in CS Gas Chamber Building Report. In addition, lead was screened using x-ray fluorescence with one soil sample submitted to laboratory. VOC analysis of samples collected from the UST site was restricted to benzene, toluene, ethylbenzene, and xylene.

CMQAL - Chemical and Materials Quality Assurance Laboratory
CS - 2-chlorobenzalmalononitrile
MS/MSD - matrix spike/matrix spike duplicate
PCB - polychlorinated biphenyl
PPL - priority pollutant list
Q - Quanterra Environmental, Inc.
QA - quality assurance
QC - quality control
SVOC - semivolatile organic compound
TPH - total petroleum hydrocarbons
VOC - volatile organic compound

Table 6-3
**WATER SAMPLE ANALYSES AND QUANTITIES**
**REMEDIAL ACTION UNIT 1 SITES**
**CAMP BONNEVILLE, WASHINGTON**

| | Number of Environmental Samples | | | | | | | | | | | | Number of QA/QC Samples | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sampling Locations | TPH | PPL Metals Total[a] | PPL Metals Dissolved[a] | VOCs | SVOCs | PCBs/ Pesticides | Organo-phosphorus Pesticides | Chlorinated Herbicides | Explosives[b] | Cyanide | Conventional Analyses[c] | Fecal Coliform, Fecal Strep | Replicate/ Split (Q/CMQAL) | Rinsate Blank | Trip Blank (Q/CMQAL? | MS/ MSD |
| Landfill 2/Landfill 3 | | | | | | | | | | | | | | | | |
| Monitoring Wells | 7 | 7 | 7 | 7 | 7 | 7 | | | 7 | 7 | | | 1/1 | 1 | 4/1 | 1 |
| Former Sewage Pond | | | | | | | | | | | | | | | | |
| Monitoring Wells | 2 | 2 | 2 | 2 | 2 | | | | | | 2 | 2 | | | 1 | |
| Pesticide Mixing/Storage Building | | | | | | | | | | | | | | | | |
| Monitoring Wells | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | | | 2 | | | | | |
| Hazardous Materials Accumulation Point | | | | | | | | | | | | | | | | |
| Sump | 1 | 1 | | 1 | 1 | 1 | | | | | | | | | | |

[a] Includes barium
[b] Includes nitroaromatics and nitramines by EPA Method SW8330, PETN by EPA Method SW8321, and Picric Acid by EPA Method SW8321 modified.
[c] Includes common cations, common anions, carbonate/bicarbonate, and total suspended solids.

CMQAL - Chemical and Materials Quality Assurance Laboratory
MS/MSD - matrix spike/matrix spike duplicate
PCB - polychlorinated biphenyl
PPL - priority pollutant list
Q - Quanterra Environmental, Inc.
QA - quality assurance
QC - quality control
SVOC - semivolatile organic compound
VOC - volatile organic compound
TPH - total petroleum hydrocarbons

Table 6-4
**RATIONALE FOR NO FURTHER ACTION PREFERRED ALTERNATIVE**

| Site | Rationale for No Further Action |
|---|---|
| Landfill No. 1 | • The landfill was not located by reconnaissance or geophysical survey methods.<br>• Previously collected information was interpreted to be consistent with the presence of a small debris pile associated with a former residence. |
| Landfill No. 2 | • The soil gas survey indicated no evidence of VOCs in the landfill materials.<br>• Metals were the only constituents detected in soil samples from downgradient borings, and none were detected at concentrations above both regulatory cleanup levels and background.<br>• Total and dissolved arsenic was detected in both groundwater wells at concentrations below regulatory cleanup levels. |
| Landfill No. 3 | • The soil gas survey indicated no evidence of VOCs in the landfill materials.<br>• Metals were the only constituents detected in soil borings, and none were detected at concentrations above both regulatory cleanup levels and background.<br>• No organic analytes were detected in any groundwater samples except for naphthalene, which was detected in one sample at a concentration less than regulatory cleanup levels.<br>• Total and dissolved arsenic was detected in four groundwater samples at a concentration below regulatory cleanup levels. |
| Former Burn Area | • VOCs and metals were the only constituents detected in soil borings; however, no metals were found at a concentration above both regulatory cleanup levels and background concentrations and the detected VOCs were below regulatory cleanup levels. |
| Burned Buildings 1962 and 1983 | • Only lead was detected in the surface and near-surface soil samples. Although concentrations detected exceeded the background value, the concentrations did not exceed regulatory cleanup levels. |
| Camp Bonneville Grease Pits | • Lindane was detected in soil at concentrations above regulatory cleanup levels in one sample; however, other soils did not contain detected lindane. It is unlikely that the Grease Pits are a source of lindane as they were used to dispose of waste cooking greases from nearby mess halls.<br>• Although the lindane concentrations slightly exceeded cleanup values in one soil sample, the concentrations at the Camp Bonneville Grease Pits 3 are extremely localized and because of incomplete exposure pathways, the concentrations do not pose a risk to human health or the environment.<br>• Barium and copper were detected in soil below regulatory cleanup levels.<br>• Arsenic and chromium were detected above regulatory cleanup levels, but below background concentrations.<br>• Groundwater was not encountered in the boring. |
| Camp Killpack Grease Pit | • No organic compounds were detected in soil at concentrations above regulatory cleanup levels.<br>• Arsenic was detected in one soil sample at a concentration above regulatory cleanup levels. However, the sample concentration was close to the background values (7.9 mg/kg vs. 7 mg/kg). The remaining samples contained concentrations of arsenic below background values.<br>• Although the arsenic concentration slightly exceeded cleanup values in one soil sample, the concentration at the Camp Killpack Grease Pits is extremely localized and because of incomplete exposure pathways, the concentrations do not pose a risk to human health or the environment.<br>• Lead and thallium were detected at a concentration above background, but less than regulatory cleanup levels.<br>• Chromium was detected in one sample above regulatory cleanup levels, but less than background.<br>• Groundwater was not encountered in the boring. |

Table 6-4 (Continued)
**RATIONALE FOR NO FURTHER ACTION PREFERRED ALTERNATIVE**

| Site | Rationale for No Further Action |
|---|---|
| Former Sewage Pond | • No organic compounds were detected in soil samples above regulatory cleanup levels.<br>• Thallium was detected in one soil sample at a concentration slightly above background but below the regulatory cleanup level. Twelve of the remaining 17 samples did not contain detectable concentrations of thallium and the other five samples contained concentrations below regulatory cleanup levels.<br>• Arsenic concentrations were above regulatory cleanup levels, but less than background in all but one sample. Sixteen of 17 samples were less than background and the single sample that exceeded background was very close to the background value (7.2 mg/kg vs. 7 mg/kg).<br>• Copper was detected slightly above background in one subsurface soil sample from the upgradient boring. However, copper concentrations for all samples were below regulatory cleanup levels.<br>• Detected cadmium and antimony concentrations exceeded background values but were less than regulatory cleanup levels.<br>• Detected chromium concentrations exceeded regulatory cleanup levels but were less than background values.<br>• No organic compounds were detected in groundwater samples. |
| Site | Rationale for No Further Action |
| Hazardous Materials Accumulation Point | • No organic compounds were detected at concentrations above regulatory cleanup levels.<br>• Arsenic was detected above regulatory cleanup levels, but below background in soil.<br>• Cadmium was detected above background but below regulatory cleanup levels.<br>• Other detected metals had concentrations below regulatory cleanup levels and background values. |
| Drum Disposal Area | • Soil samples contained TPH concentrations less than regulatory cleanup levels.<br>• No SVOCs, PCBs/pesticides, or explosives compounds were detected in soil samples.<br>• Detected VOCs were less than regulatory cleanup levels.<br>• Except for antimony, detected metals concentrations were less than background concentrations. However, antimony concentrations were below regulatory cleanup levels.<br>• Contaminated soil encountered during excavation of metal debris resulted in excavation of 26 test pits. In addition, rainwater flowed into the excavations from the surrounding area. The test pits revealed toluene, methoxychlor, and metals exceeding regulatory cleanup levels in soil samples. Naphthalene, ethylbenzene, toluene, and lead exceeded regulatory cleanup levels in samples of rainwater in the excavation.<br>• An electromagnetic survey revealed 13 anomalies, each of which was evaluated by trenching with a backhoe. One of the excavations contained paint cans, paint, and miscellaneous debris. The other anomalies evaluated appeared to be the result of pipes, reinforcement bar, barbed wire, and scrap metal.<br>• Soil excavation was conducted to remove the debris and contaminated soil. Confirmation soil sampling following soil excavation indicated non-detected contaminants or concentrations below regulatory cleanup levels. Groundwater was not encountered during the confirmation soil sampling activities. |
| Paint and Solvent Disposal Area | • Detected TPH concentrations were less than regulatory cleanup levels.<br>• No VOCs, SVOCs, PCBs/pesticides, or explosives compounds were detected in soil samples.<br>• Metals concentrations were either less than background concentrations or less than regulatory cleanup levels. |

Table 6-4 (Continued)
**RATIONALE FOR NO FURTHER ACTION PREFERRED ALTERNATIVE**

| Site | Rationale for No Further Action |
|---|---|
| Washrack 1 | • VOCs, SVOCs, and pesticide compounds detected in soil samples were either not detected or less than regulatory cleanup levels.<br>• With the exception of lead, metals concentrations were either less than background concentrations or less than regulatory cleanup levels.<br>• TPH (diesel-range organics) and lead exceeded regulatory cleanup levels. In August 2000, contaminated soil was excavated at Washrack 1. Confirmation soil sampling revealed elevated concentrations of lead and hydrocarbons still present in the soil.<br>• Additional excavation was conducted to remove the lead and hydrocarbon-contaminated soil. Confirmation soil sampling indicated lead and hydrocarbon concentrations below regulatory cleanup levels. |
| Maintenance Pit | • Detected TPH and VOC concentrations were less than regulatory cleanup levels.<br>• PCBs were not detected and detected pesticide compound concentrations were less than regulatory cleanup levels.<br>• With the exception of lead in one sample, metals concentrations were either less than background concentrations or less than regulatory cleanup levels.<br>• Soil excavation was conducted to remove contaminated soils in August 2000. Confirmation sampling resulted in additional soil excavation. Subsequent confirmation sampling revealed concentrations of contaminants below regulatory cleanup levels outside the footprint of the Maintenance Pit Building.<br>• Contaminants are suspected to potentially be present directly below the existing Maintenance Pit Building although data supporting this suspicion has not been obtained. Current reuse plans include using the Maintenance Pit Building. If those plans change and the building is demolished, additional soil sampling may be required. Institutional control will be implemented at the time of transfer for this building. A discussion of institutional controls for the Maintenance Pit Building is presented in Section 7. |
| Washrack 2 | • Detected TPH concentrations were less than regulatory cleanup levels.<br>• SVOCs were not detected in soil samples.<br>• Metals concentrations were either less than background concentrations or less than regulatory cleanup levels. |
| Pesticide Storage/Mixing Building (Building 1864) | • Detected TPH concentrations were less than regulatory cleanup levels.<br>• Detected VOC concentrations were less than regulatory cleanup levels (only subsurface samples were analyzed for VOCs).<br>• Detected SVOC concentrations were less than regulatory cleanup levels.<br>• Except for arsenic, cadmium, and lead concentrations in surface samples, metals concentrations were either less than background concentrations or less than regulatory cleanup levels.<br>• TPH, VOCs, SVOCs, PCB/pesticides, organophosphorus pesticides, and chlorinated herbicides were not detected in groundwater samples.<br>• Soil excavation was conducted to remove contaminated soils in June and August 2000. Confirmation soil sampling resulted in further soil excavation due to the presence of lead. Subsequent confirmation sampling revealed concentrations of lead below regulatory cleanup levels. |

Table 6-4 (Continued)
**RATIONALE FOR NO FURTHER ACTION PREFERRED ALTERNATIVE**

| Site | Rationale for No Further Action |
|---|---|
| ASTs | • Surface soil samples contained TPH concentrations greater than regulatory cleanup levels at seven of the AST sites.<br>• Excavation of contaminated soil was completed and confirmation sampling revealed concentrations below regulatory cleanup levels.<br>• Petroleum-contaminated soil was left in place at Building T-1932 (with concurrence from Ecology) as excavation would have threatened the structural integrity of building. One sample contained a diesel-range organic concentration of 2,690 mg/kg adjacent to Building T-1932. Although it is unlikely that contaminated soil would be so widespread, extending the hydrocarbon contamination at the edge of the structure over the footprint of the building (approximately 1800 square feet), and to a depth of 6 inches would result in approximately 33 cubic yards of petroleum-contaminated soil beneath the building. Institutional controls will be implemented at the time of transfer for this building. A discussion of institutional controls for Building T-1932 is presented in Section 7. |
| CS Gas Training Building | • CS gas and cyanide were not detected in any of the samples.<br>• Detected concentrations of SVOCs were less than regulatory cleanup levels.<br>• Detected concentrations of lead exceeded regulatory cleanup levels and background. Therefore, in August 2000, lead-contaminated soil was excavated at the CS Gas Training Building. Confirmation soil sampling revealed lead in concentrations above regulatory cleanup levels. Additional soil excavation was conducted and subsequent confirmation sampling revealed lead at a concentration below regulatory cleanup levels. |
| Pesticide Storage Building (Building 4126) | • Pesticides and herbicide concentrations were below regulatory cleanup levels.<br>• PCBs and hydrocarbons were either not detected or detected in concentrations below regulatory cleanup levels.<br>• Lead was detected in soil concentrations that exceeded regulatory cleanup levels and background. Other detected metals were either below background values or regulatory cleanup levels. The building was demolished in May 2001 and contaminated soil was excavated. Confirmation soil sampling revealed that further excavation was unnecessary with detected contaminant concentrations below regulatory cleanup levels.<br>• |
| Ammunition Storage Bunkers (#2953, #2951, #2950) | • Metals, explosives, and propellants exceeded cleanup levels in surface soil samples. As a result, in May 2001, contaminated soil was excavated at the Ammunition Storage Bunkers. Confirmation soil sampling revealed concentrations of contaminants below cleanup levels. |
| CS Gas Chamber Building (Building 1834) | • CS and its breakdown products were not detected in soil samples collected from beneath Building 1834.<br>• Lead concentrations were below regulatory cleanup levels in soil samples.<br>• Asbestos was not detected in building material samples.<br>• Although lead was detected in building material samples, the concentrations were below Washington Dangerous Waste levels.<br>• Building 1834 was demolished and the debris was disposed of in a municipal landfill. |

Table 6-4 (Continued)
**RATIONALE FOR NO FURTHER ACTION PREFERRED ALTERNATIVE**

| Site | Rationale for No Further Action |
|---|---|
| Underground Storage Tank (associated with Building 4475) | • A 300-gallon diesel UST was removed from the east side of Building 4475 in 1995. Soil sampling conducted at the time of the UST removal indicated diesel concentrations exceeding regulatory cleanup levels.<br>• Later investigations in 1996 and 1997 revealed petroleum-contaminated soil in the UST area and an adjacent drainage area.<br>• Remediation activities included excavation and thermal treatment of approximately 375 cubic yards of petroleum-contaminated soil and treatment and disposal of approximately 250 gallons of petroleum-contaminated water.<br>• Confirmation sampling indicated that contaminated soil was removed. However, the concentrations of hydrocarbons remaining at the site beside a roadway are below the MTCA Method A cleanup level for diesel fuel of 2,000 mg/kg. |

Notes:
CS - 2-chlorobenzalmalononitrile
MCL - maximum contaminant level
MTCA – Washington State Model Toxics Control Act
PCBs – polychlorinated biphenyls
SVOCs – semivolatile organic compounds
TPH – total petroleum hydrocarbons
VOCs – volatile organic compounds

## 7.1 BASIS FOR SELECTION

This CAP encompasses the 20 individual sites within RAU 1 for Camp Bonneville described in Section 2. Numerous investigations have been conducted have been conducted at these sites since Camp Bonneville was selected for site closure by the BRAC '95 Commission. The predominant contaminants detected at these sites were various petroleum hydrocarbons and related compounds, metals, and a limited number of VOCs, SVOCs, pesticides and herbicides, and explosives residue. Remediation activities where contaminants were detected in concentrations above regulatory cleanup levels consisted of building or structure demolition, debris removal, soil excavation, and subsequent confirmation soil sampling and laboratory analysis. Based on the data gathered during the investigation and remediation activities at the RAU 1 sites, No Further Action (NFA) is the selected remedy because contaminants were not detected, detected in concentrations below cleanup levels (or background), or remediation activities reduced the concentrations to below cleanup levels. The NFA selection is supplemented by a variety of institutional controls described below.

## 7.2 INSTITUTIONAL AND ENGINEERING CONTROLS

Institutional controls are measures to prevent or limit exposure to hazardous substances left in place at a site, or to assure effectiveness of the chosen remedy until cleanup levels are achieved. Institutional controls are usually, but not always, legal controls, such as easements, restrictive covenants, and zoning ordinances. A distinction between engineering controls (landfill caps, fences, and other physical barriers) and institutional controls should be made. Engineering controls and institutional controls can be collectively referred to as land use controls. Institutional controls and engineering controls are placed on property where contaminants remain at levels above regulatory requirements for cleanup, and where exposure pathways, if they exist, may cause harm to human health and the environment.

Institutional controls are imposed to ensure that the engineering controls stay in place or, where there are no engineering controls, to ensure the restrictions on land use stay in place to protect human health and the environment. For Remedial Action Unit 1, the selected institutional controls include land use restrictions and reporting on land use control maintenance. Engineering controls encompass a variety of engineered remedies to contain and/or reduce contamination, and/or physical barriers intended to limit access to property. Engineering controls may include fences and signs. The institutional controls that are addressed in this plan include the following land use restrictions described in this section.

### 7.2.1 Land Use Restrictions

MTCA requires cleanup of hazardous substances that have been released into the environment to a degree that is determined to be protective of human health and the environment. The purpose of institutional controls is to ensure compliance with land use assumptions used in establishing cleanup levels. How a parcel of land is anticipated to be used in the future is an important consideration in evaluating the extent of cleanup necessary to achieve the required protectiveness. For example, if the site is an industrial area, and it is anticipated to remain industrial, residual contamination may remain on site under the assumption that the land will not be used for residential purposes. The contaminant levels left on-site are safe for workers, but may not be safe for full-time residents living on the property if future land use became

residential. In this scenario, institutional controls are necessary to restrict present and future land use to industrial purposes and ensure that engineering controls remain intact throughout the year. The investigations conducted by the Army at RAU 1 sites, in cooperation with the Ecology and U.S. EPA, require certain restrictions on the land based on reasonable land use considerations. Those land use restrictions include areas restricted to outdoor recreational uses. Applicable land use restrictions will be noted through equitable servitudes on the title of the sites where the restrictions apply.

### 7.2.2 Equitable Servitudes

There are two types of institutional controls involving land transfer documents or equitable servitudes.

- Notices. 40 CFR Part 373 implementing Section 120(h) of the CERCLA requires notice of any hazardous substance that was stored for one year or more, known to be released or disposed of in any contract for the sale or transfer of property.
- Restrictive Covenant. Army policy regarding land use controls requires that the United States insure that institutional controls "run with the land" such that the immediate transferee and subsequent transferees are required to abide by the ICs. State real property laws determine the form of the restrictive covenant. Ecology guidance suggests that the restrictive covenant should take the form of an equitable servitude.

Equitable servitude restrictions are slightly different from other controls because they are the sole or primary mechanism by which the land, groundwater, and excavation restrictions are implemented. Equitable servitude notices provide information to future purchasers of property by being contained in the title records of the property. Equitable servitudes and restrictive covenants in Washington are placed by the grantor (seller) that transfers ownership of real property to the grantee (buyer). Such servitudes or covenants indicate that the grantor is not giving the grantee every possible right of ownership that could be given. Rather, the grantor reserves certain rights, and the grantee takes the property subject to the reserved rights of the grantor. The equitable servitude that transfers parcels of property that have land use restrictions will have reserved those rights and uses. The grantor has the authority to enforce those reserved uses against future owners. By this mechanism, the restrictions will be part of the title of the real property. Thus they will run with the land and future owners of the parcels will not be given the rights that are reserved.

It should be noted that this Draft Final CAP does not contain the final equitable servitude notice language; the appropriate language will be included in the Finding of Suitability to Transfer. The exact form of the equitable servitude is subject to negotiations among Army and the regulatory agencies.

### 7.2.3 Institutional Controls for RAU 1 Sites

#### *Maintenance Pit*

The Maintenance Pit is located under a concrete slab within the west end of Building 4475 in the Camp Killpack cantonment area. The pit, now abandon and covered with a slab, was an area where vehicles were repaired and maintained. Based on this use, it is possible vehicle fluids such as gasoline, used oil, lubricants, antifreeze, and solvents may have been released

to the ground. The pit was reported to be an unlined excavation of unknown depth. Length of use of the pit is also unknown.

During field sampling a hole was cut in the concrete slab and a hand auger was used to attempt to sample the floor of the pit. The auger encountered rubble that had been placed in the pit when it was abandoned. The rubble prohibited sampling of the pit floor and the building would have to be demolished and the slab and rubble removed to complete the sampling. Since future use of the facilities and buildings in the Camp Killpack cantonment area may include Building 4475, no further sampling of the pit was accomplished. If in the future the building is demolished, additional soil sampling may be required. Until then, the Army will retain control of the building. If in the future the property is released from Army control, land use controls including signage and deed restrictions, will be implemented for the building. The institutional controls will minimize potential human exposure to possible site chemicals.

### *Above Ground Storage Tank, Building T-1932*

Aboveground 275-gallon diesel heating oil tanks were used at Camp Killpack and Camp Bonneville cantonment areas since the 1920s and 1930s. Surface soil samples were collected from eight tank locations exhibiting evidence of contamination within the Camp Bonneville cantonment. Remediation activities including excavation, confirmation sampling, and backfilling at the eight locations. Contaminated soil was removed from seven of the tank locations; however, one confirmation sample collected from the tank at Building T-1932 contained concentrations exceeding the MTCA Method A cleanup level. Further excavation of soil from beneath the building was considered. However, to continue excavation would have undermined the foundation of the building. Since future use of the facilities and buildings in the Camp Bonneville cantonment area may include Building T-1932, no further soil sampling or remediation was accomplished. With concurrence of Ecology, excavation was terminated and the site was backfilled with imported soil. If in the future the building is demolished, additional soil sampling and removal may be required. Until then, the Army will retain control of the building. If the property is released from Army control, land use controls, including signage and deed restrictions, will be implemented for the building. The institutional controls will minimize potential human exposure to possible site chemicals.

### *Soil Excavation Restrictions*

A soil excavation permit shall be required for each proposed excavation within the boundary of Camp Bonneville. The permit shall be required for each excavation or subsurface activity, regardless of the planned depth of the activity. The permit will be evaluated to determine whether a proposed site is consistent with the land use restrictions. The permits are an additional tool for the Army to receive timely information to monitor the land use restrictions. The permit will also provide information to the requestor regarding previous hazardous materials remediation at the proposed excavation site. Such excavation restrictions will be noted in the equitable servitude on the property transfer documentation. A flow chart outlining the permit process and a permit application are presented in Appendix D.

### *Enforcement of Institutional Controls*

Institutional controls are part of a legally selected remedy. Institutional controls are generally enforced through periodic inspections and periodic reports. The Army will promptly report violations of ICs to Ecology and will engage in a dialogue with the landowner and entity violating the institutional control. Additionally, if there is a violation of institutional controls, legal action may be considered in a court of competent jurisdiction to judicially enforce the requirements of the land use restrictions. The term "judicially enforce" means to initiate civil litigation to have a court order provided to a violator to cease the behavior and to impose other remedies that may be fair and equitable. The incentives for individuals to comply with institutional controls are that in non-compliance could be deleterious to their health and well being and that compliance is legally required.

### *Removal of Institutional Controls*

Equitable servitude restrictions or other institutional controls put in place to ensure the protectiveness of the remedy may need to be revised if a remedy has performed as expected and cleanup objectives have been met. Institutional controls may be removed once the Army can demonstrate to Ecology that the site is suitable for unrestricted use. Examples of how institutional controls may be removed from a site are if an intended action will alter or negate the need for the institutional control (e.g., a construction activity that will include removing contamination on site that form the basis for the institutional control). Another example is if there is documented evidence that the site has achieved its remedial action objectives and met appropriate cleanup levels such that the IC is no longer necessary to protect human health and the environment. In such a case, the Army will initiate action to revise an equitable servitude restriction or other institutional controls, as appropriate. For the Maintenance Pit and Above Ground Storage Tank, Appendix B lists the specific contaminants of concern and their detected concentrations for sites that require institutional controls due to potential adverse risks.

The Army will petition Ecology, in writing, to remove or terminate an institutional control. The written petition will provide the appropriate documentation that an unrestricted land use is appropriate.

### *Inspections and Reporting*

The institutional controls identified in this Draft Final CAP will be inspected and reported on an annual basis, or as necessary. The reports will assess the need for additional, or a reduction in, inspection requirements, as well as determine whether the institutional controls in place are effective. The annual reports will be the basis for evaluating the institutional controls effectiveness as part of the MTCA 5-year review process. Due to the presence of chemicals above non-restrictive land use cleanup levels at specified sites since the majority have met cleanup levels RAU 1 sites, Camp Bonneville will continue to be subject to 5-year reviews pursuant to CERCLA § 121(c) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) §300.430(f)(4)(ii).

### 7.2.4 Education Program

Effective communication of institutional controls is required to obtain public support for and understanding of the need for ICs. Institutional control education is fundamental to their success. The Education Plan provides for a proactive plan to involve the community in developing appropriate information for hazard awareness.

The Education Program is intended to familiarize local residents and visitors about the hazards on Camp Bonneville. The hazard awareness program will familiarizes personnel with the history, use, storage, and handling of hazardous materials on Camp Bonneville; basic characteristics of hazardous materials on the Camp; and the procedures that should be followed if a suspected hazardous material item is encountered.

### 7.2.5 Engineering Controls

There are no engineering controls identified for the RAU 1 sites.

To be completed upon submission for public review and comment.

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