

CHAPTER 3

AFFECTED ENVIRONMENT — FORT LEWIS

This chapter describes the affected environment for Fort Lewis. The affected environment is the portion of the existing environment that could be affected by project activities. The affected environment varies for each resource. Both the nature of the resource and components of the alternatives dictate this variation. The following sections concentrate on providing only the specific environmental information necessary to assess the potential effects of the alternatives analyzed in **Chapter 4**.

3.1 SOIL EROSION

Fort Lewis's topography is generally flat to gently rolling, with localized areas of moderately sloping lands. Surficial geologic units primarily consist of glacial deposits formed during the retreat of the Vashon glacier and include glacial outwash terraces, channels, glacial ponds, till, and outwash gravels. Due to the coarse nature of the glacial deposits, Fort Lewis soils are highly resistant to compaction and are typically permeable and well drained, despite high regional precipitation levels (Army 2001e). These properties, combined with generally gentle topography, result in limited erosion constrained to localized areas of steep slopes and escarpments along the Nisqually River and Puget Sound (Randolph et al. 2008).

The soil types on Fort Lewis are dominated by the Spanaway-Nisqually association (Pringle 1990). Spanaway soils are formed on gravelly glacial outwash and are typically gravelly sandy loam, whereas the Nisqually soils are formed on sandy glacial outwash and are loamy fine sands. Other well- to poorly drained soils exist throughout Fort Lewis. Soils on Fort Lewis have the potential to be moderately productive under good management practices, and the Nisqually loamy sand is cultivated in Pierce County to produce hay and minor berry crops (Zulauf 1979).

3.2 WATER RESOURCES

The affected environment section for water resources lays out the foundation for addressing issues identified during the public scoping process. These issues include the effects of Army Growth and Force Structure Realignment on surface water resources and the effects of construction and demolition activities and long-term operations on surface water and groundwater quality, including drinking water sources and hydrology.

The ROI for water resources includes portions of several jurisdictional units designated by Washington's natural resource agencies (**Figure 3-1**). Fort Lewis lies within three Water Resource Inventory Areas (WRIAs) that were designated by the Washington Department of Ecology, Department of Natural Resources (WDNR), and Department of Fish and Wildlife (WDFW) to facilitate watershed planning. In addition, WDNR further divides the WRIAs into smaller Watershed Administrative Units (WAUs). The three WRIAs are Nisqually River (WRIA 11), Chambers-Clover (WRIA 12), and Deschutes River Basin (WRIA 13). The five WAUs are Chambers-Clover, Muck Creek, Yelm Creek, McAllister, and Lower Deschutes (**Figure 3-1**).

3.2.1 Surface Water

Surface water resources in the ROI include rivers, streams, lakes, wetlands, and marine areas. The following sections describe the occurrence, quantity, and quality of water present in these resources.

3.2.1.1 Surface Water Occurrence and Quantity

The main surface water feature in the ROI is the Nisqually River, which crosses Fort Lewis in a southeast to northwest direction and discharges into the Nisqually Reach of Puget Sound (**Figure 3–1**). Other major streams include Muck Creek, Murray Creek, and Sequalitchew Creek. In addition, 29 lakes exist on Fort Lewis, the largest of which are American, Lewis, Nisqually, and Sequalitchew Lakes.

Due to the pervious nature of the surface soils and the presence of groundwater near the surface of the land, several surface water bodies exist as surface expressions of the shallow groundwater table. Examples are American Lake; Sequalitchew Lake; several wetlands; at times, Sequalitchew Creek and Murray Creek in the cantonment area; and numerous other lakes, wetlands, and some tributaries to Muck Creek. Some of these areas are both groundwater discharge and recharge areas, depending on seasonal changes in groundwater elevation and on the direction of groundwater flow.

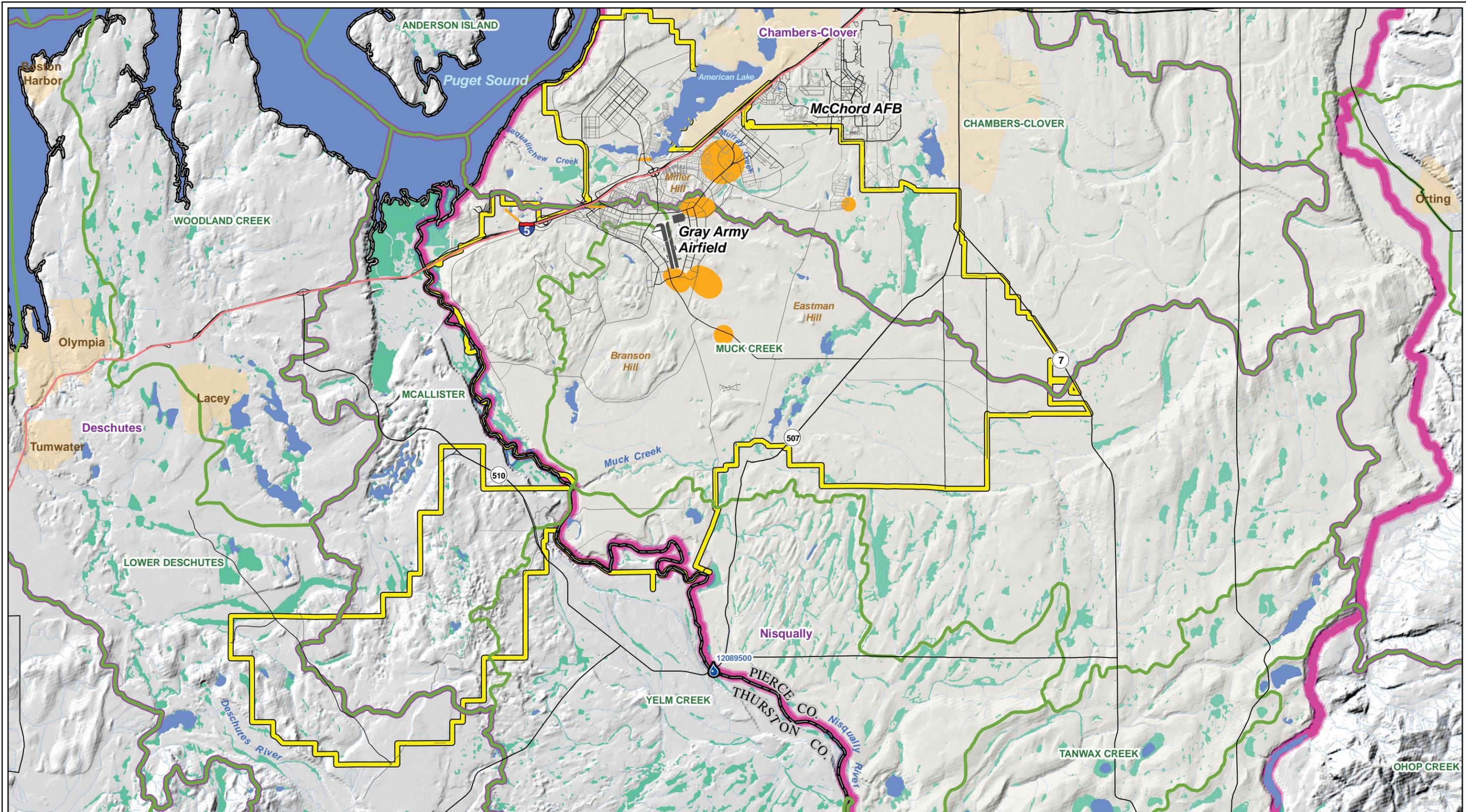
Although no streamflow data are specifically available for water resources on Fort Lewis, the U.S. Geological Survey (USGS) monitors streamflows in the Nisqually River at the McKenna gauging station (Station 12089500) upstream of Fort Lewis. Annual streamflows from 1947 through 2007 range from 590 cubic feet per second (cfs) (1,000,000 liters per minute [L/min]) to 2,240 cfs (3,806,000 L/min), with an average of 1,280 cfs (2,170,000 L/min) for the 60-year period. Average monthly streamflows during this period range from a low of 438 cfs (744,000 L/min) in August to a high of 2,290 cfs (3,890,000 L/min) in December (USGS 2008).

Natural surface water, groundwater, and stormwater flow systems are mixed in some portions of Fort Lewis because of interconnections among the three systems.

The stormwater drainage system primarily accommodates runoff from the major built-up areas, such as North Fort and Main Post. Drainage of these areas generally is to the north, with discharges into Puget Sound. Within the drainage basin are American Lake, American Lake Marsh, Bell Marsh, Elliot Marsh, Hamer Marsh, Kennedy Marsh, Lynn Lake, McKay Marsh, Murray Creek, Sears Lake, Sequalitchew Creek, and Sequalitchew Lake. Sequalitchew Creek is the major drainage channel for American and Sequalitchew Lakes. In addition to Sequalitchew Creek, a drainage canal on North Fort conveys its associated waters into Puget Sound (Chavez 2009).

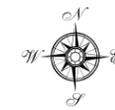
In several areas, stormwater drainage systems include natural surface waters as part of their conveyance system. Examples are Murray Creek and Bell, Hamer, and McKay marshes near Sequalitchew Creek. Murray Creek receives several stormwater discharges, including a motor pool area discharge that routes first through Kennedy Marsh. Hamer, Bell, and McKay marshes, which are situated adjacent to Sequalitchew Creek, receive stormwater flows from two large storm drains and several small storm drains. Stormwater flows through the marshes as sheet flow or in channels, depending on which drain is involved. Most stormwater flow passes under Sequalitchew Creek in culverts and continues through a constructed storm drainage channel that discharges to Puget Sound near the sewage treatment plant at the northwest corner of Fort Lewis. Stormwater flows from areas that include commercial or industrial activity are treated prior to discharge to the marshes. Because of the interconnections between natural surface water, groundwater, and stormwater, the three flow systems are mixed in some areas of Fort Lewis.

The Federal Emergency Management Agency/Flood Insurance Rate Map (FEMA/FIRM) “Special Flood Hazard Areas” maps suggest that the Nisqually River and Muck Creek are the only drainages subject to major flooding (Washington Department of Ecology 2008). Local flooding occurs because of backups in the storm drainage system along Pendleton Avenue between its intersections with



Legend

- USGS Monitoring Station
- Interstate
- State Route
- WAU Boundary
- County Boundary
- WRIA Boundary
- Water Body
- Fort Lewis Boundary
- Pierce County Sole Source Aquifer Boundary
- River / Stream
- Well Head Protection Area
- Wetland
- Municipal Area



FORT LEWIS GTA EIS

*Figure 3-1
 Water Resources at
 Fort Lewis*

ANALYSIS AREA: Thurston & Pierce Counties, Washington

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Kaufman Avenue and Division Street. Inadequate storm drain size in the lower part of the drainage basin is believed to cause this flooding along Pendleton Avenue. Additional local flooding has been reported for the stormwater system in North Fort, but blocked storm drain inlets are believed to cause that flooding because the system is adequately sized to carry expected stormwater flows.

3.2.1.2 *Surface Water Quality*

The State of Washington classifies marine waters into four classes (AA, A, B, and C) based on meeting their water quality standards. Class AA represents extraordinary, class A represents excellent, class B good, and class C represents fair marine aquatic resources environment. All marine waters receiving surface water from streams on Fort Lewis are classified as AA (Kolosseus 2006).

The State of Washington also classifies freshwater surface bodies based on their water quality into five categories, with Category 1 representing the cleanest waters and Category 5 representing the most polluted waters. Category 5 is the list of impaired water bodies known as the 303(d) list in the Clean Water Act. Placement in Category 5 means that water quality standards have been violated for one or more pollutants, and there is no Total Maximum Daily Load (TMDL) or other pollution control plan in place (Washington Department of Ecology 2004).

Although none occurs within the Fort Lewis ROI, several water bodies in the Nisqually WRIA have been placed on the 303(d) list for impairment. McAlister Creek, which is northwest of Fort Lewis, is listed as impaired by fecal coliform and dissolved oxygen. Ayer Creek (located west of the Fort Lewis boundary) and Nisqually Reach are each listed as impaired by fecal coliform. Some upstream tributaries to Nisqually River are listed as impaired by temperature, phosphorus, or both (Washington Department of Ecology 2004).

Surface water quality problems within the Chamber-Clovers watershed (WRIA 12) are mainly fecal coliform bacteria and phosphorus (Washington Department of Ecology 1995). Within the boundaries of Fort Lewis, American Lake is listed as impaired by phosphorus based on the 303(d) list. Other 303(d) listed segments are located outside of Fort Lewis (Washington Department of Ecology 2004).

In the WRIA 13, the Deschutes River (located just west of Fort Lewis), is listed as impaired by temperature on the 303(d) list of impaired streams. However, no water bodies or stream segments within the boundaries of Fort Lewis are listed as impaired (Washington Department of Ecology 2004).

Effluents from the Fort Lewis sewage treatment plant and nonpoint stormwater runoff discharge into Puget Sound near the northwest corner of the installation. Treatment is provided for stormwater at several locations. Wastewater from motor pools is treated and discharged to the sanitary sewer for further treatment. Occasional overflows from the sewage treatment plant and stormwater collection system discharge to surface waters.

Stormwater flows from commercial and industrial sections of the cantonment area are routed through treatment facilities before discharge through wetlands or the constructed storm drainage channel to Puget Sound. The treatment facilities are designed to remove suspended solids, infiltrate, and separate oils. Although some residential and light commercial sections may discharge without a specific treatment facility, in most cases the stormwater must travel through dense vegetation before entering any body of water. A large discharge to American Lake from residential housing and streets with no treatment does exist (Chavez 2009).

The Army discharges treated wastewater from the Solo Point wastewater treatment plant (WWTP) to Puget Sound under its EPA National Pollutant Discharge Elimination System (NPDES) permit. Over the 2004-to-2009 period of the previous permit, the Army exceeded the permit treatment requirements six times (EPA 2009c). The Solo Point treatment plant has sufficient capacity to handle the demand from the proposed action. However, given the past performance of the facility it is expected that discharges will violate permit treatment requirements more frequently in the future as demand increases. Increased demand combined with more stringent requirements for discharges under future NPDES permits will render the Solo Point WWTP insufficiently protective of Puget Sound water quality.

3.2.2 Groundwater

3.2.2.1 Groundwater Occurrence

The geologic strata beneath the Fort Lewis ROI form a complex system of hydrogeologic units that control groundwater flow in the area. This groundwater system has been characterized on both a broad regional scale and a detailed, site-specific scale (Army 1994).

The regional groundwater system consists of alternating aquifers (water-bearing strata composed of sand and gravel) and aquitards (strata composed of silts and clays not capable of producing significant quantities of groundwater). The shallowest aquifer encountered beneath the Fort Lewis ROI occurs in coarse gravels within the Vashon Drift. This aquifer usually exhibits unconfined or water-table conditions, meaning that groundwater levels occur at atmospheric pressure and are below the top of the aquifer. The depth to water in the shallow Vashon Drift Aquifer ranges from 10 feet (3 meters [m]) to 30 feet (9 m) throughout Fort Lewis, with lesser depths near lakes and streams and greater depths beneath the higher hills. The Vashon Drift Aquifer is continuous across the Fort Lewis ROI.

Deeper aquifers within the Salmon Springs Drift, Stuck Drift, and Orting Drift contain groundwater under confined conditions and are separated from shallower units by low-permeability aquitards. Under confined conditions, groundwater is contained in the aquifer under pressure by the overlying strata, resulting in groundwater levels that are above the top of the aquifer. Confined aquifers are generally less susceptible to surface sources of contamination than are unconfined aquifers.

On a regional scale, groundwater recharge originates as precipitation on the western flank of the Cascade Mountains. From here, it is transmitted in a generally westerly direction through the multiple layers of the hydrostratigraphic system and discharges to the Puyallup and Nisqually River valleys and to Puget Sound. Local recharge of the groundwater system beneath Fort Lewis is provided primarily by infiltration of direct precipitation, stormwater runoff, wastewater disposal, and reaches of lakes and streams that lie above the prevailing water table.

Groundwater in the shallow Vashon Drift Aquifer generally flows in a west-to-northwest direction across Fort Lewis, with localized changes in flow direction near discharge areas (major lakes, creeks, and the Nisqually River). Flow of groundwater in the deeper aquifers is also generally west to northwest. Groundwater elevations decrease with aquifer depth, indicating a downward vertical gradient. Groundwater velocities have been estimated at 0.02 feet (0.06 m) per day to 2 feet (0.6 m) per day for the shallow Vashon Drift aquifer and 0.1 foot (0.03 m) per day to 1 foot (0.3 m) per day for the Salmon Springs aquifer (Army 1994).

3.2.2.1.1 Groundwater Use

Fort Lewis operates four public water systems, all of which rely entirely on groundwater. The principal water supply system at the installation is the cantonment area system. The cantonment area system supplies water to more than 47,000 people in the cantonment area. The twelve source wells vary in depth from 17 feet (5.1 m) to 1,340 feet (408 m) and meet the water supply needs of the cantonment area. Rated capacities of these wells range from 400 to 1,650 gallons per minute (gpm) (1,510 to 6,250 L/min) (Chavez 2009). This system consists of one drinking water source, Sequalitchew Spring, and eight drinking water source wells at various locations around the Post. It has a supply capacity of approximately 19 million gallons per day (mgd) (72 million L/day) and a storage capacity of approximately 6.9 mgd (26 million L/day) (Chavez 2009).

The other three public water systems are relatively small and supply the Golf Course, the Ammo Supply Point, and Range 17. Single-source wells supply the Golf Course and Range 17, whereas the Ammo Supply Point has two source wells.

In 2008, demand for water in the cantonment area ranged from an average daily of 3.2 to 5.6 mgd (12 to 21 million L/day) with a yearly daily average demand of approximately 3.8 mgd (14 million L/day) (Chavez 2009). Year-round water demand in general, and summer water demand for irrigation in particular, have declined due to implementation of an installation water conservation regulation (Fort Lewis Regulation 11–5 *Water Conservation*) and water conservation program, which includes public education. Historically, the water demand has ranged from approximately 5 to 16 mgd (19 to 61 million L/day) with an average demand of approximately 8 mgd (30 million L/day) (Chavez 2009).

3.2.2.2 Groundwater Quality

Most of the groundwater quality problems in the regional area are attributed to natural conditions and are generally related to iron and manganese. A 1998 USGS study concluded that contamination of groundwater in Thurston County by commercial and industrial activities is minimal. In terms of meeting drinking water standards, groundwater quality appears to be good. Nitrate is the most widespread pollutant in shallow aquifers, and although it is not a problem throughout the entire region, there are localized areas that exhibit elevated nitrate levels (Golder Associates 2003).

Groundwater in the Fort Lewis ROI is generally low in total dissolved solids and shows a predominance of calcium and bicarbonate as major constituents, associated with lower concentrations of magnesium, sulfate, and chloride (Brown and Caldwell 1985, as cited in Army 1994). Discharges from septic tanks and stormwater recharge systems (dry wells) have resulted in detectable increases in constituents such as nitrates and chlorides in developed portions of Pierce County. Monitoring records for the Fort Lewis water system indicate that, with few exceptions, water quality complies with requirements for water supplies (Gray and Osborne 1991).

The groundwater quality beneath specific areas of Fort Lewis has been adversely affected by waste disposal, leaks, and spills of chemicals. Three sites in the Fort Lewis ROI are on the EPA NPL of contaminated sites. These include the Logistics Center and two sites on McChord AFB. A fourth site, Landfill No. 5 site, was delisted from the NPL in 1995 (EPA 2008c). Current status and sources of contamination are discussed in **Section 3.12.8**.

Tungsten ammunition (5.56 mm) was used at Fort Lewis's small arms ranges in the early part of the last decade. The Army has now ceased using this ammunition. In 2007, the Army tested soil and water for tungsten at two of Fort Lewis's ranges. Although the report for this sampling has not been

completed, preliminary results show that tungsten is limited to a depth near the surface. The testing indicates that tungsten is not migrating to the groundwater.

3.2.2.2.1 Groundwater Protection Programs

EPA designates sole-source aquifers to protect drinking water supplies in areas where few or no alternative sources to the groundwater resource exist and where, if contamination occurred, using an alternative source would be extremely expensive. These areas have no alternative drinking water sources that physically, legally, and economically could supply all those who depend upon the aquifer for drinking water (EPA 2009b). EPA defines a sole-source aquifer as an underground water source that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer. Most of the Fort Lewis ROI is underlain by the Central Pierce County Aquifer, which EPA has designated as a sole-source aquifer. **Figure 3–1** shows the areal extent of the Central Pierce County Aquifer.

Under the 1990 Growth Management Act, every county and city in Washington undergoing comprehensive planning was required to adopt critical areas ordinances to protect the integrity of natural resources. Many entities within the Nisqually Watershed include Wellhead Protection Areas (WHPAs) as a component of their critical areas ordinances, with the intention of protecting groundwater quality and supply (Golder Associates 2003). Several WHPAs occur within Fort Lewis (**Figure 3-1**). A WHPA is defined as the area that lies within the 10-year time of travel zone boundary of a Group A public water system well, as delineated by the water system purveyor pursuant to Washington Administrative Code (WAC) 246–290–135 (Golder Associates 2003).

In addition, Fort Lewis has been actively involved in the Puget Sound Federal Caucus. This Caucus is a sub-group of the Puget Sound Partnership. The Caucus was established in 2007 to better integrate, organize, and focus federal efforts in the Puget Sound Ecosystem. Through the Caucus, 13 federal agencies, including the Army, align resources and programs to address Puget Sound priority problems.

3.3 BIOLOGICAL RESOURCES

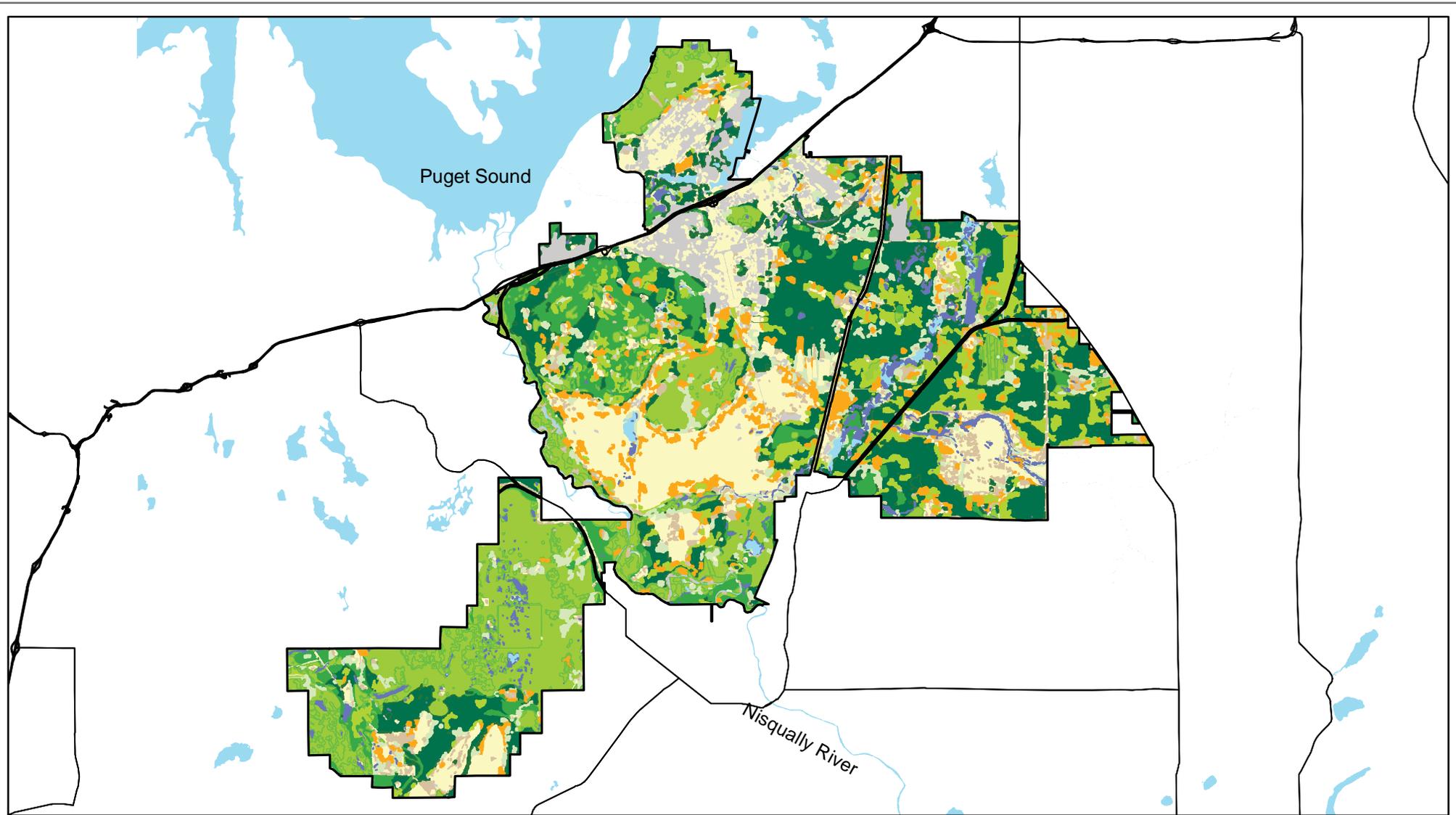
3.3.1 Vegetation

3.3.1.1 Plant Communities

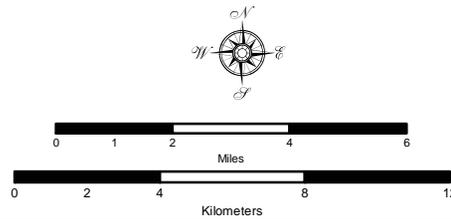
The plant communities on Fort Lewis can be divided into four broad habitat types: coniferous forests, grasslands (commonly known as prairies), oak/oak-mixed woodlands, and wetlands/riparian zones (**Figure 3–2**).

3.3.1.1.1 Coniferous/Mixed Forests

Nearly two-thirds of Fort Lewis (approximately 54,800 acres [22,200 ha]) is dominated by closed forest, primarily conifer-dominated. Three coniferous forest types are present on Fort Lewis. The most prevalent type is prairie colonization forest, dominated by Douglas-fir (approximately 30,300 acres [12,200 ha]). These forests consist of first-generation stands growing on prairie soils. Ponderosa pine occurs in small, pure stands (approximately 780 acres [316 ha]) or scattered in the overstory, and Oregon white oak is a fairly common overstory associate (scientific names of all species cited in the EIS are in Appendix H). These forests are the result of Douglas-fir encroachment into grasslands in the absence of fires set by historical inhabitants. The second type of coniferous forest is historical dry forest (7,300 acres [3,000 ha]), which is similar to prairie colonization forest, but occurs in areas where similar forests were in existence prior to European settlement. The third coniferous forest type is moist coniferous forest, which is dominated



- | | |
|---|---|
|  Prairie Colonization Forest |  Shrubland |
|  Historic Dry Forest |  Grassland |
|  Historic Moist Forest |  Water |
|  DF/DP Forest |  Wetland |
|  Woodland |  Developed/Bare Ground |
|  Savanna | |



FORT LEWIS GTA EIS	
<p><i>Figure 3-2</i> General Plant Communities on Fort Lewis</p>	
ANALYSIS AREA: Thurston & Pierce Counties, Washington	
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by Douglas-fir and western hemlock, with western red cedar present in both the understory and overstory (approximately 17,200 acres or 6,900 ha). Following logging or fire, some areas in a moist coniferous forest are temporarily dominated by red alder and big leaf maple. Hardwood stands cover approximately 6,400 acres (2,600 ha) of Fort Lewis.

Plant communities with a significant component of ponderosa pine occur in both prairie colonization forest and oak woodlands (**Section 3.3.1.1.3**). Fort Lewis has the largest occurrence of native ponderosa pine west of the Cascade Mountains, including a few acres of native pine savanna with native grassland understory, which is a unique plant community found nowhere else.

3.3.1.1.2 Prairies/Grasslands

There are approximately 16,500 acres (6,677 ha) of grassland habitat on Fort Lewis. These grasslands vary in quality, with quality typically defined in terms of the amount of native vegetation relative to the amount of non-native vegetation on a given site. Intact, high-quality prairie is an open grassland habitat dominated by the native bunchgrass Roemer's fescue (up to 70 percent cover), with lesser amounts of long stolon sedge, California oatgrass, and prairie junegrass. The spaces between clumps are occupied by numerous forbs, primarily perennials, which often grow up through a biological soil crust. Grasslands also include significant areas that are dominated by Scotch broom and can therefore be classified as shrubland, at least temporarily. The acreage and location of shrubland varies from year to year, based on the level of Scotch broom control and/or regrowth.

According to descriptions provided by the Washington Natural Heritage Program (WNHP), relatively undisturbed prairies can be defined by the Roemer's fescue – white-top aster association community type. Disturbed grasslands typically support substantial populations of invasive species and are defined by several different disturbance community types, which vary based on their species assemblages. On Fort Lewis, the vast majority of prairies have low to medium cover of native graminoids, and only 18 percent of surveyed prairies are estimated to have more than 50 percent cover of native graminoids, based on data from 2007 (Randolph 2008).

Table 3–1 provides information on the native graminoid cover of the main prairie areas on Fort Lewis. Native graminoid cover does not reflect overall prairie quality, as it does not consider native forb diversity and cover. Areas such as TA 7S, Range 51, and Ranges 74/76 have some of the highest forb diversity and cover of any South Puget Sound prairie, although native graminoid cover is relatively low in these areas. Areas for which complete data are unavailable, such as parts of the Artillery Impact Area (AIA), are not included in **Table 3–1**.

WNHP ranks South Puget Sound prairies in their plant community ranking system with a Global and State rank of G1S1 (the most threatened ranking possible), which means that they are imperiled on both global and state levels. Given that less than 10 percent of the original prairie grasslands in the south Puget Sound region remain (Crawford and Hall 1997), and that Fort Lewis contains some of the largest tracts of remaining prairie habitat in the region, Fort Lewis prairies are very important from a regional landscape perspective. Additionally, prairies on Fort Lewis provide habitat for numerous special-status plant and animal species.

3.3.1.1.3 Oak/Oak-mixed Woodlands

Oak and oak-mixed woodlands, which cover approximately 4,700 acres (1,900 ha) on Fort Lewis, range from pure Oregon white oak to a mix of oak, coniferous, and deciduous trees. Oak woodlands are typically ecotonal habitat between the grasslands and the surrounding forests and occur in association with Oregon ash in riparian zones within the grasslands. Historically, these communities supported open canopies that allowed grasses to persist in the understory and ranged from open

savannas with a low density of trees to woodlands with more closed canopies and abundant shrub cover in the understory. Today, most of the remaining prairie-forest ecotones are woodlands; a large percentage of savannas have been altered by fire suppression and the subsequent invasion of trees and Scotch broom. Oregon white oak habitat in Washington is declining, and the remaining stands are often small, fragmented, or isolated, and degraded (Kertis 1986 as cited in Larsen and Morgan 1998). The remaining stands are at risk for encroachment from Douglas-fir and loss through urban development. It is estimated that Fort Lewis contains 35 percent of the remaining oak habitat in western Washington State (GBA Forestry Inc. 2002). For these reasons, they are important from a regional landscape perspective. Because Oregon white oak woodlands provide habitat for many rare animals, including the western gray squirrel and several bird species, WDFW lists them as a Washington State Priority Habitat.

Table 3–1 Native Graminoid Cover of Fort Lewis Prairies

Prairie	Acres in Good Condition¹	Acres in Fair Condition²	Acres in Poor Condition³
Mortar Point 13 ⁴	N/A ⁵ (10.1%)	N/A (35.0%)	N/A (54.9%)
Range 51 ⁴	10 (10.1%)	20 (27.8%)	42 (62.1%)
Range 74/76 ⁴	17 (2.7%)	87 (14.3)	507 (83.0%)
TA 6 ⁶	51 (5.8%)	119 (13.5%)	709 (80.7%)
TA 7S ⁴	1 (0.8%)	3 (2.1%)	137 (97.1%)
TA 8 ⁶	0	0	371 (100%)
TA 14 (13 th Division Prairie) ⁶	37 (2.5%)	178 (12.1%)	1,257 (85.4%)
TA 15 ⁴	24 (4.8%)	72 (14.2%)	410 (81.0%)
Marion Prairie ⁶	8 (3.7%)	25 (11.7%)	181 (84.6%)
Johnson Prairie ⁶	43 (20.7%)	40 (19.2%)	125 (60.1 %)
Lower Weir Prairie ⁶	54 (11.1%)	59 (12.2%)	371 (76.7%)
Upper Weir Prairie ⁶	221 (43.4%)	73 (14.3%)	215 (42.2%)

Notes:

- 1 Good condition = 51 to 100% cover of native grass.
- 2 Fair condition = 31 to 50% cover of native grass.
- 3 Poor condition = 0 to 30% cover of native grass.
- 4 Source: Land Condition Trend Analysis (LCTA) land condition mapping data, 2008 (Lyon et al. 2008).
- 5. N/A = Not available.
- 6 Source: LCTA land condition mapping data, October 2003 (Gilbert 2003).

3.3.1.1.4 Wetlands/Riparian Areas

On Fort Lewis, wetlands cover approximately 4,100 acres (1,700 ha) and are widely distributed. Types of wetlands on Fort Lewis include:

- aquatic beds with aquatic vascular plants, such as duckweed, pondweed, and Eurasian water-milfoil;
- emergent wetlands, some of which are open, marshy habitats supporting numerous species of sedge, cat-tail, and other herbaceous species;
- scrub-shrub habitats that support low-growing woody species, such as spirea and willows; and
- forested wetlands, which are characterized by red alder and Oregon ash in the overstory and salmonberry, vine maple, and stinging nettle in the understory.

3.3.1.2 Noxious Weeds

There are 114 noxious weeds targeted for control in Pierce County (Pierce County Noxious Weed Control Board 2008) and 36 noxious weeds targeted for control in Thurston County (Thurston County Noxious Weed Control Agency 2008). Noxious weeds are found in all habitat types on Fort Lewis, but occur primarily along fence lines, buildings, and roads, and in training and open areas. Management of invasive species is guided by the Integrated Pest Management Plan (IPMP). Weed control management on Fort Lewis focuses on Scotch broom and listed noxious weeds, including tansy ragwort, knapweeds, leafy spurge, mouse-eared hawkweed, and sulphur cinquefoil. Wetlands on Fort Lewis contain scattered populations of reed canarygrass, purple loosestrife, yellow-flag iris, and Eurasian watermilfoil. Control efforts on the installation include mechanical control, hand and machine removal, tree girdling, establishment of desirable cover, and use of herbicides. Control of invasive species is done by numerous programs, including Forestry, Fish and Wildlife, ITAM, and Pest Management.

3.3.1.3 Special Status Species

According to information from the U.S. Fish and Wildlife Service (USFWS) and WNHP, 15 plant species of special status may occur on or near Fort Lewis (**Table 3–2**). Included are species that historically occurred on or near Fort Lewis, but are not known to occur there currently. These species are federally designated as threatened or endangered under the Endangered Species Act (ESA), or as species of concern, or are state-designated as endangered, threatened, or sensitive.

Table 3–2 Special Status Plant Species That May Occur On or Near Fort Lewis

Common Name	Scientific Name	Federal Status ¹	State Status ¹
Bog clubmoss	<i>Lycopodiella inundata</i>	--	S
Bristly sedge	<i>Carex comosa</i>	--	S
Chain-fern	<i>Woodwardia fimbriata</i>	--	S
Common blue-cup	<i>Githopsis specularioides</i>	--	S
Golden paintbrush	<i>Castilleja levisecta</i>	T	E
Hall's aster	<i>Symphiotrichum hallii</i>	--	T
Marsh sandwort	<i>Arenaria paludicola</i>	E	XN
Pine-foot	<i>Pityopus californica</i>	--	T
Small-flowered trillium	<i>Trillium parviflorum</i>	--	S
Tall agoseris	<i>Agoseris elata</i>	--	S
Texas toadflax	<i>Nuttallanthus texanus</i>	--	S
Torrey's peavine	<i>Lathyrus torreyi</i>	SC	T
Water howellia	<i>Howellia aquatilis</i>	T	T
White meconella	<i>Meconella oregana</i>	SC	T
White-top aster	<i>Sericocarpus rigidus</i>	SC	S

Note:

1. E = endangered; T = threatened; S = sensitive; SC = species of concern; and XN = possibly extirpated or extinct.
Sources: USFWS 2010; WNHP 2008c.

Detailed information for federally listed and special concern plant species that may occur at or near Fort Lewis is provided in the following sections.

3.3.1.3.1 Golden Paintbrush

The golden paintbrush is a perennial herb that occurs in open grasslands at elevations below 328 feet (100 m) around the periphery of the Puget Trough. Most populations occur on glacially derived soils.

Associated species include Roemer's fescue, red fescue, camas, common velvetgrass, yarrow, bracken fern, vetch, and brome (Gamon 1995). Many populations of this species have been extirpated (made locally extinct) by conversion of habitat to agricultural, residential, and commercial development. In Oregon, the golden paintbrush historically occurred in the grasslands and prairie of the Willamette Valley, but has since been extirpated from all of these sites.

The golden paintbrush was federally listed as threatened on June 11, 1997. Critical habitat has not been designated. In Washington, golden paintbrush is listed as a state endangered species. The species is threatened by habitat modification through succession of grassland to shrub and forest habitat. In addition, the potential for expansion and persistence of refugia (suitable habitat) is low due to reduction of habitat. Because the current distribution of the species has been greatly fragmented and reduced from the historical distribution, the species is vulnerable to other threats like interspecific competition with native and non-native woody species and reduced vigor and reproductive potential caused by trampling or collecting during public recreational use of sites. The species is particularly vulnerable in sites zoned for use as residential development or commercial use.

The USFWS lists the golden paintbrush as a species that may occur on Fort Lewis. Fort Lewis contains suitable habitat for this species, but several surveys have failed to find it (Army 2001c, e). However, six native grasslands near Fort Lewis, all of which are Army Compatible Use Buffer (ACUB) areas, have experimental, introduced populations of this species (Dunwiddie 2009).

3.3.1.3.2 Marsh Sandwort

Marsh sandwort is a perennial herb that occurs in wetlands and freshwater marshes in Washington, Oregon, and California from sea level to more than 1,400 feet (425 m) (USFWS 1993). As of May 14, 2001, however, the only remaining populations were located in California (USFWS 2006). Populations occur in saturated acidic bog soils, which are predominantly sandy with a high organic content.

The marsh sandwort was federally listed as endangered on August 3, 1993. Critical habitat has not been designated. In Washington, marsh sandwort is considered possibly extirpated or extinct. Many populations of this species have been extirpated by the elimination of wetlands in which the species grows, degradation of wetlands through urban development, conversion of the habitat for agriculture and ranching activities, and off-road vehicle recreational use.

The marsh sandwort was listed by the USFWS as a species that may occur on Fort Lewis. Fort Lewis contains suitable habitat for this species, but several surveys have failed to find it (Army 2001c, e). The WNHP does not list this species as present in Thurston or Pierce counties (WNHP 2008c).

3.3.1.3.3 Torrey's Peavine

Torrey's peavine is a perennial legume native to wooded regions of the West Coast of the United States. It ranges as far north as Pierce County, Washington and as far south as Monterey, California. It sprouts bluish flowers that range from 0.31 to 0.51 inches (8 to 13 mm) in length. The Torrey's peavine is a federal species of concern and a state threatened species. There are only two current records of the existence of Torrey's peavine in Pierce County, Washington. The only known extant occurrences in Washington are in somewhat open areas within Douglas-fir-dominated sites within the Western Hemlock Zone (Franklin and Dyrness 1973). The sites have varying canopy cover, but all are greater than 60 percent. The topography of the sites is relatively gentle. Associated species include Douglas-fir, western swordfern, bracken fern, Cascade barberry, salal, bedstraw, and blackberry.

It is likely that natural disturbances, such as fire and wind-throw, helped create habitats historically. The species appears to favor forest openings, especially trail edges. It forms dense patches where competition from other species is low. It does not appear to do well, however, where there is significant cover of other species. The Torrey's peavine is listed by the USFWS as a species that may occur on Fort Lewis. Fort Lewis contains suitable habitat for this species, but it has not been found on the installation.

3.3.1.3.4 *Water Howellia*

Water howellia is a self-pollinated, annual aquatic plant that was federally listed as a threatened species on July 14, 1994 (USFWS 1994). No critical habitat has been designated for the species. In Washington, water howellia is listed as a state threatened species. Its historical range consists of five states in the Northwest United States: California, Idaho, Montana, Oregon, and Washington. In Washington, water howellia has been reported in Clark, Spokane, Pierce, and Thurston counties. The population has declined due to competition with introduced plants, loss of wetland habitat, and changes in habitat caused by timber harvesting, livestock grazing, and residential development.

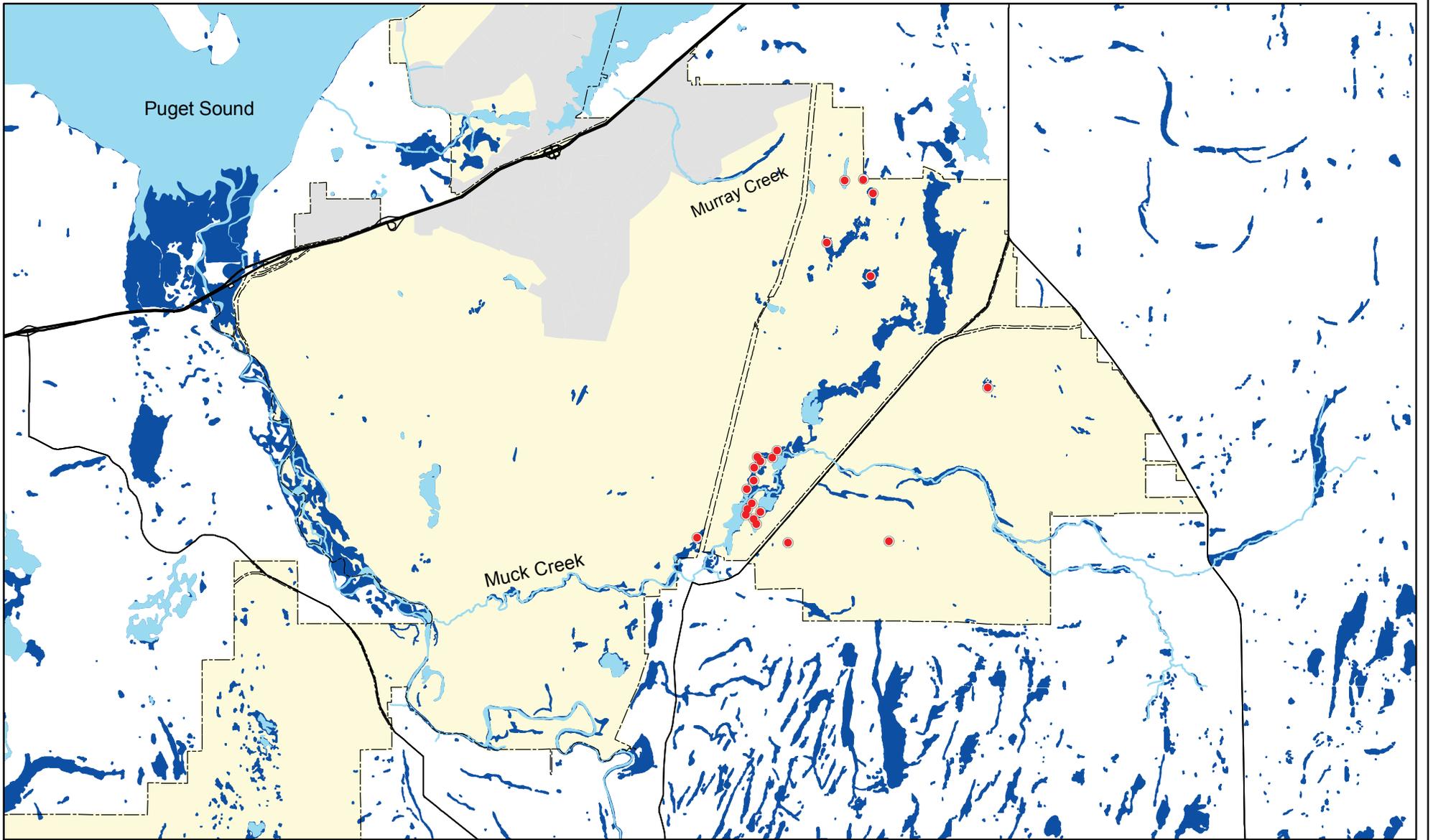
Water howellia is an annual aquatic forb that occurs in ephemeral freshwater marshes (Gilbert 2001). The species depends on an annual cycle of inundation and exposure of substrate to persist, with seeds germinating on exposed substrate in the fall, the majority of growth occurring the following April, and seed dispersal occurring from June into late summer. The stems grow under water in an erect manner, and rely on the water for structural support.

Water howellia was first discovered on Fort Lewis in 1994. During surveys in 2003 and 2004, 22 wetlands on the Main Post were identified as occupied by water howellia (**Figure 3–3**; Lynch 2005). These wetlands occur within the Ammunition Storage Area and in TAs 6, 8, 11, 12, and 13. These populations have been monitored since 1998 and appear to be stable (Gilbert 2002). All areas that could potentially contain water howellia were identified during these surveys, although all wetlands are considered to have potential habitat. The wetlands on Fort Lewis that have populations of water howellia range in size from less than 1 acre to 40 acres (0.4 to 16 ha), contain substrate of either Tanwax peat or Semiahmoo muck, and undergo significant annual fluctuations in water level (Gamon 1998). Other occurrences of water howellia in the region include two locations at McChord AFB, one location in Thurston County, and one location in Clark County.

Water howellia grows in firm, consolidated clay and organic sediments, in freshwater wetlands that are filled by spring rains and snowmelt runoff and that exhibit some drying during the growing season. The species' microhabitat consists of shallow water and the edges of deep ponds that are partially surrounded by broadleaf deciduous trees. One of the key habitat features necessary for water howellia survival is drying of wetlands during the autumn to allow seed germination, followed by submergence in the spring to permit growth and flowering. Water howellia is often found in relatively open wetlands with little surrounding deciduous forest (The Nature Conservancy 1997). The primary threats to water howellia include encroachment of invasive plant species into wetlands, unauthorized use of wetlands by humans, altered hydrology, and plant succession (Gamon 1997a). It is thought that the presence of water howellia on Fort Lewis represents a metapopulation, which must grow in several areas to maintain a viable population through time because of the potential for frequent local extinction (USFWS 1996).

3.3.1.3.5 *White-top Aster*

White-top aster is a perennial prairie forb that is endemic to low-elevation prairies west of the Cascade Range. Its north/south geographic range extends from Vancouver Island, British Columbia to the Willamette Valley of Oregon (Gamon and Salstrom 1992). The distribution of white-top aster



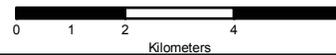
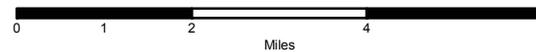
U.S. ARMY



● Water Howellia locations

■ Wetlands

■ Lakes and Streams



FORT LEWIS GTA EIS

*Figure 3-3
Water Howellia Locations
on Fort Lewis*

ANALYSIS AREA: Thurston & Pierce Counties, Washington	
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Prepared By: KA	Layout: ProjectArea.pdf

throughout its range is patchy and discontinuous, with the largest recorded population of the species found on Fort Lewis. White-top aster is found primarily on prairies with greater than 50 percent cover of native species (Thomas and Carey 1996). The species appears to favor at least partially open conditions, and its demographics are influenced by its long-lived, clonal nature.

On Fort Lewis, white-top aster is found on all prairies, but is much more common on prairies with a large native species component, such as Lower Weir and Johnson prairies, TA 15, and portions of the AIA. Because white-top aster is unable to colonize new sites readily, the species is threatened by factors that can potentially destroy existing populations (Bigger and Paine 1998). After 5 years of data collection, modeling predictions estimated that white-top aster populations appear to be shrinking by nearly 50 percent annually; however, field observations do not support this finding and predict that a much more stable population exists (Wolford 2001). If an existing population is eradicated, there is little chance that a new population will replace it. At the federal level, white-top aster is listed as a species of concern. In Washington, white-top aster is a sensitive species and was recently delisted from threatened status.

3.3.1.3.6 White Meconella

White meconella is a grassland annual that is state-listed as threatened and a federal species of concern. Although it historically occurred in the Puget Sound lowlands, it is currently known to occur in only three locations in Washington, and is thought to be extirpated from the South Puget Sound region (Gamon 1997b, WNHP and Bureau of Land Management 1997). White meconella is not known to occur on Fort Lewis. Although suitable habitat may occur, the species has not been identified during past surveys of grassland habitat on the installation. It occurs in open grasslands or forest/grassland mosaics, in habitats that were likely historically maintained by fire (WNHP and Bureau of Land Management 1997).

3.3.2 Fish Resources

3.3.2.1 Fish Species and Populations

At least 25 fish species live in lakes, ponds, marshes, rivers, and streams on Fort Lewis (**Table 3–3** and **Table 3–4**). Populations include resident, anadromous, and warm water fish species that live in aquatic habitats on Fort Lewis (Army 2007d). Common resident and anadromous fish species that may occur on Fort Lewis include steelhead/rainbow trout, Chinook salmon, chum salmon, coho salmon, pink salmon, sockeye salmon/kokanee, cutthroat trout, bull trout, and mountain whitefish. For anadromous fish species, incubation of eggs and rearing of juveniles occurs in freshwater before the fish migrate to seawater for adult development, later returning to freshwater to spawn. Common warm water fish species found on Fort Lewis include rock bass, largemouth bass, brown bullhead, bluegill sunfish, pumpkinseed sunfish, black crappie, and yellow perch.

Chambers Lake, Johnson Marsh, and Halverson Marsh in the Muck Creek system provide rearing habitat for both sea-run and resident coastal cutthroat trout (Army 1984). The kokanee population in American Lake is self-sustaining, as there is no outlet for fish migration to and from Puget Sound. Kokanee populations have been supplemented by a fish pen rearing and release program operated by Camp Murray and WDFW in 2005, 2006, and 2007. Additionally, WDFW stocked and reared juvenile coho salmon in Sequelitchew Lake from 1976 to 1996, which migrated outward to Puget Sound via Sequelitchew Creek. This program was terminated when water quality deteriorated in the lake due to the nutrient-rich foods fed to the juvenile fish. Runs of adult coho salmon were observed in Sequelitchew Creek during autumn, although there is no evidence to suggest that these fall runs still occur.

Table 3–3 Fish Species Found in Fort Lewis Lakes, Ponds, and Marshes

Name	Size (acres)	Maximum Depth (feet)	Fish
American Lake	1,123	90	Rainbow trout, kokanee, cutthroat trout, largemouth bass, yellow perch, rock bass, brown bullhead, black crappie
American Lake Pond	1	6	Rainbow trout, kokanee, cutthroat trout, largemouth bass, yellow perch, rock bass, brown bullhead, black crappie
Cat Lake	4	25	Largemouth bass, brown bullhead, black crappie
Chambers Lake	100	10	Cutthroat trout, largemouth bass, yellow perch, pumpkinseed sunfish, brown bullhead, black crappie
Clay Pits	3	8	Cutthroat trout, pumpkinseed sunfish
Clear Creek Pond	3	12	Cutthroat trout, rainbow trout
Dailman Lake	30	4	Cutthroat trout, largemouth bass, yellow perch, pumpkinseed sunfish, brown bullhead, black crappie
Deschutes Marsh	8	4	Largemouth bass
Fiander Lake	30	8	Largemouth bass, black crappie, brown bullhead, carp
Halverson Marsh	24	17	Cutthroat trout, chum salmon, coho salmon
Hamilton Lake	16	10	Cutthroat trout, largemouth bass, yellow perch, pumpkinseed sunfish, brown bullhead, black crappie
Hardhack Marsh	115	5	Black crappie
Hodge Lake	4	8	Unknown
Johnson Marsh	125	10	Cutthroat trout, largemouth bass, black crappie, pumpkinseed sunfish, brown bullhead
Jolly Lake	27	4	No fish, very shallow in summer
Lewis Lake	54	8	Largemouth bass, black crappie, pumpkinseed sunfish
Lynn Lake	4	6	Brown bullhead
Nisqually Lake	120	20+	Largemouth bass
No Name Lake	3	11	Cutthroat trout
Oxbow Lake	4	8	Cutthroat trout, pumpkinseed sunfish, largemouth bass
Sears Lake	4	8	Largemouth bass, pumpkinseed sunfish, black crappie, rock bass, brown bullhead
Sequalitchew Lake	80	10	Yellow perch, largemouth bass, bluegill sunfish, pumpkinseed sunfish, black crappie, rock bass, brown bullhead, coho salmon
Shannon Marsh	5	6	Unknown
Shaver Lake	6	Shallow	Cutthroat trout (in Muck Creek)
Spanaway Marsh	373	6	Cutthroat trout, largemouth bass, black crappie
Vietnam Village Marsh	69	10	Largemouth bass, pumpkinseed sunfish, black crappie
Watkins Lake	5	8	Unknown
Wright's Lake	11	6	Largemouth bass, pumpkinseed sunfish, brown bullhead

Source: Army 1984.

The Nisqually River and Muck Creek, along with eight smaller streams, are the primary water systems within the installation for anadromous fisheries (**Table 3–4**). The Nisqually River drainage basin is a significant producer of chum salmon within the South Puget Sound region, and Muck Creek is the primary production area for this species within the Nisqually watershed. Muck Creek also supports populations of sea-run cutthroat trout, coho salmon, and steelhead trout. Johnson Creek, a tributary to Muck Creek, supports small runs of coho and chum salmon and steelhead trout.

South and Lacamas creeks receive little fish use because of low flows. Production of pink and Chinook salmon is minimal on Fort Lewis, as these species spawn mainly in the mainstem of the Nisqually River. It has been determined that Chinook salmon utilize the lowermost reaches of the Nisqually River (Nisqually Chinook Recovery Team 2001).

Table 3–4 Fort Lewis Stream Characteristics and Fish Species

Name	Length on Fort Lewis (miles)	Discharge (cubic feet per second)	Fish Species	Remarks
Cabin Creek	1	6-8	Chinook salmon, chum salmon, coho salmon, cutthroat trout, steelhead trout	Year-round flow
Clear Creek	1	12-25	Chinook salmon, chum salmon, coho salmon, cutthroat trout, steelhead trout	Year-round flow
Exeter Springs	600 feet	15 (average in winter)	Chum salmon, coho salmon	Dries up most years in late summer
Halverson Channel	0.5	10 (average in winter)	Chum salmon, coho salmon, cutthroat trout, steelhead trout	Year-round flow
Johnson Creek	0.75	Up to 40 in winter	Cutthroat trout, chum salmon, coho salmon, steelhead trout	Dries up partially in summer
Lacamas Creek	0.5	Estimated 5-10	Coho salmon, cutthroat trout, steelhead trout	Year-round flow
Muck Creek	14.5	300 average in winter	Chum salmon, coho salmon, cutthroat trout, steelhead trout	Some sections dry up in summer and fall
Murray Creek	3	12-25	Cutthroat trout	Year-round spring-fed stream
Nisqually River	15.5	575-2,300	Chum salmon, coho salmon, Chinook salmon, pink salmon, steelhead trout, cutthroat trout, bull trout, largescale sucker, mountain whitefish	Year-round flow
Sequalitchew Creek	1	Up to 17	Coho salmon (smolts)	Very brushy and swampy
South Creek	1.3	Up to 75	No observations of fish since 1970s	Dries up in late spring

Sources: Army 1984, Clouse 2002.

Fish species present in South Puget Sound and near the installation include Pacific herring, surf smelt, hake, cod, pollock, rockfish, surfperch, flounder, sole, spiny dogfish, Chinook salmon, chum salmon, coho salmon, pink (or humpback) salmon, sockeye salmon, and sea-run cutthroat trout. Surf smelt do not spawn in near-shore areas of Solo Point (Army 1998b). Pacific herring were harvested for bait, roe, and food until this fishery was closed in 1983 because herring are a major food fish for declining salmon populations. Herring spawn on kelp and eelgrass found in near-shore regions, but this habitat is not found in abundance near Solo Point or nearby islands. However, a large concentration is found west of Anderson Island (Palsson 1998). Groundfish and salmonids are harvested off Solo Point (Puget Sound Water Quality Authority [PSWQA] and WDNR 1992).

Puget Sound is home to many shellfish and crustaceans: Dungeness crab, red rock crab, spot prawn, geoduck, Japanese oyster, Olympia oyster, European flat oyster, horse clam, butter clam, manila clam, native littleneck clam, soft-shell clam, spiny scallop, pink scallop, rock scallop, pinto abalone,

sea urchin, and sea cucumber. Shellfish and crustaceans are abundant within Puget Sound in near-shore, shallow areas to depths greater than 300 feet (91 m), although they are not found in major abundance near Solo Point (PSWQA and WDNR 1992).

3.3.2.2 *Fish Habitat*

Fish habitats on Fort Lewis include lakes, ponds, streams, marshes, and more than 2 miles (3 km) of shoreline along Puget Sound. Most of the 29 bodies of water on Fort Lewis are relatively small (less than 30 acres [12 ha] of surface water) and shallow (less than 10 feet [3 m] in depth).

The various rivers and streams within Fort Lewis connect some of these bodies of water with Puget Sound, thereby providing habitat and migration corridors for anadromous fish. Streams and rivers on the installation generally can be characterized as low- to moderate-gradient waters having alternating pool and riffle habitats, with substrates dominated by cobble and gravel. Seasonal springs such as Nixon, Halverson, and Exeter springs are extremely important to anadromous fish for spawning grounds. Gravel has been added to each of the springs to enhance spawning habitat. These waterways are highly important to fish, as they provide spawning and rearing habitat for anadromous species, particularly chum, steelhead, and coastal cutthroat trout.

Infestations of reed canarygrass in some of the streams at Fort Lewis have reduced water flow, limiting the ability of salmon and trout to successfully navigate and spawn within them. Projects involving reed canarygrass removal, and other enhancement projects aimed at improving spawning habitat, have been in effect since the mid-1970s. Since the implementation of these projects, significant numbers of salmon and trout have returned to spawn within the restored streams. At Exeter Springs, a primary spawning site for late-returning native chum salmon in Muck Creek, a 600-foot-long (183 m) by 12-foot-wide (4 m) spawning channel was built in 1974 as part of an enhancement project. Lined with spawning gravel and regularly maintained and enhanced (reed canarygrass and sand removed and native vegetation planted), salmon escapement within the channel reached an all-time high in 1998 to 1999. A total of 2,442 fish returned during this time, which was approximately 20 percent of the combined total escapement from Muck Creek and Exeter Springs (Army 2001c). In 2001, a 940-foot-long (286 m) by 15-foot-wide (5 m) spawning channel was created from an existing drainage ditch that is hydrologically connected to Muck Creek as a cooperative project with the Nisqually Tribe. Chum salmon have used this channel since it was completed.

Because of historical land use practices prior to government acquisition, many wetlands on Fort Lewis were ditched and drained for agricultural purposes, which severely degraded many aquatic habitats on the installation. Extensive restoration of lakes and marshes on Fort Lewis occurred during the 1970s and 1980s. Restoration projects have included installing dikes for water level manipulation, clearing vegetation and silt from stream channels, installing culverts, and constructing headgates and spillways. These projects should restore historical spawning areas and increase salmon production on Fort Lewis.

The north end of Fort Lewis is adjacent to approximately 2.5 miles (4 km) of shoreline. This area provides habitat for out-migrating juvenile anadromous salmonids and in-migrating adult salmonids using Nisqually River to the south and Chambers Creek to the north. Chinook salmon may run along the coast on their way to spawning habitat in Nisqually River and Chambers Creek, but it is unlikely that they spawn in Sequelitchew Creek (Baranski 1998, Carlson 1998, Fraser 1998, Mills 1998, Norman 1998, Walter 1998). Chinook salmon may congregate at the mouth of Sequelitchew Creek before moving on to the Nisqually River and Chambers Creek. Steep gradients and marsh habitat in the upper reaches of Sequelitchew Creek make for poor spawning habitat. However, adult coho and

chum salmon are known to spawn intermittently in the lower 650 feet (200 m) of the creek near Puget Sound, and sea-run cutthroat trout are thought to utilize the creek when flows are adequate.

3.3.2.3 Special Status Species

Three salmonids species that are federally listed as threatened may occur on or near Fort Lewis: the Puget Sound Evolutionary Significant Unit (ESU) of Chinook salmon and steelhead, and the Puget Sound Distinct Population Segment (DPS) of bull trout may occur near Fort Lewis (**Table 3–5**). Additionally, three federally listed rockfish species occur in Puget Sound near Fort Lewis: the Georgia Basin DPS of bocaccio (endangered), the Georgia Basin DPS of canary rockfish (threatened), and the Georgia Basin DPS of yelloweye rockfish (threatened). The Hood Canal ESU for summer-run chum salmon is also federally listed as threatened in the Puget Sound; however, there are no listed runs of this species within the vicinity of either the Nisqually River drainage or Fort Lewis. The sea-run cutthroat trout, Puget Sound/Strait of Georgia ESU coho salmon, and the Pacific and river lampreys are all species of concern at the federal level.

Table 3–5 Special Status Fish Species That May Occur on or Near Fort Lewis

Species	Scientific Name	Federal Status ¹	State Status ¹
Bocaccio	<i>Sebastes paucispinus</i>	E	SC
Bull trout	<i>Salvelinus confluentus</i>	T	C
Canary rockfish	<i>Sebastes pinniger</i>	T	SC
Chinook salmon	<i>Oncorhynchus tshawytscha</i>	T	C
Coho salmon	<i>Oncorhynchus kisutch</i>	SC	--
Pacific lamprey	<i>Lampetra tridentate</i>	SC	--
River lamprey	<i>Lampetra ayresi</i>	SC	C
Sea-run cutthroat trout	<i>Oncorhynchus clarki clarki</i>	SC	--
Steelhead	<i>Oncorhynchus mykiss</i>	T	--
Yelloweye rockfish	<i>Sebastes ruberrimus</i>	T	SC

Note:

¹ T = threatened; C = candidate; SC = species of concern. Species of concern receive no legal protection under the ESA. Sources: USFWS 2010; National Marine Fisheries Service 2009a, 2010; and WDFW 2009.

More detailed information on federally listed fish species that may occur on or near Fort Lewis is provided in the following sections.

3.3.2.3.1 Bull Trout

Bull trout are native to the Pacific Northwest and Western Canada, and were federally listed as a threatened species on June 10, 1998 (USFWS 1998). Historically, bull trout were found throughout the Pacific Northwest, including Montana, Idaho, northern California, Washington, and Nevada (Knowles and Gumtow 1996). They exhibit both resident and migratory life-history strategies throughout much of their current range (Rieman and McIntyre 1993). Resident bull trout complete their life cycles in the tributary streams in which they spawn and rear. Migratory bull trout spawn in tributary streams, and juvenile fish rear for 1 to 4 years before migrating to either a lake (adfluvial), river (fluvial), or, in certain coastal areas, saltwater (anadromous), to mature (Fraley and Shepard 1989, Goetz 1989).

The Coastal-Puget Sound DPS of bull trout is significant to the species as a whole because it contains the only anadromous forms of bull trout in the coterminous United States. The DPS includes the Puget Sound Management Unit, which includes all watersheds within the Puget Sound Basin and the marine near-shore areas of Puget Sound (USFWS 2004a). Bull trout have been observed in the Nisqually River, which passes through Fort Lewis (Fresh et al. 1979, Bortorff and Swanson 1993, Chan 2004). Bull trout historically were present in the Nisqually River, and there have been recent sightings in the Nisqually River, where they have likely been foraging bull trout (Chan 2000, 2003, Ellings 2004). One juvenile was collected during stream sampling in the lower reaches of the Nisqually River in the mid-1980s (WDFW 1998), and in the late 1990s one adult was observed at Clear Creek hatchery in mid-September (USFWS 2004a). In July 2004, one bull trout was collected in the lower reaches of the Nisqually River (Army 2006a). Bull trout are most likely to be found in the Nisqually River during the winter and spring months, and are unlikely to be found there later in the summer and fall when they journey upstream into glacial streams to spawn. The Bull Trout Recovery Unit Team has decided that the Nisqually River Basin is not a core population watershed for Puget Sound bull trout. However, the team has designated it as “core habitat,” given the possibility that bull trout from other South Puget Sound watersheds may use the Nisqually River estuary for habitat.

In 1996, a study was conducted to determine the presence of bull trout and potential habitat on Fort Lewis. Cabin, Sequelitchew, and Murray Creeks were surveyed for bull trout presence. Muck and Clear creeks were not surveyed because they did not contain suitable habitat for bull trout. The survey did not locate any populations of bull trout on Fort Lewis (Army 2006a).

On September 25, 2005, the USFWS designated critical habitat for the Coastal-Puget Sound DPS of bull trout, including 1,212 miles (1,951 km) of stream and marine shoreline in the Puget Sound region (USFWS 2005b). Fort Lewis water bodies are exempt from this critical habitat designation.

3.3.2.3.2 Chinook salmon

This species is found from the Bering Strait south to southern California. The Puget Sound ESU for Chinook salmon is federally listed as threatened. The Nisqually River maintains a summer and fall stock of the Puget Sound ESU of Chinook salmon. Adults enter the river from July through September, with peak spawning occurring in mid-October (Nisqually Chinook Recovery Team 2001). Seaward migration of Nisqually River Chinook salmon is assumed to be predominantly in the spring and summer of the first year of freshwater residence. Historically, there was a spring component in the Nisqually River, but these runs were last observed in the early 1950s, and the ESU is now considered extinct from this river. Some experimental rearing of Chinook and coho salmon has been conducted in Sequelitchew Creek on Fort Lewis in the past. Since the survival of Chinook salmon was poor (Mills 1998), this program was terminated in the early 1990s (Zuchowski 2006). Although some Chinook salmon may use the lower reaches of Sequelitchew Creek, it is unlikely that they spawn in the creek, as there is little spawning habitat immediately downstream of Sequelitchew Lake (Carlson 1998, Norman 1998).

On September 2, 2005, the National Marine Fisheries Service (NMFS) designated critical habitat areas in Washington for Puget Sound Chinook salmon (USFWS 2005a). However, none of the streams on Fort Lewis is classified by NMFS as critical habitat for Chinook salmon.

3.3.2.3.3 Steelhead

The original range of steelhead was from northern Mexico to southeastern Alaska, and inland to the tributaries of the upper Columbia River, to Hell’s Canyon Dam on the Snake River, and the Clearwater and Salmon rivers in Idaho. Puget Sound ESU steelhead is present in most drainages of

Puget Sound, coastal streams, and the lower Columbia River. The Nisqually River has both winter- and summer-run steelhead (Hiss et al. 1982). The winter run consists of both native fish and hatchery fish of outside origin, but is managed for natural production. This run contributes to both the Nisqually Indian commercial and non-Indian sport fisheries on the Nisqually River. The summer run consists of hatchery fish of outside origin and contributes to a small non-Indian sport fishery on the river. Hatchery plants of both winter and summer steelhead have occurred historically in the basin, but have been eliminated to protect the native wild stock (Army 2006a). Spawning occurs from April through June, with fry emerging from late May through August.

Critical habitat designations for steelhead in the Pacific Northwest were finalized on August 15, 2005; these designations only apply to Columbia River steelhead ESUs. All military areas are excluded from the critical habitat designation (pursuant to the National Defense Authorization Act for Fiscal Year 2004). In the Pacific Northwest, these exclusions total 29 stream miles (47 km) and 48 shoreline miles (77 km) in Puget Sound.

3.3.2.3.4 Bocaccio

Bocaccio are very rare in the Puget Sound and have declined substantially since 1965, particularly relative to other rockfish species in the Puget Sound (NMFS 2009b). The occurrence of large adult bocaccio in the Georgia Basin appears to be limited to certain areas. In past years, they were most commonly caught in the areas around Point Defiance and the Tacoma Narrows in the South Puget Sound. Based on limited information, they are frequently found in areas lacking hard substrates. The main predators of adult bocaccio are marine mammals. Threats to the species include low dissolved oxygen within their range, bycatch in recreational and commercial harvest, and a reduction in kelp habitat necessary for juvenile recruitment (NMFS 2009b).

3.3.2.3.5 Yelloweye Rockfish

Yelloweye rockfish occur from Baja California to Alaska. They are distributed throughout the Strait of Georgia in the northern Georgia Basin, but are less frequently observed in South Puget Sound (NMFS 2009b). They typically occur in waters 80 to 1,560 feet (25 to 475 m) deep and often occur in areas with high relief and complex rocky habitats. Juveniles settle in shallow, high relief zones, crevices, and sponge gardens and then move to deeper waters as they grow. Predators include salmon and orcas. Threats to the species include low intrinsic productivity, bycatch in recreational and commercial harvest, loss of near shore habitat, chemical contamination, and areas of low dissolved oxygen (NMFS 2009b).

3.3.2.3.6 Canary Rockfish

Within their range (from Baja California to the Western Gulf of Alaska), canary rockfish are most common off the coast of central Oregon (NMFS 2009b). They were once considered fairly common in the greater Puget Sound area. They inhabit waters 160 to 820 feet (50 to 250 m) deep and are associated with the various rocky and coarse habitats throughout the basins of the Puget Sound. Predators include yelloweye rockfish, lingcod, salmon, sharks, dolphins, seals, and possibly river otters. Threats to the species include low intrinsic productivity, bycatch in recreation and commercial harvest, loss of near shore habitat, chemical contamination, and areas of low dissolved oxygen.

3.3.2.3.7 Other Species

Sea-run cutthroat trout may be present in some on-site streams, such as Sequelitchew Creek, when flows are adequate (Baranski 1998). Puget Sound/Strait of Georgia ESU coho salmon have been seen congregating at the mouth of Sequelitchew Creek before moving on to the Nisqually River and Chambers Creek (Walter 1998). There is little spawning habitat within Sequelitchew Creek, except

for the lower reaches near Puget Sound, and fish offspring have little chance of surviving in the marshes associated with the upper reaches of the creek (Baranski 1998, Mills 1998, Norman 1998). The Pacific and river lampreys have not been observed on Fort Lewis, although they have been documented as occurring within the area surrounding the installation (Clouse 2002). Both lamprey species spawn in the gravel riffles of clear coastal streams and then migrate to the ocean to mature.

3.3.3 Wildlife Resources

3.3.3.1 Wildlife Species and Their Habitats

Fort Lewis has a mosaic of plant community distributions and productive wildlife habitats utilized by approximately 20 species of reptiles and amphibians, 200 species of birds, 50 species of butterflies, and 50 species of mammals (Army 1994). Throughout the installation, there are large expanses of undeveloped, low-elevation wetland and upland habitats influenced by the Puget Sound maritime climate, glacial plains, and the Nisqually River watershed. These habitats are also present in the areas surrounding the installation, although they generally exist as small, fragmented pieces given the extensive development in the region.

3.3.3.1.1 Forests

Forests are the largest ecosystem type on Fort Lewis and in the region, predominantly consisting of coniferous forests dominated by Douglas-fir. As the largest contiguous block of natural landscape in the South Puget Sound area, Fort Lewis is a critical component in regional attempts to preserve and enhance biological diversity. Forestlands adjacent to Fort Lewis are mostly fragmented and less valuable to forest-dependent species than forests on the installation.

Wildlife species typically associated with forested environments inhabit a wide array of habitat conditions. Important factors influencing the distribution and abundance of wildlife species within forests include the seral stage of forest stands, understory densities, canopy connectivity, and the quantity and distribution of coarse woody debris and snags. Common forest-dwelling amphibians and reptiles include northwestern salamander, long-toed salamander, western toad, common garter snake, and rubber boa. Larger trees and snags are utilized as foraging, nesting, and perching sites for bald eagles, great blue herons, osprey, band-tail pigeons, and a variety of woodpeckers and owls (Kavanagh 1991). The coniferous forests are also home to black-capped chickadees, red-breasted nuthatches, brown creepers, whereas ruffed grouse, kinglets, and warblers are attracted to deciduous and mixed coniferous-deciduous forests. Raptors known to nest in coniferous forests include red-tailed hawk, Cooper's hawk, and the sharp-shinned hawk. Upland game birds, bluebirds, thrushes, flycatchers, and warblers use the forest edge. Although many of these bird species are resident year-round on Fort Lewis, kinglets, flycatchers, warblers, and other birds found on Fort Lewis are migratory birds that spend only a portion of their year on Fort Lewis. Migratory birds may winter or breed on Fort Lewis, or may just use the installation for short periods while migrating between their breeding grounds to the north and wintering grounds to the south. Migratory birds are protected under the Migratory Bird Treaty Act of 1918, as amended, that provides protections to reduce the risk of harm to migratory birds or their habitats from Army or other federal actions. Forests provide cover and forage for a variety of mammal species, including Columbia black-tailed deer, raccoon, coyote, black bear, various bat species, Townsend chipmunk, and northern flying squirrel. Several wildlife species of concern, including the bald eagle, the pileated woodpecker, and several neotropical birds, rely upon the installation's large blocks of forest for all or part of their life history needs.

3.3.3.1.2 Prairies/Grasslands

The grassland landscape in South Puget Sound once extended from just south of Tacoma to beyond Oakville along the Chehalis River (Army 1998b). In 1995, less than 3 percent of that area remained as grassland dominated by native vegetation (Crawford and Hall 1997). However, a significant portion of the Fort Lewis-McChord AFB complex still contains native grasslands. The grasslands represent some of the last remaining grasslands in western Washington.

Native grasslands provide habitat for several rare plant and animal species, such as white-top aster, pocket gopher, and several species of butterflies. Hawks, common nighthawks, lazuli buntings, swallows, and sparrows forage and/or nest in the prairies. Fort Lewis contains bird species specifically adapted to prairie environments, including the western bluebird, streaked horned lark, western meadowlark, Oregon vesper sparrow, and savannah sparrow. Most of these species are migratory birds that spend only a portion of the year on Fort Lewis. Prairies provide food and limited cover for small- and medium-sized mammals, such as pocket gopher, deer mouse, vagrant shrew, Pacific jumping mouse, moles, and Eastern cottontail.

3.3.3.1.3 Oak Woodlands

Since Euro-American settlement, more than one-half of all oak habitats in the South Puget Sound region have been eliminated. Historically, oak savanna and open woodlands were common and consisted of large, continuous stands containing large, mature, widely spaced oaks with single trunks and broad, spreading crowns. The understory was one herbaceous layer of native bunchgrasses and forbs. Frequent and regular fires helped to maintain these communities.

Reduction in the use of fire, land conversion and development, livestock grazing, military training, and other factors have resulted in the loss of oak woodlands. Oak stands are now much smaller and mostly isolated from other oak stands. Fire suppression has led to the invasion of woody pest species, primarily Scotch broom and Douglas-fir, which compete with oaks for scarce nutrients, and in the case of Douglas-fir, overtop and kill younger oaks.

Oak woodlands occur predominantly on grassland margins and provide important transitional wildlife habitat between grassland and forest ecosystems. On Fort Lewis, oak woodlands primarily occur within grassland/conifer forest ecotones, and to a lesser extent in grassland/riparian ecotones and as individual stands, which may or may not be adjacent to conifer forest. Oregon white oak woodlands are used by an abundance of mammals, birds, reptiles, and amphibians. Many invertebrates, including various moths, butterflies, gall wasps, and spiders, live exclusively in association with this oak species. Oak/conifer associations provide contiguous aerial pathways for animals such as the state threatened western gray squirrel, and they provide important roosting, nesting, and feeding habitat for numerous birds and mammals. Dead oaks, and dead portions of live oaks, harbor insect populations and provide nesting cavities. Acorns, oak leaves, fungi, and insects provide food. Some birds, such as the Nashville warbler, exhibit unusually high breeding densities in oak. Oaks on Fort Lewis may play a critical role in the conservation of neotropical migrant birds that migrate through, or nest in, Oregon white oak woodlands (Larsen and Morgan 1998). Oak woodlands provide important forage and nesting habitat for Columbia black-tailed deer, Douglas squirrel, western gray squirrel, and northern flying squirrel.

3.3.3.1.4 Wetlands

Approximately 4,100 acres (1,700 ha) of wetlands occur on Fort Lewis. Wetlands are widely distributed throughout the installation, and range in type from open water to forested swamps. They support numerous species of plants and animals. Ten amphibian and four reptile species were reported on Fort Lewis during a 1996 to 1997 herpetofauna inventory, including the northwestern

salamander, long-toed salamander, Pacific giant salamander, rough-skinned newt, western red-backed salamander, ensatina, western toad, Pacific treefrog, red-legged frog, bullfrog, northern alligator lizard, western terrestrial garter snake, northwestern garter snake, and common garter snake (Hallock and Leonard 1997).

The western pond turtle may also occur on or near Fort Lewis, but has not been found on the installation (Forrester and Storre 1992). Western fence lizard, racer, sharp-tailed snake, and gopher snake, all species historically reported to occur in the vicinity of Fort Lewis, also were not detected.

The shrubs, trees, and water found in wetlands and riparian corridors provide foraging, nesting, and rearing sites for rufous-sided towhees, swallow, American robins, ruffed grouse, red-winged blackbirds, cedar waxwings, and belted kingfishers. Wetlands and riparian corridors also provide habitat for waterfowl and a variety of other water-dependent birds found year-round at Fort Lewis. Robins, blackbirds, waxwings, and several species of waterfowl are migratory birds that may breed or winter on Fort Lewis, or only use the installation for a short period each year while migrating between breeding and wintering grounds.

Wetlands and riparian corridors are a source of food and cover for both upland- and wetland-associated mammals. Species typically found in wetland and riparian environments in the Fort Lewis region include river otter, mink, muskrat, and beaver. Columbia black-tailed deer, black bear, raccoons, striped skunks, and spotted skunks are also frequent users of wetland and riparian corridors.

Approximately 620 acres (250 ha) of freshwater wetland and 260 acres (105 ha) of riparian/forested wetland habitat are found on the Nisqually National Wildlife Refuge (Nisqually Refuge), located northwest of Fort Lewis. These habitats support wildlife that are similar in species composition to those found on Fort Lewis. More than 20,000 waterfowl use the refuge during winter. Numerous other wetlands are found in the South Puget Sound region near Fort Lewis, as well.

3.3.3.1.5 Estuarine and Marine Habitats

Fort Lewis borders Puget Sound. Fish and other marine organisms found along the coast and near Fort Lewis are discussed in **Section 3.3.2**.

Bird species attracted to the protected marine habitats of Puget Sound include seabirds (such as alcids, gulls, and shearwaters) and shorebirds (such as phalaropes, sandpipers, herons, and plovers). Pigeon guillemot and glaucous-winged gull, the primary seabirds commonly found nesting south of Whidbey Island, are the only breeding seabirds with nests found in highly industrial areas in Puget Sound (e.g., Commencement Bay near Tacoma). Pigeon guillemots are particularly common near Solo Point, and the steep slopes adjacent to Solo Point provide suitable nesting habitat. They breed along the Pacific Coast from northwest Alaska to southern California, nesting in crevices and cavities on rocky shores and coastal cliffs.

Several marine mammal species may be found in the waters of South Puget Sound, including harbor seal, Steller sea lion, California sea lion, river otter, Dall's porpoise, harbor porpoise, killer whale, minke whale, humpback whale, and gray whale. Marine mammals in Puget Sound are heavily dependent on good water quality, sufficient food, and undisturbed habitat for their health and survival. Five of these species are resident to Puget Sound: harbor seal, Dall's porpoise, harbor porpoise, killer whale, and minke whale. The other species are migratory (PSWQA and WDNR 1992).

Seals and sea lions rest or haul-out on shorelines throughout Puget Sound. Haul-out areas are found in South Puget Sound, Hood Canal, Port Gardner, Admiralty Inlet, the San Juan Islands, and the Strait of Juan de Fuca. California sea lions are found in Puget Sound in winter at haul-out sites near Fox Island, Port Gardner, and on Sucia Island in the northern San Juan Islands. California sea lions are occasionally seen near Solo Point, and one was found beached at Solo Point following a shooting injury (Clouse 1998).

River otters are mainly found on quiet shorelines with inflowing freshwater streams. They are found in South Puget Sound. Dall's porpoise and harbor porpoise travel in groups or pods within Puget Sound, but Dall's porpoises are more commonly seen. These porpoises sometimes ride in ships' bow waves. Harbor porpoise is rarely seen south of Central Puget Sound, and Dall's porpoise is only occasionally seen south of Admiralty Inlet. Killer whales are occasionally seen in Central and South Puget Sound, but the three resident pods travel throughout Puget Sound feeding on fish, squid, and other mammals. Humpback and gray whales are rare visitors to Puget Sound (Army 1998b).

The Nisqually River Delta, a biologically rich and diverse area at the southern end of Puget Sound and within miles of Fort Lewis, supports a variety of habitats. Here, the freshwater of the Nisqually River combines with the saltwater of Puget Sound to form an estuary rich in nutrients and detritus. These nutrients support a web of sea life, the benefits of which extend throughout Puget Sound and beyond. Together with McAllister and Red Salmon Creeks, the Nisqually River forms one of the largest remaining relatively undisturbed estuaries in Washington. Although most major estuaries in Washington have been filled, dredged, or developed, the estuary of the Nisqually River has been set aside especially for wildlife as the Nisqually Refuge. The Refuge is home to thousands of waterfowl and other wildlife from fall through spring, and large numbers of migratory and resident birds and other wildlife during all times of the year. Waterfowl, shorebirds, raptors, and marsh and water birds all are attracted to the mosaic of habitats found on the Nisqually Delta.

3.3.3.2 Special Status Species and Critical Habitat

Numerous species in the Fort Lewis region have been given a special status at the federal and/or state level, based on their risk of decline and extirpation (**Table 3-6**). The presence of several of these species on Fort Lewis has not been documented in the recent past, but potential habitat for these species does exist on the installation. In addition, some species occupy small territories or occur in isolated sites in Pierce or Thurston counties that are located outside the Fort Lewis boundary. Federally listed species and species that are candidates for listing at the federal level and that could be found on or near Fort Lewis, as well as the bald eagle and western gray squirrel, are discussed in more detail below. The Canada lynx, gray wolf, and grizzly bear are very unlikely to be found on or near Fort Lewis and are not discussed in this section.

3.3.3.2.1 Prairie Butterflies

The prairies on Fort Lewis support populations of several special status butterfly species, including the mardon skipper and Taylor's checkerspot, both of which are candidates for federal listing. Another prairie butterfly, the valley silverspot, is a federal species of concern. Fort Lewis contains the largest colony of Taylor's checkerspot in Washington, but colonies of this species have been extirpated in recent years at several locations on Fort Lewis where they once occurred (Wolford et al. 2008). Numbers of Taylor's checkerspots observed at the location of the large colony on Fort Lewis in 2007 were only one-half the numbers seen during 2006, and numbers of butterflies seen in 2008 were about one-half the numbers seen in 2007. The mardon skipper is found in only four counties in Washington. These butterfly species are non-migratory and typically associated with high-quality prairie habitat. Threats to all three species include loss and fragmentation of high-quality prairie habitat, fire, human disturbance, and off-road vehicles.

Table 3–6 Special Status Wildlife Species that may be Found on or in the Vicinity of Fort Lewis

Common Name	Scientific Name	Federal Status ¹	State Status ¹
Invertebrates			
Fender’s soliperlan stonefly	<i>Soliperla fenderi</i>	SC	--
Mardon skipper	<i>Polites mardon</i>	C	E
Taylor’s checkerspot	<i>Euphydryas editha taylora</i>	C	E
Valley silverspot	<i>Speyeria zerene bremeri</i>	SC	C
Reptiles and Amphibians			
Cascades frog	<i>Rana cascadae</i>	SC	--
Larch mountain salamander	<i>Plethodon larselli</i>	SC	S
Leatherback sea turtle	<i>Dermochelys coriacea</i>	E	E
Northwestern pond turtle	<i>Clemmys marmorata marmorata</i>	SC	E
Oregon spotted frog	<i>Rana pretiosa</i>	C	E
Rocky Mountain tailed frog	<i>Ascaphus truei</i>	SC	C
Van Dyke’s salamander	<i>Plethodon vandykei</i>	SC	C
Western toad	<i>Bufo boreas</i>	SC	C
Birds			
Bald eagle	<i>Haliaeetus leucocephalus</i>	SC	S
Common loon	<i>Gavia immer</i>	--	S
Marbled murrelet	<i>Brachyramphus marmoratus</i>	T	T
Northern goshawk	<i>Accipiter gentilis</i>	SC	C
Northern spotted owl	<i>Strix occidentalis caurina</i>	T	E
Olive-sided flycatcher	<i>Contopus borealis</i>	SC	--
Oregon vesper sparrow	<i>Pooectetes gramineus affinis</i>	SC	C
Peregrine falcon	<i>Falco peregrinus</i>	SC	S
Pileated woodpecker	<i>Dryocopus pileatus</i>	--	C
Purple martin	<i>Progne subis</i>	--	C
Slender-billed, white-breasted nuthatch	<i>Sitta carolinensis aculeata</i>	SC	C
Streaked horned lark	<i>Eremophila alpestris strigata</i>	C	E
Yellow-billed cuckoo ²	<i>Coccyzus americanus</i>	C	C
Mammals			
California wolverine ²	<i>Gulo gulo luteus</i>	SC	C
Canada lynx ²	<i>Lynx canadensis</i>	T	T
Gray wolf ²	<i>Canis lupus</i>	E	E
Grizzly bear ²	<i>Ursus arctos</i>	T	E
Humpback whale	<i>Megaptera novaeangliae</i>	E	E
Long-eared myotis	<i>Myotis evotis</i>	SC	--
Long-legged myotis	<i>Myotis volans</i>	SC	--
Mazama pocket gopher	<i>Thomomys mazama</i>	C	T
Northern sea otter	<i>Enhydra lutris kenyoni</i>	SC	--
Pacific Townsend’s big-eared bat	<i>Corynorhinus townsendii townsendii</i>	SC	C
Southern resident killer whale	<i>Orcinus orca</i>	E	E
Steller sea lion	<i>Eumetopias jubatus</i>	T	T
Western gray squirrel	<i>Sciurus griseus griseus</i>	SC	T

Notes:

1. E = endangered; T = threatened; C = candidate; S = sensitive; and SC = species of concern.

2. Species occurs on USFWS lists, but is not known to occur in the region currently.

Sources: NMFS 2009a; USFWS 2010; and WDFW 2009.

3.3.3.2.2 Leatherback Sea Turtle

The leatherback sea turtle is the largest turtle and the largest living reptile in the world (NMFS 2008). Leatherback sea turtles are commonly known as pelagic animals, but also forage in coastal waters. In fact, leatherback sea turtles are the most migratory and wide-ranging of sea turtle species.

Leatherback sea turtle nesting grounds are located around the world, with the largest remaining nesting assemblages found on the coasts of northern South America and western Africa. Leatherback sea turtles are rarely seen in southern Puget Sound (Army 1998b).

3.3.3.2.3 *Oregon Spotted Frog*

Oregon spotted frogs are highly aquatic and live in or near permanent bodies of water, including lakes, ponds, slow streams, and marshes. They are most often found in non-woody wetland plant communities that support vegetation such as sedges, rushes, and grasses. Oregon spotted frogs were collected near Fort Lewis during the early 20th century and at least one historical site once existed on Fort Lewis; however, no Oregon spotted frogs were detected during extensive surveys conducted in the early 1990s. The last documentation of Oregon spotted frogs in Pierce County was in 1959 at Spanaway Pond, located northeast of Fort Lewis (Hallock and Leonard 1997). A population in the Black River watershed in Thurston County, which is 12 miles (19 km) southwest of Fort Lewis, is the only known extant population in the lowlands of western Washington and Oregon (Leonard 1990, McAllister 1995). In September 2008, about 500 Oregon spotted frogs were released into Dailman Lake on Fort Lewis. Because Fort Lewis provides enough appropriate habitat, the WDFW believes a pilot Oregon spotted frog reintroduction is likely to be successful on Fort Lewis (Reinert 2008). Oregon spotted frogs will be released annually on Fort Lewis through at least 2012.

3.3.3.2.4 *Bald Eagle*

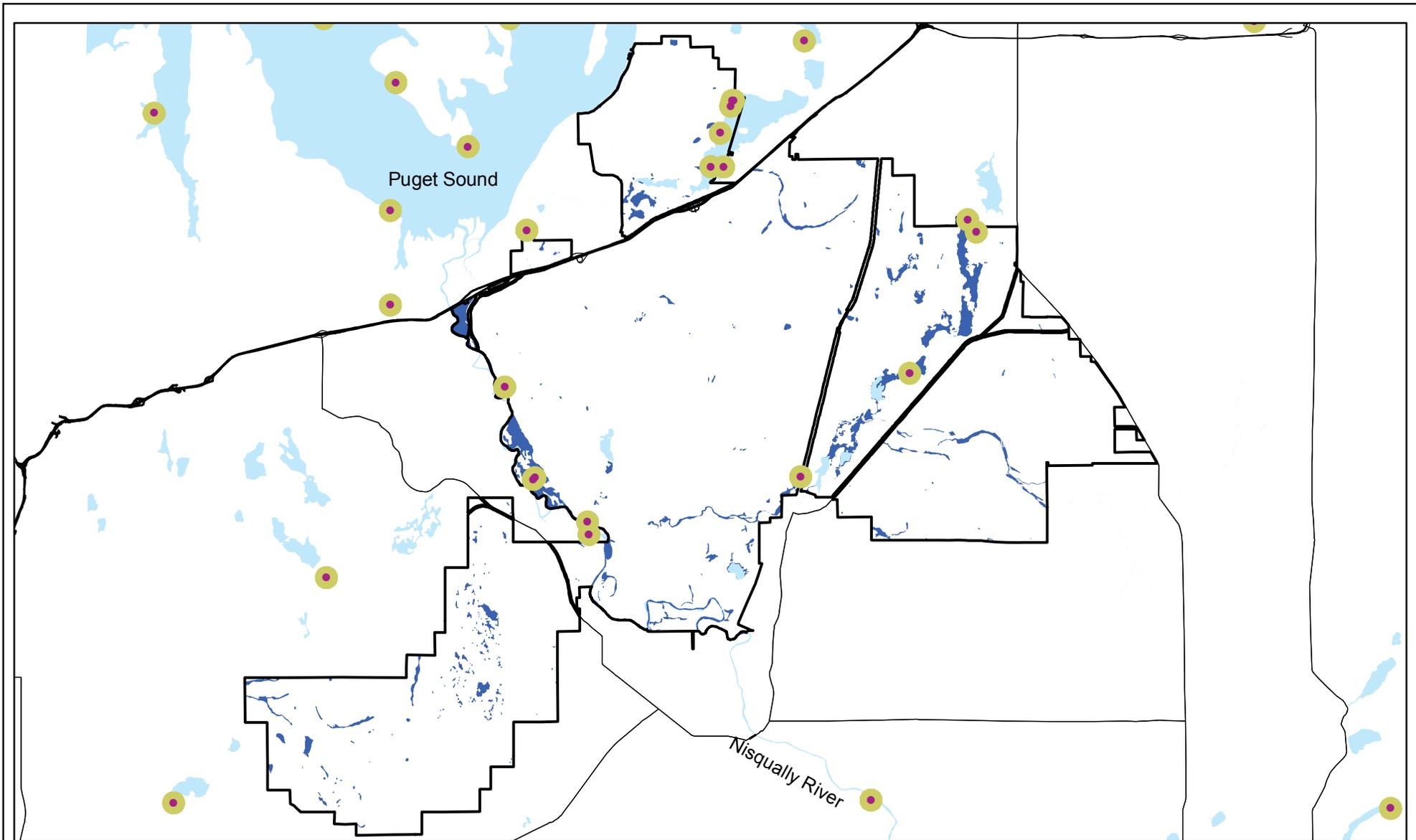
On July 28, 2007, the USFWS delisted bald eagles that inhabit the lower 48 states because the species was meeting or exceeding established recovery goals throughout its range. However, the bald eagle is still protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act.

Bald eagles are year-round residents on Fort Lewis. Upwards of 270 bald eagles may winter on the installation (Stalmaster and ENSR 2006). In addition, ten bald eagle nesting territories have been identified: Nisqually River, Nisqually Bluff, Collard Woods, American Lake north, American Lake south, American Lake west, Spanaway Marsh, Johnson Marsh, Halverson Marsh, and Fort Lewis Golf Course (**Figure 3–4**). Seven territories were active in 2008, and six fledged young (Zuchowski 2008). Although not unusual, productivity fluctuates within these nesting territories. During the last decade, numbers of both nesting and wintering bald eagles on Fort Lewis have increased, a trend that has been observed throughout the South Puget Sound region (Stinson et al. 2001). Food supplies are the most important factor in maintaining the wintering population at Fort Lewis (Stalmaster 1992a, Stalmaster and ENSR 2005). Additional concerns are the maintenance of habitat near and within extensively used roost sites and foraging areas, particularly along Muck Creek and Carter Woods along the Nisqually River, and disturbance factors that could preclude bald eagles from using suitable habitat.

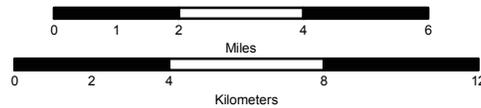
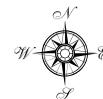
3.3.3.2.5 *Marbled Murrelet*

The marbled murrelet is a marine bird species that nests on large-diameter upper branches of coniferous trees in older forests along the marine coast and inland up to approximately 40 miles (64 km) (Hamer and Cummins 1991). Murrelets are usually found in marine areas with mature forests nearby to provide nesting habitat (Washington Department of Wildlife 1993). The greatest concentration of marbled murrelets in Washington is found in northern Puget Sound.

Marbled murrelets are not known to occur on Fort Lewis. Surveys have been conducted twice at Fort Lewis (Bottorff et al. 1991, Bottorff et al. 1992), and though birds were observed near Fort Lewis on the Nisqually River and in the Puget Sound area near Solo Point, none were found on the installation. Marbled murrelet critical habitat has been designated in Pierce County (USFWS 2004b); however, this habitat is located primarily in late-succession reserve forests on federal land in the Cascade Range, in the eastern section of the county. There is no critical habitat designation within Fort Lewis.



-  Bald Eagle Nests and Buffers
-  Wetlands
-  Lakes and Streams



FORT LEWIS GTA EIS

*Figure 3-4
Bald Eagle Nests
on Fort Lewis*

ANALYSIS AREA: Thurston & Pierce Counties, Washington
 Date: 7/16/2009 File: Arcadis\DEIS Figures.mxd
 Prepared By: BC/KA Layout: ProjectArea.pdf

3.3.3.2.6 *Northern Spotted Owl*

The northern spotted owl is associated with most of the major types of coniferous forest in the Pacific Northwest. Suitable habitat for the species on Fort Lewis was identified and mapped by the USFWS, and in 1992, 62,000 acres (25,100 ha) of Fort Lewis were designated as critical habitat for the northern spotted owl (USFWS 1991). Based on a recent ruling by the USFWS, however, the areas previously designated as critical habitat for the northern spotted owl on the installation were removed as part of the overall critical habitat revision for this species (USFWS 2008a). Fort Lewis is considered a strategic location between known spotted owl populations on the Olympic Peninsula to the west and the Cascade Range to the east.

Surveys for northern spotted owls using calling stations on Fort Lewis were conducted during nine years between 1991 and 2009 (USFWS 1991; Raedeke and Associates, Inc. 1995; Malkin 1999; ENSR 2003, 2006; AECOM Environmental 2008, 2009). No spotted owls were detected during these surveys. Fort Lewis has prepared a management plan that will encourage management of forestlands to develop the characteristics of northern spotted owl habitat (Bottorff and Rhode 1994).

3.3.3.2.7 *Streaked Horned Lark*

The streaked horned lark, one of the four breeding subspecies of horned lark in Washington, breeds in the lowlands of western Washington, in remnant grasslands on prairies and beaches (Smith et al. 1997). Streaked horned larks have declined with the loss of prairie habitats to development and succession to forest. With the cessation of burning of the prairies by Native Americans, Douglas-fir has spread over much of the prairie and introduced grasses, weeds, and Scotch broom have degraded much of the remainder. Streaked horned larks may have also been restricted to portions of the prairie where the vegetation was short and sparse due to excessive dryness or repeated burns (Stinson 2005).

At present, known breeding locations of streaked horned larks within the vicinity of the installation include Fort Lewis/McChord AFB and the Olympia Airport in Thurston County (Pearson 2003, Pearson and Hopey 2005). On Fort Lewis, streaked horned larks use three open areas with limited vegetative cover as breeding sites. From 2002 to 2004, 90 active nests were recorded near GAAF, 31 active nests were recorded on 13th Division Prairie, and one active nest was recorded in the AIA (Pearson and Hopey 2005). Of these, 39 percent near GAAF were successful, 19 percent in 13th Division Prairie were successful, and the nest in the AIA failed. However, extensive nest surveys were not conducted in the AIA due to unexploded ordnance danger. More than 70 percent of nest failures were due to depredation, primarily by crows and small mammals, such as raccoons.

3.3.3.2.8 *Yellow-billed Cuckoo*

The yellow-billed cuckoo is considered extirpated in Washington, but vagrant birds are very rarely seen in the state during the summer (Seattle Audubon Society 2002). Historically, yellow-billed cuckoos nested along wooded rivers in eastern Washington, as well as in various locations in western Washington. The species has not been seen on Fort Lewis, nor have there been any recent sightings of the species near the installation.

3.3.3.2.9 *Mazama Pocket Gopher*

The Mazama pocket gopher is a regional endemic found only in western Washington, western Oregon, and northern California (Stinson 2005). Mazama pocket gophers are known to persist at 27 sites scattered across the southern Puget Sound grasslands and alpine meadows of the Olympics. Although gophers may total in the low thousands, many are small populations on marginal sites that are unlikely to persist. Most gopher populations are restricted to grasslands on remnant and former prairie sites. Mazama pocket gophers are not constrained to live on native vegetation and will eat

many introduced grasses and weedy forbs. Soil type seems to affect their distribution, because they are absent from most prairies with particularly rocky soils. On Fort Lewis, there is evidence of pocket gopher populations at several grassland locations, including the edges of the AIA, ranges in the South Small Arms Impact Area (SSAIA), Marion and Johnson prairies, and the Weir prairies (Fort Lewis Directorate of Public Works [DPW] 2006b).

3.3.3.2.10 Western Gray Squirrel

The western gray squirrel is found in three areas within Washington: the Puget Trough (primarily Fort Lewis), north-central Washington (Okanogan and Chelan counties), and south-central Washington (Klickitat and Yakima counties) (Ryan and Carey 1995). Its primary habitat in these areas is in oak-conifer woodlands, particularly those containing large ponderosa pines. These habitats are being replaced by conifers, agricultural lands, and development, limiting the squirrel to small, scattered populations. On Fort Lewis, pockets of squirrels occur in mixed conifer and oak or pine woodlands that are adjacent to water sources (DPW 2006a). Past records and observations, compared to recent monitoring efforts and surveys, show that the population on Fort Lewis has declined dramatically in the last decade. Factors impacting squirrel declines on Fort Lewis include automobile traffic, food availability, and possibly disease (Ryan and Carey 1995). Annually, Fort Lewis averages three to four western gray squirrel deaths per year due to vehicles (DPW 2006a).

3.3.3.2.11 Steller Sea Lion

The Steller sea lion, also known as the northern sea lion, is the largest member of the Otariid (eared seal) family. Steller sea lions “forage” near shore and in pelagic waters (NMFS 2008). They are capable of traveling long distances in a season and can dive to depths of approximately 1,300 feet (400 m). They also use terrestrial habitat as haul-out sites for periods of rest, molting, and as rookeries for mating and pupping during the breeding season. At sea, they are seen alone or in small groups, but may gather at the surface near rookeries and haul outs. Fewer than 50 Steller sea lions are seen in Puget Sound each year (Army 1998a). Numbers are highest in April and May, and then decline rapidly (Steiger and Calambokidis 1986). Steller sea lion haul-out sites are known near Fox Island in the South Puget Sound, Port Gardner, the San Juan Islands, and the Strait of Juan de Fuca (Army 1998b). No critical habitat has been designated in Washington.

3.3.3.2.12 Southern Resident Killer Whale

Killer whales are the most widely distributed cetacean (e.g., whales, dolphins, and porpoises) species in the world (NMFS 2008). Killer whales are highly social animals that occur primarily in pods, or groups, of up to 50 animals. The Southern Resident Killer Whale (SRKW) population contains three pods (or stable family-related groups), and is considered a stock under the Marine Mammal Protection Act. The range of killer whales during the spring, summer, and fall includes the inland waterways of Puget Sound, Strait of Juan de Fuca, and Southern Georgia Strait. Their occurrence in the coastal waters off Washington has been documented. The SRKW population is currently estimated at about 88 whales, a decline from its estimated historical level of about 200 during the mid- to late-1800s. Critical habitat has been designated in most of Puget Sound, including along Fort Lewis and the northern Washington coast.

3.3.3.2.13 Humpback Whale

The humpback whale is distributed worldwide in all ocean basins, though in the north Pacific it does not occur in Arctic waters (NMFS 2008). In winter, most humpback whales occur in the subtropical and tropical waters of the Northern and Southern Hemispheres. The north Pacific population was considerably reduced because of intensive commercial exploitation during the 20th century and recovery has been very slow. Studies indicate that humpback whales from the western and central

north Pacific mix on summer feeding grounds in the central Gulf of Alaska and perhaps the Bering Sea. No critical habitat has been designated for humpback whales. Humpback whales are rarely seen in southern Puget Sound (Army 1998b).

3.3.3.3 *Game Fish and Wildlife Species*

Hunting and fishing are allowed on much of Fort Lewis in locations that do not interfere with military training activities. Game species on Fort Lewis include black bear and Columbia black-tailed deer, 11 additional species of mammals, 8 species of upland birds, 24 species of waterfowl, and 24 species of fish.

Recent surveys suggested that there are approximately 10 to 12 black bear on Fort Lewis. Columbia black-tailed deer are common throughout most of the installation, especially in wooded areas and near prairie edges.

Bobwhite quail and ring-necked pheasant are the most common upland game species on the installation. Approximately 2,000 to 5,000 pheasants are released annually on controlled hunting areas during October and November.

Waterfowl use much of the 4,100 acres (1,700 ha) of wetlands found on Fort Lewis and are seen along the coastline near Solo Point. Waterfowl have benefited from several management programs on the installation, including the protection of wetlands; installation of wood duck boxes, which are used by wood ducks and a variety of other cavity nesting birds; control of aquatic weeds; and management of ponds and lakes for open water. More than 20,000 waterfowl use the Nisqually Refuge during winter.

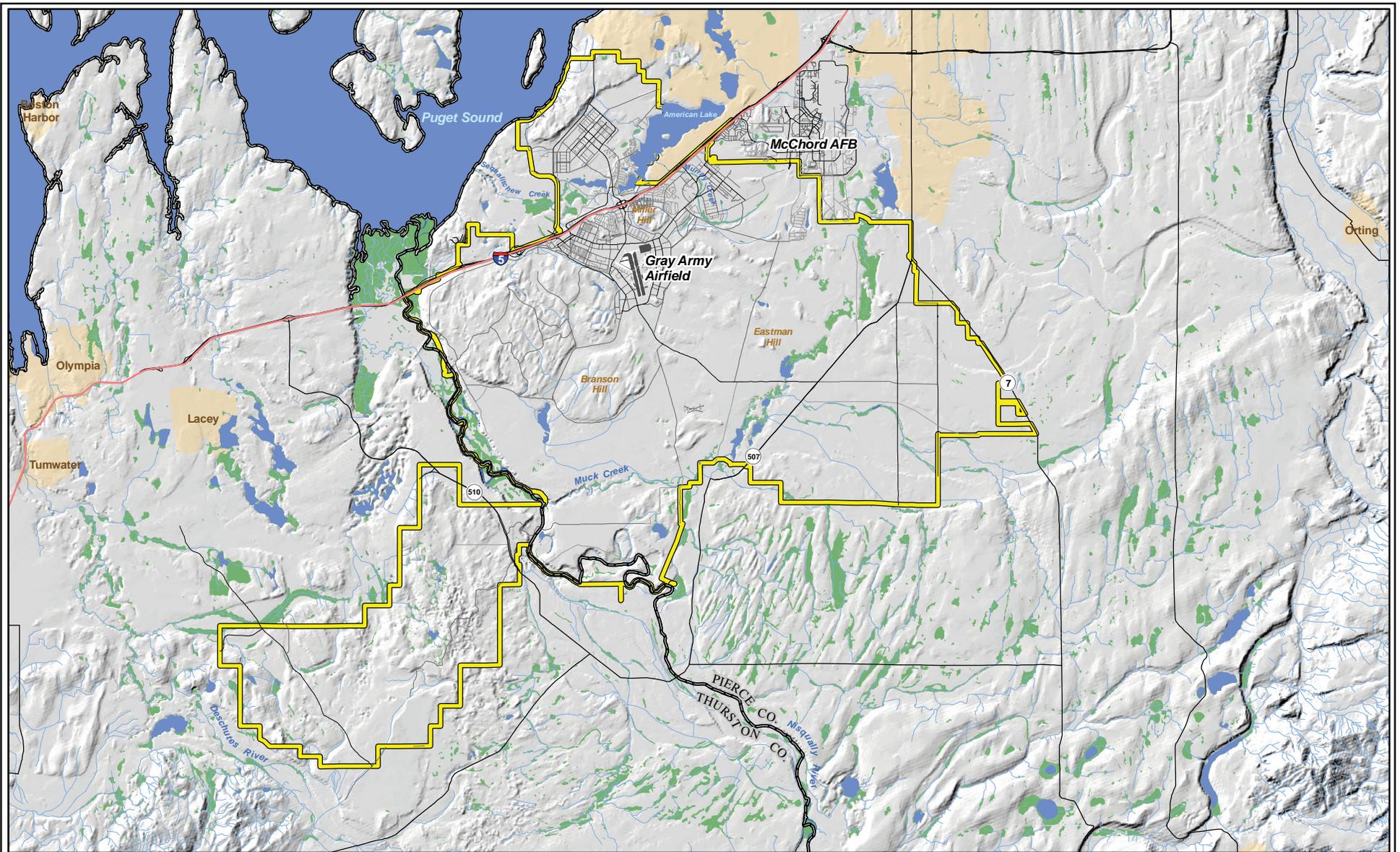
3.4 WETLANDS

Wetlands and other aquatic habitats are widely distributed over Fort Lewis (**Figure 3–5**), covering roughly 4,100 acres (1,700 ha) or about 5 percent of the installation. This relative lack of wetland habitat is largely the result of the underlying coarse outwash gravels deposited by the Vashon glaciation and the resultant soils formed within it (Army 1994). Somewhat excessive internal drainage of soils, such as Spanaway gravelly sandy loams, precludes the development of the anoxic site conditions representative of wetland environments.

Types of wetlands present include aquatic beds, emergent, scrub-shrub, and forested. Aquatic beds are characterized by the presence of aquatic vascular plants, such as duckweed, pondweed, and Eurasian watermilfoil. Emergent wetlands include open, marshy habitats that support numerous species of sedge, cattail, and other herbaceous species. Scrub-shrub habitats support low-growing woody species, such as spirea and willows. Forested wetlands are characterized by red alder and Oregon ash in the overstory, and salmonberry, vine maple, and stinging nettle in the understory.

Most major wetlands on Fort Lewis have a hydrological connection to creek and river drainages, such as Muck Creek and the Nisqually River, and are therefore limited to creek and river drainages. In particular, the Nisqually River, Muck Creek, and their tributaries support a wide array of wetland types. Johnson and Spanaway marshes are important examples of western Washington marsh habitat.

Prior to government acquisition in the early 1900s, many of the wetlands in the Fort Lewis area were ditched and drained for agricultural purposes. Water has been restored to these drained wetlands through various restoration projects on the installation. Restoration projects include manipulating water levels through dike construction, installing overflow channels, and installing fish ladders.



Legend

- Fort Lewis Boundary
- Interstate
- State Route
- Municipal Area
- County Boundary
- Water Body
- River / Stream
- Wetland



FORT LEWIS GTA EIS

*Figure 3-5
Distribution of Wetlands
across Fort Lewis*

ANALYSIS AREA: Thurston & Pierce Counties, Washington	
Date: 3/5/2010	File: FortLewisWetlands.mxd
Prepared By: JG	Layout: Wetlands.pdf

Wetlands on Fort Lewis are managed to maintain wetland training opportunities, enhance anadromous fish habitat, provide recreational opportunities, and control non-invasive species (Army 2007d). Several wetlands also have been incorporated into Fort Lewis's stormwater collection and conveyance system and, consequently, they receive discharges of stormwater.

3.5 WILDFIRE MANAGEMENT

Wildfire poses a threat to the sensitive ecosystems, cultural sites, and training lands of the Army. Army training activities require the use of munitions and weapons systems that often increase the chance of wildfire ignition that may damage important resources. The ROI covered in this analysis includes those Army-administered lands that would be affected by implementing the stationing and realignment decisions of the ROD for the 2007 GTA FPEIS, as well as the future stationing of additional CSS Soldiers and a medium CAB. Information on wildfire management provided in this section serves as baseline data for the analyses and comparison of the alternatives discussed in **Chapter 4**.

3.5.1 Wildfire Management Direction

Fire protection and management direction at Fort Lewis are guided by the following policies, laws, regulations, and procedures:

- Army Regulation 420–74, which requires military personnel involved in training or testing activities to be aware of fire hazards, and allows for military testing and training programs to be adjusted or suspended to avoid high fire hazard areas or periods.
- Department of the Army Pamphlet (PAM) 420–7, which requires that fire weather data be collected and establishes a fire danger classification system based on observed forecasted weather data. During periods of very high fire hazard conditions, as determined by this classification system, the installation fire marshal is authorized to suspend testing or training activities that use incendiary devices or that may result in fires.
- Department of Defense Wildland Fire Management Policy (September, 28 1998), which sets guidelines and recommendations for the management of wildland fires and the use of prescribed fire on Department of Defense (DoD) installations and properties.
- Memorandum: Army Wildland Fire Policy Guidance (September 4, 2002), which establishes Army policies and standards for integrated wildland fire management, establishes certification and training standards for wildland fire management personnel, and directs the development and content of Integrated Wildland Fire Management Plans (IWFMPs).
- Fort Lewis Regulation 350–30 (Fort Lewis Range Regulations), which describes the seasonal fire restrictions, use of pyrotechnics, and reporting procedures for wildland fires.
- Memorandum: DoD Civilian Support for Wildland Fire Fighting (September 12, 2000), which sets forth the procedures for dispatching civilian resources for mutual aid not covered by state agreements.

Fort Lewis has developed an IWFMP for the installation (Army 2000b). The IWFMP is the primary guidance document with respect to fire prevention, fire suppression, post-fire actions, and fire management direction for the installation. An update of the 2000 IWFMP for Fort Lewis is currently being conducted, but is not yet complete (Leeper 2010).

Fire protection for structural and airport fires at Fort Lewis is the responsibility of the Fort Lewis Fire Department (Leeper 2009). The Fort Lewis Fire Department maintains mutual aid agreements

with all fire departments in the surrounding municipalities, including DuPont, Steilacoom, Lakewood, Tacoma, Roy, Yelm, McKenna, Gig Harbor, Spanaway, and Tillicum (Army 2001e).

Wildland fire incidents at Fort Lewis are handled by the Forestry Section of the Environmental Division, Public Works (Army 2004b). The Wildland Fire Program Manager from the Forestry Section provides daily direction about fire danger levels on the installation. Range Control is responsible for obtaining information on fire prevention from troops within the TAs, as well as issuing daily training restrictions to reduce fire occurrence (Army 2005c, 2007d).

3.5.2 Fire History and Risk of Fire

The risk of fire at Fort Lewis depends on several factors, including weather conditions; fuel availability (vegetation); the frequency, type, and intensity of military training activities; and location in relation to fire suppression resources (i.e., water and fire fighting personnel). The combination of climate (relatively mild) and vegetation at Fort Lewis contribute to a low to moderate fire danger at the installation for the majority of the year. For most of the year, precipitation maintains a high-moisture content in the installation's vegetation and reduces its ability to burn. However, the warmer, drier summer months (between June and October) can create a high fire danger (Army 2001e).

From 1988 to 2000, the Fort Lewis Forestry Section conducted 1,492 fire runs, with a high of 156 runs in one year and a low of 76 in another year. The sizes of these wildfires ranged from campfire size to 160 acres; however, most were small in size (Army 2000b). Between 2001 and 2008, the Forestry Section conducted 615 fire runs, with a high of 149 runs in one year, and a low of 19 in another year. The total number of acres burned by wildfires during these years was 7,861 acres (3,181 ha). However, acreages were not reported for fires less than one acre in size or for every fire that occurred in the AIA because these fires are allowed to burn for safety reasons (e.g., UXO concerns) and to reduce fire intensity in the AIA in future years. The sizes of the reported fires occurring between 2001 and 2008 ranged from less than one acre (0.4 ha) to 650 acres (260 ha), though most were 10 acres (4 ha) or less in size. Although 2008 experienced the greatest number of reported acres burned (3,487 acres [1,411 ha]) during the past 8 years, it should be noted that 2008 was the only year for which wildfires in the AIA were consistently reported. Wildfires in the AIA accounted for approximately 2,145 acres (868 ha) of the 3,487 acres (1,411 ha) burned during 2008, including the 650-acre (260-ha) wildfire noted above (Leeper 2009).

Approximately 80 percent of the fires on Fort Lewis are a result of military training exercises and result from the use of pyrotechnics and tracers and ignitions from campfires and vehicles. Such fires vary in size and location, but are predominately small and limited to impact areas where gunnery training is conducted (Army 2007d). On Fort Lewis, the effects of ammunition are concentrated at four impact areas. These include the North Small Arms Impact Area (NSAIA) and Central Small Arms Impact Area (CSAIA) (which are for small arms only) and the AIA and SSAIA (which are for small arms and live-fire maneuver/combined arms live-fire exercises) (Army 2006b). The remaining 20 percent of fires on Fort Lewis are caused by activities other than training and typically occur in the cantonment area. In forests on the installation, numerous small fires occur annually and are extinguished quickly, with an annual burned area of less than 500 acres (200 ha) (Army 2007c).

While wildfire suppression is a management approach used over most of the installation, many accidental ignitions in prairie habitats on Fort Lewis are allowed to burn. In the AIA, ignitions caused by exploding shells occur regularly. These fires are not extinguished and burn approximately 2,470 to 3,000 acres (1,000 to 1,200 ha) of predominantly prairie habitat annually (Army 2007d).

The Forestry Section establishes a fire danger level at the installation depending on the climate and fuel moisture conditions (Army 2005c). With the exception of within the AIA, including Ranges 52 through 79 and Mortar Points 1 through 14, seasonal fire hazards on Fort Lewis (between June 1 and October 31) restrict the use of tracers and other potentially incendiary ammunition (Army 2000b, 2006b). Fire hazard levels are posted daily, with the following associated restrictions to ignition sources:

- Level I – Tracers, pyrotechnics, troop fires, and smoking are authorized.
- Level II – Pyrotechnics, troop fires, and smoking allowed on roads, gravels, or other cleared surfaces (no tracers).
- Level III – Pyrotechnics, troop fires, and tracers prohibited. Smoking is allowed on roads, gravels, or specially prepared areas free of flammable materials (Army 2006d).

3.5.3 Fire Management Areas and Activities

Although most wildfires occurring on Fort Lewis are suppressed, no fire suppression activities occur within the AIA, the SSAIA, the buffer zone in between these areas, or other areas of known explosive contamination. These fires are monitored to ensure no catastrophic events develop. On occasion, burning out from firebreaks ahead of the fires in these areas is conducted.

Following each fire season, data from fires occurring during the year (for example, location, size, fuel loads, response times, and damage) are evaluated to develop a Fire Risk/Hazard Assessment. This assessment is used to develop recommendations for fire prevention and control and, where appropriate, these recommendations are incorporated into Fort Lewis's fire prevention education program (Army 2000b).

On TAs, the Range Division is responsible for preventing fires caused by training activities, with direction provided by the Forestry Section. To reduce the risk of wildfires occurring and spreading in TAs, early detection, firebreaks, and prescribed burning for fuels reduction are used. Early detection is usually made by military troops or people with area access permits, and fires are reported to the Fort Lewis Fire Department dispatcher, Fort Lewis Fire Alarm Central (FAC), Range Control, or nearby municipal fire departments (Army 2000b, 2007c). In 2008, the dispatching function moved from the Forestry Section to the Fort Lewis Fire Department dispatch center (Leeper 2009).

Appropriate fire suppression actions are taken at Fort Lewis depending on the location of the fire, season, fire danger level, weather conditions, planned prescribed burns, and fuel availability. In TAs on Fort Lewis, most small fires are suppressed by troops. Larger wildfires are suppressed by Forestry Section staff, unless they fall within the parameters of planned prescribed burns. Planned prescribed fires are allowed to burn under Army observation, usually to the limits of the closest firebreak (Army 2007c). In addition, fire fighters sometimes ignite backfires to control the spread of wildfires in Fort Lewis impact areas, rather than enter areas with potential UXO hazards (Army 2005c).

Firebreaks on Fort Lewis consist of roads (paved or gravel) and streams. Firebreaks serve to limit the spread of fires on the installation and prevent fires from extending beyond Post boundaries. The Fort Lewis Forestry Section maintains more than 200 miles (320 km) of fire trails, which include boundary fire trails, forest plantation fire trails, and firing range trails. Firing range trails serve to prevent fires started during training in the small arms and artillery impact areas from spreading into areas of higher value, such as the cantonment area (Army 2000b). Forestry equipment operators grade many range roads and firebreaks annually in support of fire control efforts (Army 2007c).

Prescribed burning is conducted on Fort Lewis to maintain a landscape of variable, discontinuous fuels and to reduce total fuel loads. Since inception of the prescribed burning program in 1983, 1,500 acres (600 ha) on average have been treated with prescribed fire annually (Army 2000b). Forestry Section staff conduct these prescribed burns and schedule them once a year, with most burns conducted in the summer. Fish and Wildlife and Range Division staff provide recommendations for areas that would benefit from prescribed burning. In many cases, prescribed fire burning is combined with other management tools, such as mowing (Army 2007c).

Fort Lewis has 125 separate prescribed fire units, covering more than 14,300 acres (5,790 ha). The units include areas of ponderosa pine, native prairie, and oak woodlands, as well as firing points and live fire ranges. Because Fort Lewis is in the early stages of the pine restoration process, most prescribed burning in ponderosa pine stands have occurred as initial burns conducted during summer months. According to the IWFMP, once these stands are established, they should be treated every 6 to 8 years. Prairie ecosystems are burned every 3 to 4 years, with burning typically occurring in the spring. Once fuels have been sufficiently reduced, burning in prairie areas may be conducted in the fall. Oak woodlands are burned every 4 to 5 years and are typically burned in the fall or summer.

Actual units burned and exact dates of prescribed burns are scheduled using Annual Work Plans and Forest Activity Reports. The Fort Lewis IWFMP outlines the procedures that must be followed during implementation of prescribed burning, including maintenance of 164-foot (50-m) buffer areas around Post boundaries and 66-foot (20-m) buffer areas around high-intensity power lines and roads with public right-of-way or easement. All appropriate state and local agencies and fire districts (Army 2000b) are contacted prior to any prescribed burn operation at Fort Lewis.

3.5.4 Firefighting Resources

Fire protection for structural and airport fires at Fort Lewis is the responsibility of the Fort Lewis Fire Department. The Fort Lewis Fire Department employs 60 operational firefighters, nine fire prevention staff, and eight management and support staff (Leeper 2009). The Fort Lewis Fire Department has four fire stations (three on the Main Post and one on North Fort) and is responsible for providing fire and emergency services to a service area of approximately 86,000 acres (35,000 ha) and a population of more than 35,000. In addition, the Fort Lewis Fire Department maintains mutual aid agreements with all of the fire departments in the surrounding municipalities. During emergencies, these municipal fire departments respond to Fort Lewis as they would any other 911 call (International Association of Fire Fighters [IAFF] 2003).

Wildland fire incidents at Fort Lewis are handled by the Forestry Section of the Public Works Environmental Division (IAFF 2003, Army 2004b). The Forestry Section has seven full-time permanent employees who conduct fire control activities (Leeper 2009). These employees are supplemented with two full-time permanent employees of the Fish and Wildlife Section when needed (Army 2000b). During the high fire danger period at Fort Lewis (June through October), an additional 14 temporary forestry technicians and two full-time heavy equipment operators are employed (Leeper 2009). For fires occurring during non-duty hours, the Forestry Section provides the Fort Lewis FAC with an emergency “on call” list of forestry personnel. All personnel conducting fire suppression activities, including prescribed burning operations, are required to be Red Card certified for the duties they are assigned. Training for forestry technicians is required to meet the standards outlined in the National Wildfire Coordinating Group’s 310–1, Wildland and Prescribed Fire Qualification Guide (Army 2000b).

Under most circumstances, permanent and temporary employees in the Forestry Section are capable of controlling wildfires occurring at Fort Lewis. However, during the high fire danger period,

Soldiers from I Corps and Fort Lewis may be required to provide support. In addition, help from the WDNR and local fire districts is available through mutual aid agreements. The Fort Lewis and McChord AFB Fire Departments may also respond to requests for assistance in fire suppression (Army 2000b).

Two standpipes on Fort Lewis's main water system are used as water fill points for wildland fire equipment. One is located at Building T1206, and the other is located adjacent to the ball fields near the Post cemetery. All wildland fire engines are equipped to enable any fire hydrant located on- or off-Post to be used as a fill point. In addition, nearby lakes and streams, including Cat Lake, Fiander Lake, Nisqually River, Muck Creek, Lewis Lake, Chambers Lake, and Johnson Marsh, may be used as water sources for wildfire suppression (Army 2000b).

Equipment for both ground and aerial fire suppression is used for wildfires at Fort Lewis. Among other equipment, five Type 6 wildland engines (200-gallon [760-L] capacity), four Type 4 engines with 1,000-gallon (3,800-L) capacity, one Type 3 water tender, one dozer with transport, and one 1-ton 4x4 stake truck (command vehicle) provide ground suppression assistance (Army 2000b). In addition, Fort Lewis has two full-time Aircraft Rescue Fire Fighting (ARFF) companies that respond to airfield fires (Leeper 2009).

3.6 CULTURAL RESOURCES

The ROI for cultural resources encompasses the area within the boundaries of Fort Lewis. The affected environment for cultural resources for the GTA undertaking includes archaeological sites (prehistoric and historic-period sites), historic districts, individual historic buildings and structures, and Native American traditional cultural resources.

Baseline data for cultural resources are derived from the existing Fort Lewis ICRMP (Army 2005d), which is in the process of being revised and updated, and previous cultural resources work completed on the installation. Information is presented in **Sections 3.6.3** through **3.6.4** for each resource type.

3.6.1 Applicable Federal Authorities

Potential impacts to cultural resources are considered with reference to several federal authorities pursuant to Army Regulation 200–1, Chapter 6, Cultural Resources. Cultural resources are defined as:

- Historic properties, including traditional cultural properties (TCPs), as defined by Section 106 of the NHPA. A “historic property” is any prehistoric or historic district, site, building, structure, or object greater than 50 years old that is included in, or eligible for inclusion in, the National Register of Historic Places (NRHP).
- Native American cultural items (funerary objects, objects of cultural patrimony) as defined in the Native American Graves Protection and Repatriation Act (NAGPRA), which applies to federal lands.
- Archeological resources as defined in the Archeological Resources Protection Act (ARPA), which are protected from unauthorized excavation, removal, or damage on federal and Indian lands.
- Indian sacred sites, as defined in EO 13007, to which access is provided under the American Indian Religious Freedom Act (AIRFA)
- Artifact or archival collections as defined in 36 CFR 79, “Curation of Federally Owned and Administered Collections.”

3.6.2 Archaeological Resources

Archaeological survey efforts on Fort Lewis to date have recorded 382 archaeological sites spanning 8,000 years of history and prehistory. The inventory includes 334 historic period sites, 26 sites that date to the prehistoric period, and 20 sites that contain both prehistoric and historic components. To date, 216 of the sites have been filed with the Department of Archaeology and Historic Preservation (DAHP). Of these, 24 have been formally evaluated, with four sites determined eligible for listing in the NRHP.

Approximately 74 percent of Fort Lewis has been surveyed for archaeological resources. Surveys have been conducted on both a project-specific basis to examine an area of proposed ground disturbance and on an annual inventory basis for compliance with Section 110 of the NHPA, which requires federal agencies to inventory historic properties that are on lands they own or manage. Approximately 90 percent of the Fort Lewis cantonment area that is suitable for development has been surveyed for archaeological resources. Twenty-nine archaeological sites have been identified in the cantonment area, of which 26 are historic-period sites, two are prehistoric sites, and one is a multi-component site.

The majority of prehistoric sites on Fort Lewis can be characterized as sparse scatters of stone tools and tool-making debris (i.e., “lithic scatters”), or shell middens, which most likely represent temporary camps associated with subsistence procurement activities (Righter 1981, Maass et al. 2005, Dampf et al. 2008). Most of the prehistoric sites on Fort Lewis are found in alluvial settings near waterways (Nisqually River, Muck Creek) or prairie habitats where seasonal camas bulbs and other aquatic and terrestrial food resources would have been procured.

Historic-period archaeological sites are relatively more common than prehistoric sites on Fort Lewis, and are associated with the following historical themes identified in a 1999 study of historic-period archaeological site on the installation (Lewarch et al. 1999):

- early Nisqually Indian Reservation (1857 to 1917);
- Hudson’s Bay Company and Puget Sound Agricultural Company;
- American settlement and agricultural development;
- growth of late 19th to early 20th century rural agricultural communities;
- railroad transportation, logging, and milling; and
- development of Fort Lewis from its establishment in 1917 to World War II.

Five historic cemeteries are known to exist on Fort Lewis that are managed and protected as archaeological sites. They date primarily to the Nisqually Indian Reservation and early pioneer periods (circa [ca.] 1854 to 1917), although most of the cemeteries are unmarked. The Fort Lewis Military Cemetery remains in active use.

3.6.3 Historic Districts, Buildings, and Structures

Three historic districts and numerous individual buildings, structures, and objects have been inventoried on Fort Lewis. Some of these resources date to the earliest years of Fort Lewis, and many are associated with expansion of the installation during the World War II period. NRHP eligibility criteria apply to buildings and structures greater than 50 years of age (i.e., pre-1960), which comprise the majority of the historic resources on Fort Lewis.

3.6.3.1 *Historic Districts*

Three NRHP-eligible historic districts occur on Fort Lewis: the Fort Lewis Garrison Historic District, the Old Madigan General Hospital Historic District, and the American Lake Department of Veteran’s Affairs Hospital Historic District. A historic district is defined as a significant concentration of buildings, structures, or both dating to the same time period and associated with the same historical theme. A historic district has a specific geographical boundary within which contributing and non-contributing resources are present.

The Fort Lewis Garrison Historic District is listed in the Washington Heritage Register and in 2004 was determined eligible for, but not formally nominated to, the NRHP. The historic landscape in and around the Fort Lewis Garrison Historic District is recognized as contributing to its significance. The historic landscape has features that include, but are not limited to, views, open space, vegetation, site furnishings, circulation systems, and water features. The District contains 299 contributing buildings, structures, and objects distributed over 420 acres (170 ha) as follows:

- 71 buildings in the Garrison area;
- 123 residences in the Broadmoor Housing area;
- 99 residences in the Greenwood Housing area;
- the 91st Division Monument; and
- Camp Lewis road alignments railroad alignments.

The Old Madigan General Hospital Historic District was determined eligible for, but not formally nominated to, the NRHP in 2001. The District originally contained 99 buildings, 42 of which were recorded to the specifications of the Historic American Building Survey (HABS) and demolished in 1994. The remaining District’s resources include 27 contributing buildings, 29 non-contributing buildings and structures, and one road structure distributed over 32 acres (13 ha).

The American Lake Department of Veteran’s Affairs Hospital Historic District was nominated to the NRHP in May 2009, and is listed on Washington Heritage Register. The District contains 85 contributing buildings distributed over 106 acres (43 ha). All of the buildings are owned by the Department of Veteran’s Affairs on lands leased from Fort Lewis. The Army has no NHPA management responsibility for these buildings.

3.6.3.2 *Individual Historic Properties*

Several individual historic properties and commemorative objects exist on Fort Lewis. Individual NRHP-eligible historic properties on Fort Lewis include:

- Salvation Army Red Shield Inn (Fort Lewis Museum) (NRHP-listed)
- Liberty Gate (Main Gate)
- Mount Rainier Ordnance Depot Gate (Logistics Center Gate) and Headquarters Building
- Carey Memorial Theater (Building 2163)

Fort Lewis also has two commemorative objects that are notable historical resources, but are not NRHP-eligible properties: the Captain Wilkes July 4, 1841 Celebration Site, listed in the Washington Heritage Register in 1970, and the Hudson’s Bay Company Trail Monument (Building No. 4185). The monument is near the DuPont Gate and bears a Fort Lewis building number.

3.6.4 Native American Traditional Cultural Resources

Present-day Fort Lewis is located within the traditional territories of the Nisqually and Puyallup tribes as they were documented in the early 19th century. Places and resources that are important to the ongoing traditional or ceremonial practices of the Nisqually and Puyallup tribes (and other area tribes) are present on Fort Lewis. Such places include particular plant and animal habitats, natural features of the landscape, and sites where important rituals, such as vision quests, were carried out in the past, and which continue to be used for such purposes. Resources of traditional cultural or ceremonial value may not have specific geographic boundaries that can be drawn on a map, and may be known only to tribal members who wish to keep their location and nature confidential (Parker and King 1998). The following summary of tribal traditional cultural resources on Fort Lewis is based on ethnographic documentation cited in previous cultural resources studies completed for Fort Lewis.

At the time of sustained European contact, the Nisqually inhabited as many as 40 villages along the Nisqually River, from its headwaters in the foothills of Mount Rainier to its delta on Puget Sound (Ruby and Brown 1992, Carpenter 2002). Ethnographic place-names recorded by ethnographer T.T. Waterman in the vicinity of Fort Lewis include a Nisqually village at the mouth of the Nisqually River, *"sqwE'ʔe"*, from which came the modern name for the river and the people, which means "late." This may refer to the fact that salmon were said to run later in the Nisqually than in other regional rivers and streams.

As with other groups in western Washington, the Nisqually relied on salmon as a staple resource. The Nisqually established fishing stations along the Nisqually River to capture migrating salmon in addition to other fish species (Smith 1940, Ballard 1957, Lane 1973). They lived in permanent winter villages, which consisted of one or more cedar plank longhouses occupied by several related families (Carpenter 2002, Haeberlin and Gunther 1930, Smith 1940). Major village sites have been identified at the Nisqually River delta; the mouths of Muck Creek, Clear Creek, and Meshal Creek; and the cities of Roy, Rainier, and Tenino (Smith 1940).

The northern portion of Fort Lewis was also within the aboriginal territory of the Puyallup Indians (Haeberlin and Gunther 1930, Smith 1940). At the time of contact, the Puyallup lived in winter villages on the Puyallup River, Commencement Bay, Hylebos Creek, Wapato Creek, Carbon River, Stuck River, South Prairie Creek, and Vashon Island (Smith 1940). Villages were often composed of one large house occupied by four to eight families. During the summer months, each family group would leave the village and travel to seasonal resource procurement locations, such as the camas prairies.

Fort Lewis cultural resource managers are aware that there are places and resources on the installation that have traditional cultural or ceremonial importance to the Nisqually, Puyallup, and Squaxin Island tribes. Several important traditional places have been identified on Fort Lewis by elders of the Nisqually Indian Tribe, who have expressed their wish to keep their location confidential. An ongoing program of consultation with the tribes is in place to ensure accessibility and confidentiality within the parameters of the Fort Lewis mission.

As part of its responsibility under Section 106 of the NHPA, Fort Lewis initiated consultation for the GTA undertaking with the Nisqually, Puyallup, and Squaxin Island tribes in January 2009. Letters were sent to each tribe on January 30, 2009, introducing the GTA undertaking and inviting the tribes to a consultation meeting at Fort Lewis on February 3. At the meeting, Fort Lewis cultural resources management staff presented the GTA alternatives, the Section 106 consultation process, and the status of the installation's cultural resources inventory and management program. Tribal members were shown maps of the installation and were given the opportunity to explore and discuss how the

proposed intensification of training activities associated with the GTA undertaking might affect tribal cultural resources. While various tribal members confirmed that there are places and resources on Fort Lewis that are important, no specific impacts were identified. All agreed to continue consulting throughout the EIS process so that any adverse impacts the tribes may identify after reviewing the DEIS document can be avoided, minimized, or mitigated. Fort Lewis also explained that the Section 106 process would result in the development of a Programmatic Agreement (PA) pursuant to 36 CFR § 800.14(b)(3) concerning the management of cultural resources on Fort Lewis, for which the tribes would have the opportunity to provide input (the PA is discussed in **Section 4.6.8** and provided in **Appendix D**). A summary of the meeting minutes was sent to the tribes for review on February 20, 2009.

3.7 AIR QUALITY

3.7.1 Air Quality Regulations Applicable to Fort Lewis

The Clean Air Act, as amended in 1990, requires EPA to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. Primary standards set limits to protect public health, and secondary standards set limits to protect public welfare (including protection against decreased visibility and damage to animals, crops, vegetation, and buildings). NAAQSs have been set for six principal pollutants, known as criteria pollutants: carbon monoxide (CO), lead, nitrogen dioxide (NO₂), particulate matter less than 10 microns or 2.5 microns in diameter (PM₁₀ and PM_{2.5}, respectively), ozone (a product of volatile organic compounds [VOCs] and nitrogen oxides [NO_x] reacting in the atmosphere), and sulfur dioxides (SO₂) (**Table 3–7**). NAAQSs are based on concentrations averaged over various periods. Standards for pollutants with acute health effects are based on relatively short-term periods (1 hour, 3 hours, 8 hours, or 24 hours), whereas additional standards are based on relatively long periods (quarterly and annually) to gauge chronic effects. Individual states are responsible for regulating pollution sources.

Table 3–7 National Ambient Air Quality Standards

Air Pollutant	Standard Type	Concentration ¹	AQCR Classification for Fort Lewis ²
Particulate matter (PM ₁₀)	Primary and Secondary	150 µg/m ³ 24-hour average	Unclassifiable
Particulate matter (PM _{2.5})	Primary and Secondary	15 µg/m ³ annual arithmetic mean	Not currently applicable
	Primary and Secondary	35 µg/m ³ 24-hour average	Not currently applicable
Sulfur dioxide	Primary	0.030 ppm (80 µg/m ³) annual arithmetic mean	Attainment
	Primary	0.14 ppm (365 µg/m ³) 24-hour average	Attainment
	Secondary	0.50 ppm (1,300 µg/m ³) 3-hour average	Attainment
Carbon monoxide	Primary	9 ppm (10,000 µg/m ³) 8-hour average	Unclassifiable/Attainment
	Primary	35 ppm (40,000 µg/m ³) 1-hour average	Unclassifiable/Attainment
Ozone	Primary and Secondary	0.12 ppm (235 µg/m ³) 1-hour average	Attainment
	Primary and Secondary	0.075 ppm 8-hour average (2008 standard)	Not currently applicable ³
	Primary and Secondary	0.08 ppm 8-hour average (1997 standard)	Attainment
Nitrogen dioxide	Primary and Secondary	0.053 ppm (100 µg/m ³) annual arithmetic mean	Unclassifiable/Attainment
Lead	Primary and Secondary	1.5 µg/m ³ quarterly average	Unclassifiable/Attainment

Notes:

1 µg/m³ = micrograms per cubic meter; ppm = parts per million

2 AQCR = Air Quality Control Region

3 Data are currently being collected to determine this classification. Preliminary data indicate that the Puget Sound region has violated the new standard (Puget Sound Clean Air Agency 2008).

Source: EPA 2008b.

Under the General Conformity Rule of the Clean Air Act, Section 176(c), EPA established certain statutory requirements for federal agencies to demonstrate conformity of the proposed activities with the State Implementation Plan for attainment of the NAAQS. Certain actions are exempted from conformity determinations, while others are presumed to conform if the total project emissions are below *de minimis* levels and less than 10 percent of the regional emissions inventory.

EPA has divided the country into geographical regions known as Air Quality Control Regions (AQCRs) to evaluate compliance with the NAAQS. Fort Lewis is located in the Puget Sound Intrastate AQCR and the Olympic-Northwest Washington Intrastate AQCR. EPA designates AQCRs as either attainment or nonattainment areas for each of the individual criteria pollutants. Attainment areas have concentrations of criteria pollutants below NAAQSs, and nonattainment areas have concentrations above NAAQSs. Maintenance areas are attainment areas that had a history of nonattainment, but are now consistently meeting the NAAQS.

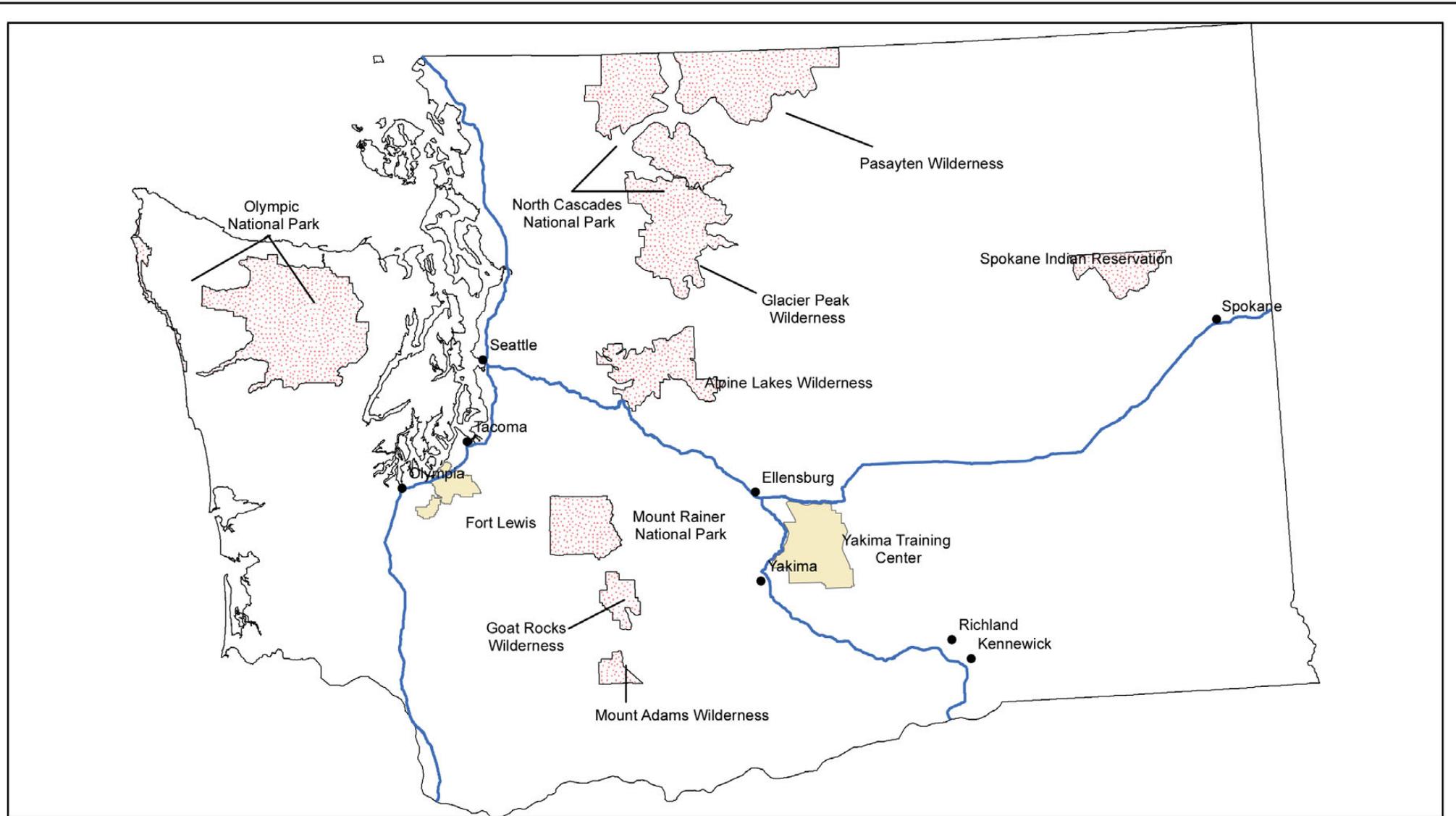
Toxic air pollutants (also known as toxic air contaminants) are known or suspected to cause cancer or other serious health effects, or to cause adverse environmental effects (EPA 2008b). Emissions of toxic air pollutants must be below Acceptable Source Impact Levels (ASILs), which are concentrations established by regulatory authorities to evaluate air quality impacts. Toxic air pollutants are referred to as hazardous air pollutants under the Clean Air Act. National emission standards for hazardous air pollutants (NESHAPs) are technology-based limits on the release of hazardous air pollutants from industrial sources. NESHAPs are not based on health risk considerations.

In accordance with Prevention of Significant Deterioration (PSD) regulations, attainment areas are classified as Class I, Class II, or Class III areas. Class I areas have the most stringent limitations on new emission sources, followed by Class II and Class III areas. EPA has designated certain national parks and wilderness areas as Class I areas. These areas are considered pristine and are therefore afforded special protection from impacts associated with air pollution. The closest PSD Class I area to Fort Lewis is Mount Rainier National Park, which is located approximately 50 miles (80 km) to the east (**Figure 3–6**).

3.7.2 Air Quality on Fort Lewis

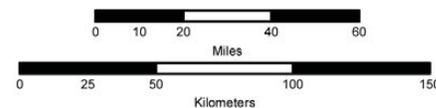
Air quality in the Fort Lewis area is good. According to the most recent air quality report from Puget Sound Clean Air Agency (2008), the major source of air pollution in the Puget Sound region is on-road vehicles, which are the greatest contributors to criteria pollutants and greenhouse gas emissions in the Puget Sound airshed. Additionally, area sources, such as outdoor and indoor burning, are major contributors to particulate matter (PM) emissions. All of Washington is in attainment with the NAAQS for criteria pollutants, or is designated as unclassified/attainment. Areas with the unclassified/attainment designation cannot be completely classified because of a lack of information, but are treated as attainment areas for regulatory purposes.

Portions of Fort Lewis are located in maintenance areas for ozone and CO (**Figure 3–7**). Maintenance areas were previously nonattainment areas but have since been redesignated to attainment areas. To maintain continued attainment with the NAAQS, federal actions occurring in maintenance areas are subject to general conformity thresholds of 100 tons (100,000 kg) per year for each pollutant formerly designated as nonattainment. Because of the new lower standards for ozone, portions of Fort Lewis could potentially be a nonattainment area for this pollutant in the near future. According to Puget Sound Clean Air Agency (PSCAA), the nonattainment designation, should it occur, would likely be in a couple of years. At that time, Fort Lewis will have to work with PSCAA to address the new designation (Carr 2009). Additionally, the EPA recently designated a new PM_{2.5} nonattainment area in southern Tacoma (EPA 2008d). The boundary of this proposed area is adjacent to the eastern boundary of Fort Lewis, but does not include the installation.

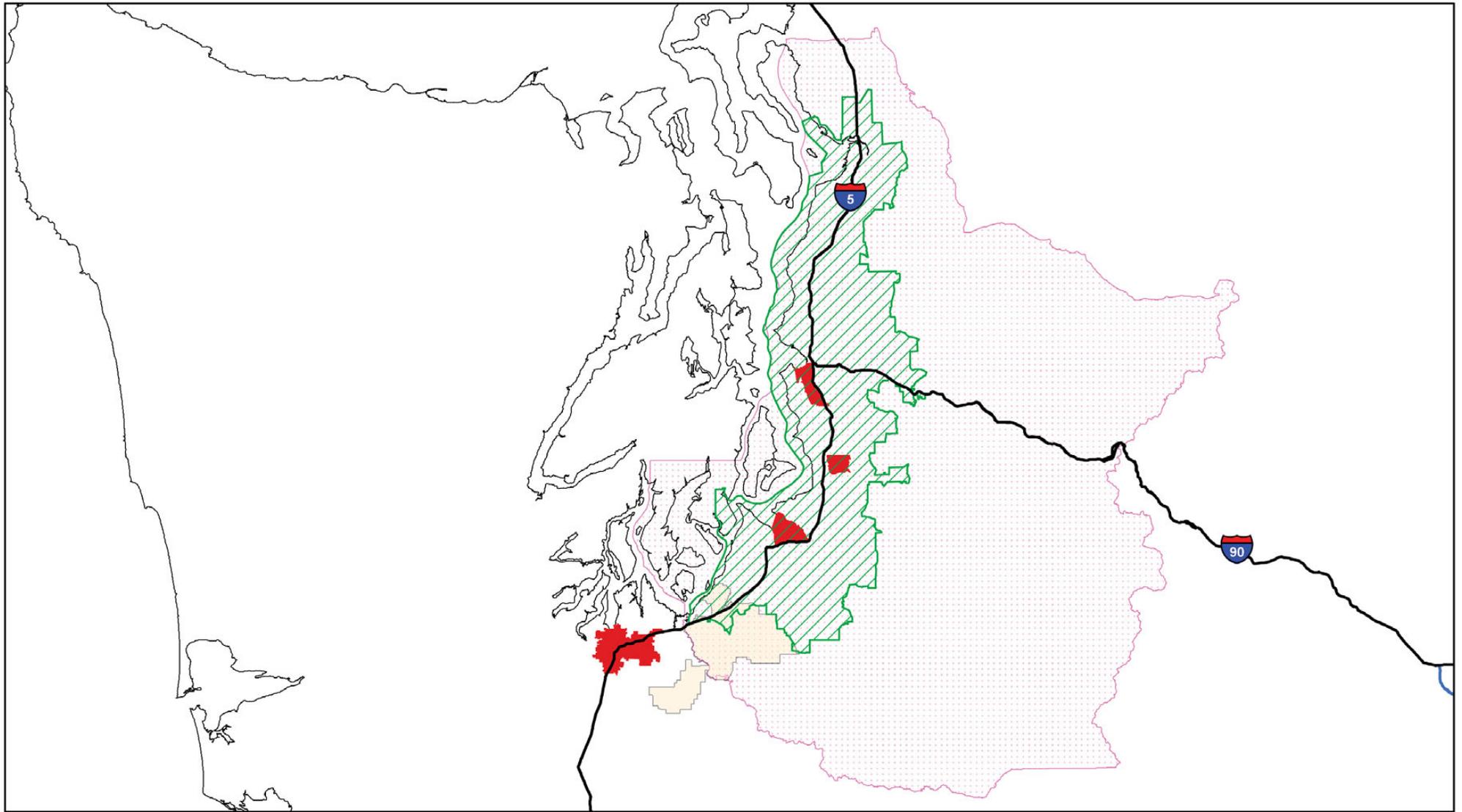


 Class 1 Areas

PRIVILEGED DOCUMENT-
 DELIBERATIVE PROCESS MATERIAL
 FOR OFFICIAL USE ONLY

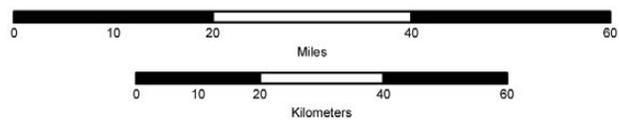


FORT LEWIS GTA EIS	
<p>Figure 3-6 Class 1 Areas in Washington State</p>	
ANALYSIS AREA: Thurston & Pierce Counties, Washington	
Date: 7/18/2009	File: Arcadis/EIS Figures.mxd
Prepared By: BC	Layout: ProjectArea.pdf



PRIVILEGED DOCUMENT-
 DELIBERATIVE PROCESS MATERIAL
 FOR OFFICIAL USE ONLY

-  CO Maintenance Area
-  PM10 Nonattainment Areas
-  Ozone Maintenance Area
-  Fort Lewis



FORT LEWIS GTA EIS	
<i>Figure 3-7 Air Quality Maintenance and Nonattainment Areas in the Vicinity of Fort Lewis</i>	
<small>ANALYSIS AREA: Thurston & Pierce Counties, Washington</small>	
<small>Date: 7/16/2009</small>	<small>File: Arcadis/DEIS Figures.mxd</small>
<small>Prepared By: BC</small>	<small>Layout: ProjectArea.pdf</small>

Fort Lewis contributes emissions from both mobile and stationary sources. The primary pollutants from motor vehicles include NO_x, CO, and VOCs. Secondary pollutants include PM₁₀ and PM_{2.5} emissions as fugitive dust, caused by motor vehicles travelling on unpaved and/or gravel roads, project construction, demolition, and training exercises. Stationary sources at Fort Lewis include aerospace maintenance and rework operations, fuel burning, fuel storage and dispensing, degreasing, woodworking, and painting operations. The primary pollutants from fuel burning are NO_x, CO, SO₂, VOCs, and PM₁₀. The primary pollutants from fuel storage and painting are VOCs. A 2007 inventory of emissions from the major stationary air pollution sources on the installation is provided in **Table 3–8**. These emissions are given in tons per year, which is how they are submitted to regulatory agencies.

Table 3–8 2007 Air Emission Inventory from Fort Lewis Stationary Sources

Pollutant	Tons/Year
Carbon monoxide (CO)	65.9
Nitrogen oxides (NO _x)	56.6
Sulfur oxides (SO _x)	7.2
Volatile organic compounds (VOCs)	29.6
Particulate matter (PM ₁₀ and PM _{2.5})	10.2
Total hazardous air pollutants	4.5
Total toxic air contaminants	10.7

Source: Rosacrans 2008.

3.8 NOISE

Noise is generally described as unwanted sound. The physical characteristics of sound include intensity, frequency, and duration. Sound is transmitted by mechanical vibrations through different mediums, like air. When sound energy increases, the noise is perceived louder. Sound levels are typically measured using a logarithmic decibel (dB) scale.

Measurements and descriptions of sounds are usually based on various combinations of the following factors:

- vibration frequency characteristics of the sound, measured as sound wave cycles per second (Hertz [Hz]) which determines the “pitch” of a sound;
- total sound energy being radiated by a source, usually reported as a “sound power level;”
- actual air pressure changes experienced at a particular location, usually measured as a “sound pressure level” (the frequency characteristics and sound pressure level combine to determine the “loudness” of a sound at a particular location);
- duration of a sound; and
- changes in frequency characteristics or pressure levels through time.

Human hearing varies in sensitivity for different sound frequencies. Human hearing is limited to frequencies between about 20 and 20,000 Hz, with the upper limit generally decreasing with age. Correction factors for adjusting actual sound pressure levels to correspond with human hearing have been determined experimentally. A-weighted correction factors are employed for measuring noise in ordinary environments and de-emphasize the very low and very high frequencies of sound in a manner similar to the response of the human ear. Therefore, the A-weighted decibel (dBA) is a good

correlation to a human's subjective reaction to noise. To the average human ear, the apparent increase in "loudness" doubles for every 10-dBA increase in noise (Bell 1982).

The following discussion provides a basis of familiarity with known and common noise levels. A quiet whisper at 5 feet is 20 dBA; a residential area at night is 40 dBA; a residential area during the day is 50 dBA; a large and busy department store is 60 dBA; rush hour traffic at 100 feet from the road is 60 to 65 dBA; interstate traffic at 200 feet is 65 dBA; a heavy truck at 50 feet is 75 dBA; and a typical construction site is 80 dBA. At the upper end of the noise spectrum, a jet takeoff at 200 feet is 120 dBA (Harris 1991). Although sound at 140 dBA causes damage and actual pain in humans, the effects of this noise level on wildlife is unknown.

Although the A-weighting scale is the most widely used decibel weighting procedure, other weighting scales are also used. The C-weighted scale and unweighted decibel values are commonly used for blast noise, sonic booms, or other low-frequency sounds capable of inducing vibrations in buildings or other structures. The C-weighted sound level is a measure read from a standard sound level meter that de-emphasizes the low and high frequencies. Additionally, evaluations of blast noise or sonic boom events sometimes use a peak overpressure measurement.

Equivalent noise levels (L_{eq}) are used to develop single-value descriptions of average noise exposure over various periods. Such average noise exposure ratings often include additional weighting factors for potential annoyance due to time of day or other considerations. The L_{eq} data used for these average noise exposure descriptors generally are based on A-weighted sound level measurements.

L_{eq} are not an averaging of decibel values, but are based on the cumulative acoustical energy associated with the component decibel values. High dB events contribute more to the L_{eq} value than low dB events.

Peak noise levels are described as L_{max} . It is the highest sound level measured over an entire noise event. Discrete noise events sometimes are characterized using the sound exposure level (SEL). The SEL measure represents the cumulative sound exposure, intensity, and duration, over an entire noise event, integrated with respect to a 1-second time frame. SEL measurements are equivalent to the L_{eq} value of a 1-second noise event producing the same cumulative acoustic energy as the actual noise event being analyzed. In effect, an SEL measure distributes or compresses the noise event to fit a fixed 1-second time interval. SEL values can be computed using any decibel-weighting scheme.

Average noise exposure over a 24-hour period is often presented as a day-night average sound level (L_{dn}). L_{dn} values are calculated from hourly L_{eq} values, with the L_{eq} values for the nighttime period (10 p.m. to 7 a.m.) increased by 10 dB to reflect the greater disturbance potential from nighttime noises. The C-weighted day-night sound level (CDNL) is used to describe the cumulative or total noise exposure during the prescribed time. The CDNL has been found to be a good measure of annoyance noise in a community.

Ambient background noise is not evaluated in environmental noise calculations because background noise varies by location, with wilderness areas being as low as 10 dBA, and because when calculating noise levels, louder sounds dominate the equation. Therefore, it is reasonable to assume that evaluation of background in calculations would have little impact on CDNL.

The Army has developed computer models that assess peak noise levels associated with random blast noise events, while also factoring in the statistical variations caused by weather (U.S. Army Center for Health Promotion and Preventive Medicine [USACHPPM] 2009). The noise contour plotted is PK15 (met) (unweighted peak, 15 percent metric). PK15 (met) is the peak sound level that

is likely to be exceeded 15 percent of the time. Because weather conditions can cause noise levels to vary significantly, even from hour to hour, the programs calculate a range of peak levels. By plotting the PK15 (met) contour, events are expected to fall within the contours 85 percent of the time. This gives the installation a way to consider the areas affected by training noise, but without placing stipulations on land that may receive high sound levels under infrequent weather conditions that favor the propagation of sound. PK15 (met) does not consider the duration or number of events, so the size of the contours will remain the same regardless of the number of events.

3.8.1 Department of Defense Noise Guidelines

DoD began developing noise evaluation programs in the early 1970s. Initial program development involved the Air Installation Compatible Use Zone (AICUZ) program for military airfields. Early application of the AICUZ program emphasized Air Force and Navy airfields. The Army implemented the program as the Installation Compatible Use Zone (ICUZ) program by addressing both airfield noise issues and other major noise sources, such as weapons testing programs and firing ranges. Joint Air Force, Army, and Navy planning guidelines were issued in 1978. The 1978 guidelines use annual average L_{dn} values to categorize noise exposure conditions on military installations.

The Army has supplemented the original 1978 guidelines to develop a more comprehensive Environmental Noise Management Program (ENMP). The ENMP program incorporates ICUZ evaluations as one component of the program. Other components of the ENMP include programs for handling noise complaints and undertaking supplemental noise evaluations when warranted by the nature of discrete noise events. Criteria for evaluation of noise levels have been expanded beyond the normal A-weighted L_{dn} descriptor to include the use of C-weighted L_{dn} values to characterize major blast noise sources and the use of peak unweighted decibel values to characterize small arms firing and large weapons training.

USACHPPM assists Army installations in developing ENMPs. USACHPPM also undertakes special noise studies to evaluate noise problems associated with various types of noise sources. When investigating noise conditions related to weapons firing or ordnance detonations, USACHPPM typically measures peak unweighted decibel levels and/or C-weighted SEL levels.

3.8.2 The Army Land Use Guidelines

The Army land use guidelines identify four noise zones (USACHPPM 2009) summarized below and in **Table 3–9**. The Land Use Planning Zone (LUPZ) day-night sound level (DNL) noise contours (60 dB A-weighted day-night sound level [ADNL] for aviation activity or 57 dB CDNL) represent an annual average that separates Noise Zone II from Noise Zone I. The contours are generated by taking all operations that occur over the year and dividing by the number of training days. The noise environment varies daily and seasonally because operations are not consistent through all 365 days of the year. In addition, the Federal Interagency Committee on Urban Noise document states, “Localities, when evaluating the application of these guidelines to specific situations, may have different concerns or goals to consider.” For residential land uses, depending on attitudes and other factors, a 60 dB ADNL or a 57 dB CDNL may be considered by the public as an impact on the community environment. To provide a planning tool that could be used to account for days of higher than average operations and possible annoyance, the LUPZ contour is included on the noise contour maps generated from the modeling. The LUPZ contour is included on the noise contour maps contained in this document.

Table 3–9 Land Use Planning Guidelines for Noise

Noise Zones	Aviation (ADNL)	Large Caliber Weapons (CDNL)	Small Arms Weapons PK15 (met)
LUPZ	60-65	57 – 62	NA ¹
I	<65	< 62	<87
II	65-75	62 – 70	87-104
III	>75	> 70	> 104

Note:

1. NA = not available.

Source: USACHPPM 2009.

Noise Zone I includes all areas around a noise source in which the DNL is less than 65 dB ADNL for aviation activity, less than 62 dB CDNL for large caliber weapons, or less than 87 PK15 (met) for small arms weapons. This area is usually acceptable for all types of land use activities.

Noise Zone II consists of an area where the DNL is between 65 and 75 dB ADNL for aviation activity, between 62 and 70 dB CDNL for large caliber weapons, or between 87 and 104 PK15 (met) for small caliber weapons. Land within Noise Zone II is usually acceptable for industrial, manufacturing, transportation, and resource production. However, if the community determines that land in Noise Zone II (attributable to small arms) areas must be used for residential purposes, then noise level reduction (NLR) features of 25 to 30 dB should be incorporated into the design and construction of new buildings to mitigate noise levels. For large caliber weapons, NLR features cannot adequately mitigate the low-frequency component of large caliber weapons noise.

Noise Zone III consists of the area around the noise source where the DNL is greater than 75 dB ADNL for aviation activities, greater than 70 dB CDNL for large caliber weapons, or greater than 104 PK15 (met) for small caliber weapons. Noise-sensitive land uses (such as housing, schools, and medical facilities) are not recommended within Noise Zone III.

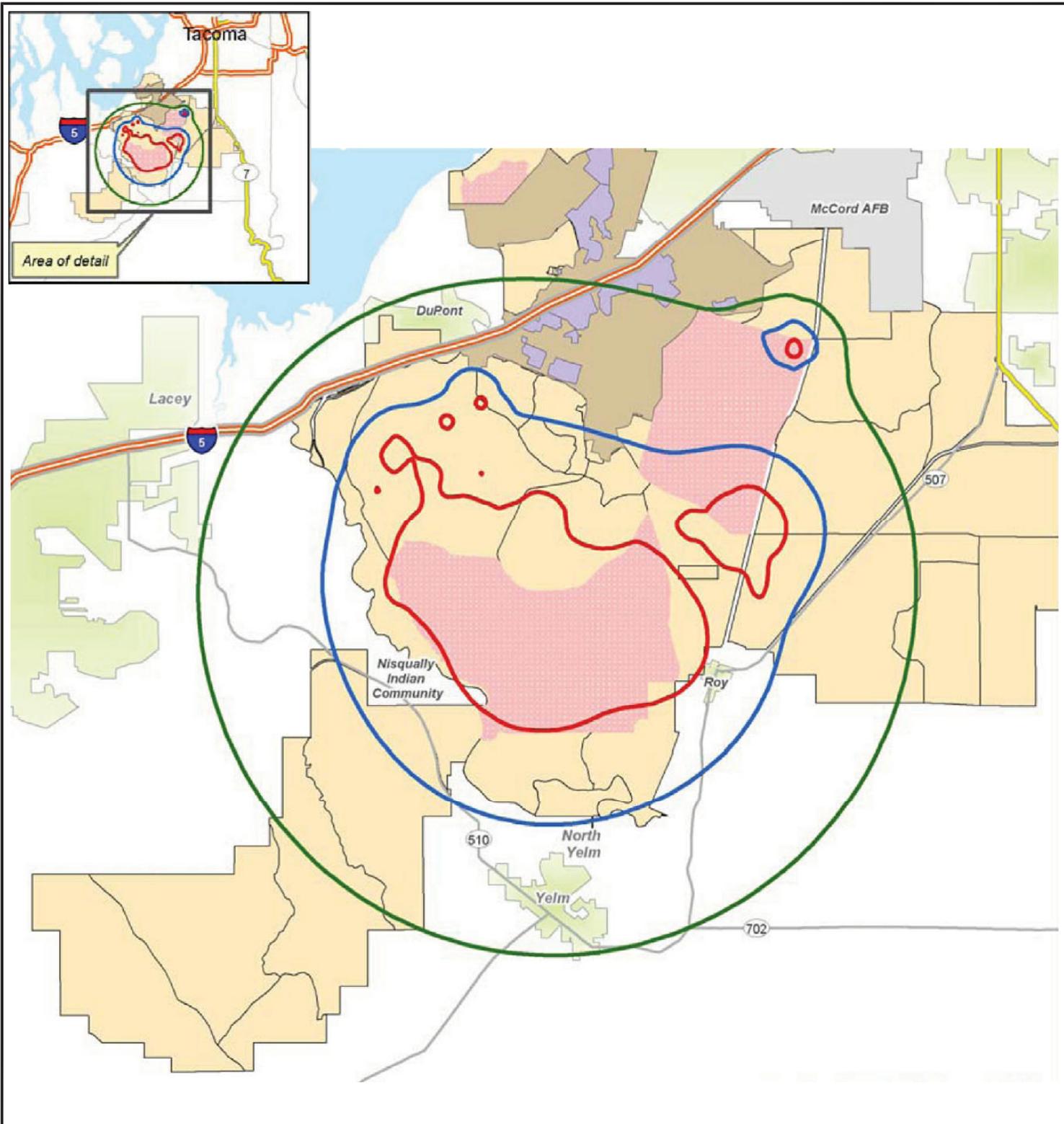
3.8.3 Existing Conditions

The chief sources of noise from Fort Lewis include aircraft (rotary- and fixed-winged) flyovers from GAAF and McChord AFB, munitions detonations, and live-fire (artillery and mortar) (Army 2007d). Range limitations are imposed on nighttime firing to reduce noise impacts to nearby residential communities. Small cities near the installation sometimes experience short-term noise level increases from training activities (Army 2007e).

Existing sources of noise at Fort Lewis include military aviation activities, small arms artillery, large caliber weapons training, and vehicular traffic. Noise from vehicular traffic is primarily located in the cantonment area. The highest noise levels are associated with weapons noise and flyovers from jets and helicopters. The Army has developed noise contours for Fort Lewis (USACHPPM 2009).

3.8.3.1 Baseline Conditions Demolition and Large Caliber Operational Noise

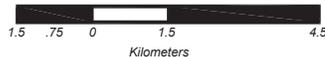
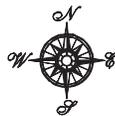
Figure 3–8 shows the baseline condition demolition and large caliber weapons noise contours for Fort Lewis. The LUPZ 57 dB CDNL extends approximately 2.8 miles (4,500 m) beyond the western boundary, toward the city of Lacey; approximately 0.9 mile (1,500 m) into the DuPont area; approximately 2.5 miles (4,000 m) beyond the southern boundary, encompassing the city of Yelm; and approximately 3.4 miles (5,500 m) beyond the southeastern boundary. Noise Zone II (62 dB CDNL) extends beyond the western boundary approximately 0.6 mile (1,000 m), encompassing the



Source: USACHPPM 2009

Legend

-  Cantonment Area
-  Housing Area
-  Impact Area
-  Fort Lewis
-  LUPZ (57 dB CDNL)
-  Zone II (62 dB CDNL)
-  Zone III (70 dB CDNL)



FORT LEWIS GTA EIS

*Figure 3-8
Fort Lewis Contemporary Operating
Environmental Demolition and
Large Caliber Operational Noise Contours*

ANALYSIS AREA: Thurston & Pierce Counties, Washington	
Date: 7/14/2009	File: Ft. Lewis Figures.dwg
Prepared By: ETC	Layout: 001

Nisqually Indian Reservation; less than 0.3 mile (500 m) beyond the southern boundary, into Yelm; and beyond the southeastern boundary 1.2 miles (2,000 m), encompassing the city of Roy. The Noise Zone III (70 dB CDNL) contour extends beyond the western boundary less 0.3 mile (500 m) into the Nisqually Indian Reservation and approximately 660 feet (200 m) beyond the southeastern boundary near the city of Roy.

3.8.3.2 GAAF Noise Contours

The noise contours for the baseline airfield operations are shown on **Figure 3–9**. The LUPZ (60 dB ADNL) and Zone II (65 dB ADNL) noise contours do not extend into the family housing areas or beyond the installation boundary. The low number of operations does not produce a Zone III (75 dB ADNL) noise contour.

3.8.3.3 Small Caliber Weapons Noise

The contours for small arms operations at Fort Lewis were created using PK15 (met). Because the contours are based on peak levels rather than a cumulative or average level, the size of the contours will not change if the number of rounds fired increases. Therefore, the baseline is equal to the projected.

The noise contours for small arms operations near the Fort Lewis cantonment area are shown on **Figure 3–10**. The Zone II PK15 (met) 87 dB noise contour extends into the Evergreen, Hillside, and Madigan housing areas. The Zone III PK15 (met) 104 dB noise contours do not extend into the housing areas.

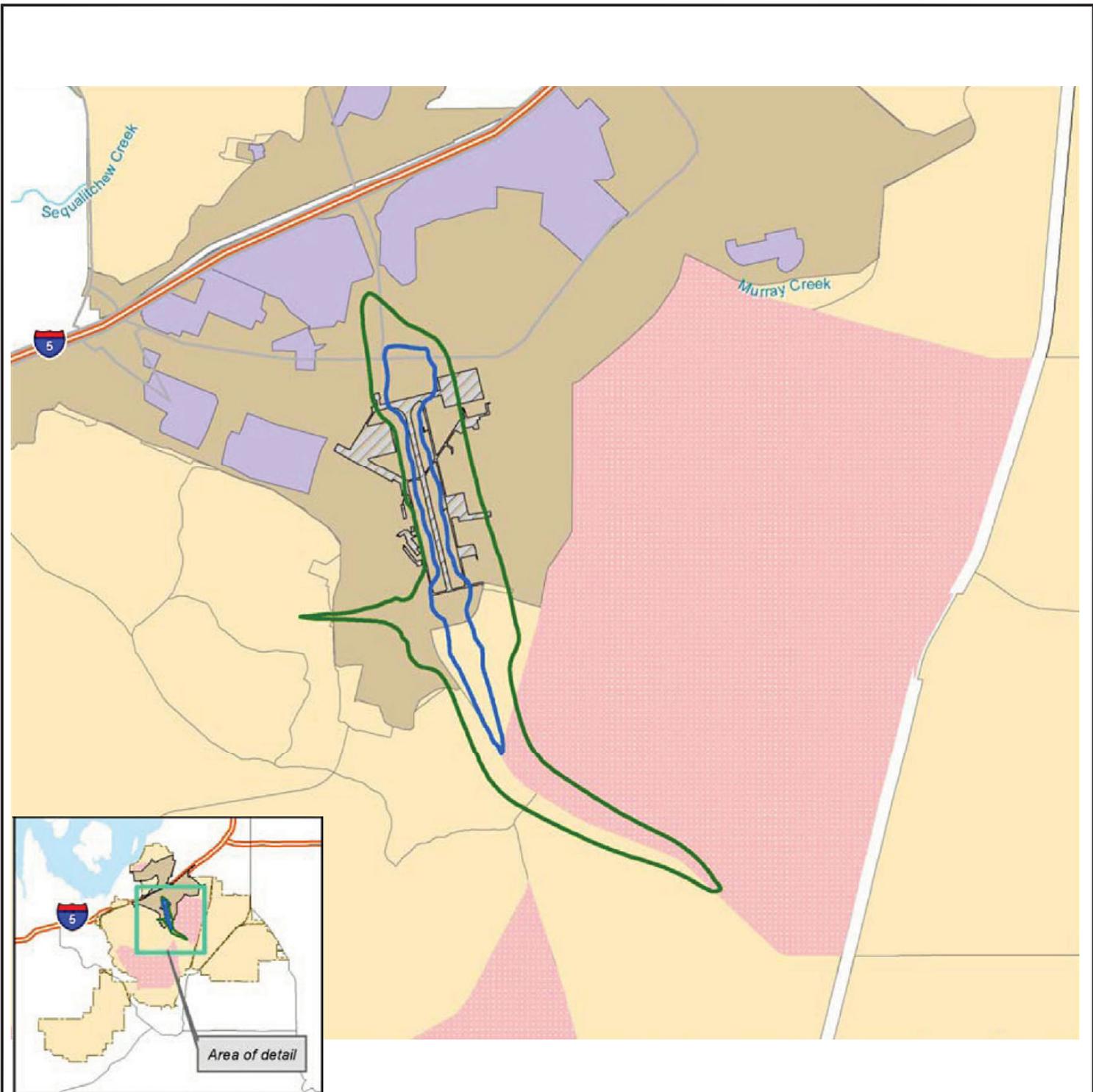
Although the local conditions at Fort Lewis require noise-sensitive land uses in Noise Zone II, on Post, this type of land use is strongly discouraged in AR 200–1 (Army 2007b). Noise-sensitive land uses are acceptable within the LUPZ and Noise Zone I, but are normally not recommended in Noise Zone II or in Noise Zone III. However, if the community determines that land in Noise Zone II (attributable to small arms) areas must be used for residential purposes, then the NLR features of 25 to 30 dB should be incorporated into the design and construction of new buildings to mitigate interior noise levels. Normal construction is expected to provide an NLR of 20 dB.

3.8.4 Complaint Risk Guidelines for Demolition Activity and Large Caliber Weapons

Under the Complaint Risk Guidelines, the peak contours show the expected level that one would get on a sound level meter when firing a weapon. This metric represents the best available scientific quantification for assessing the complaint risk of large caliber weapons ranges. The complaint risk areas for PK15 (met) noise contours are defined as follows:

- The high risk of complaint area consists of the area around the noise source in which PK15 (met) is greater than 130 dB for large caliber weapons.
- The moderate risk of complaint area is the area where the PK15 (met) noise contour is between 115 dB and 130 dB for large caliber weapons.
- The low risk of complaint area is the area where the PK15 (met) noise contour is less than 115 dB for large caliber weapons.

The large caliber weapons baseline complaint risk noise contours for Fort Lewis are shown on **Figure 3–11**. The complaint risk contours are based on peak levels rather than a cumulative or average level; therefore, the size of the contours will not change if the number of rounds fired increases.



Source: USACHPPM 2009

Legend

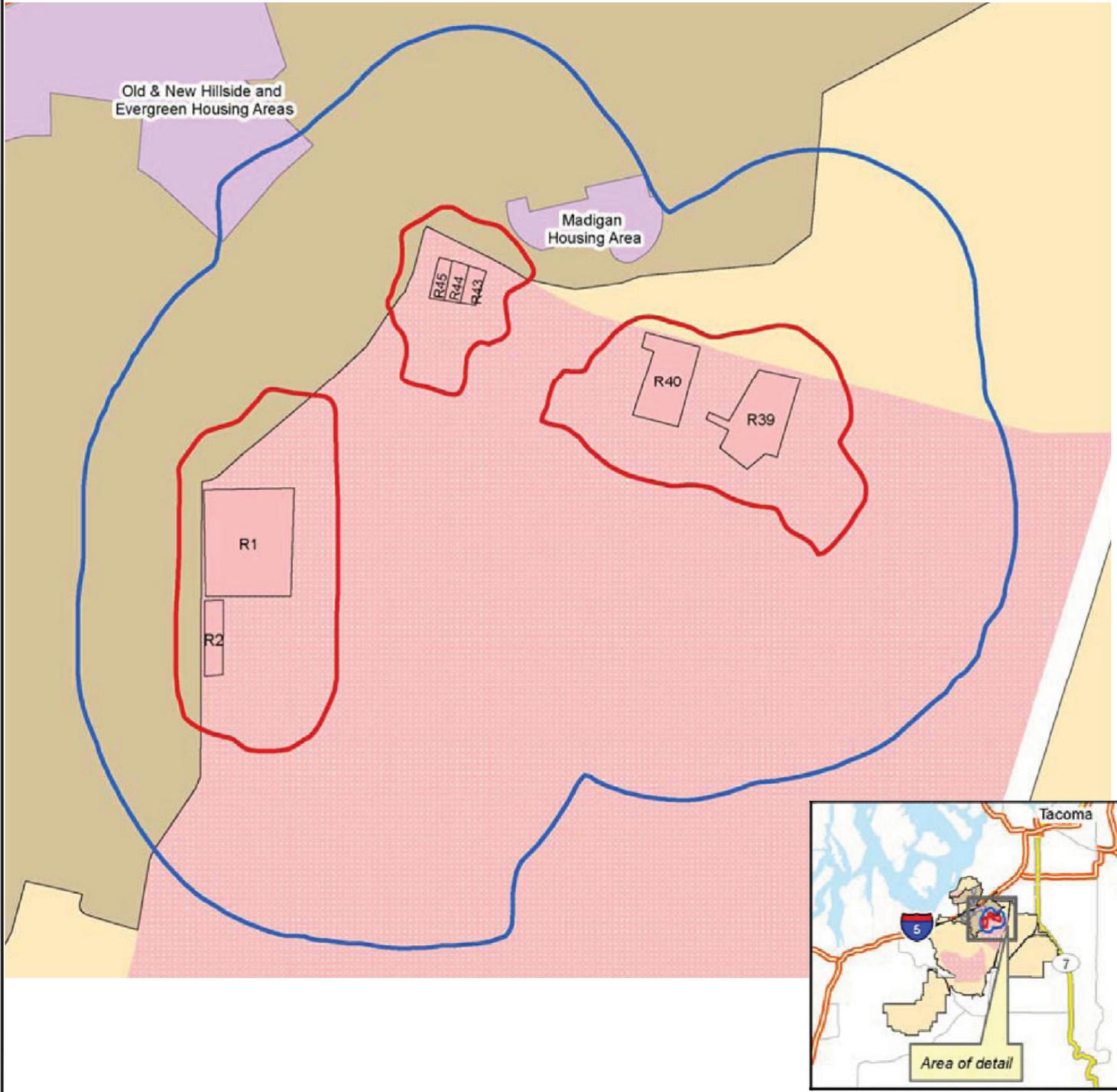
-  Housing Area
-  Cantonment Area
-  Gray Army Airfield
-  Impact Area
-  Fort Lewis
-  LUPZ (60 dB ADNL)
-  Zone II (65 dB ADNL)



FORT LEWIS GTA EIS

*Figure 3-9
Gray Army Airfield Contemporary Operation
Environment - Operational Noise Contours*

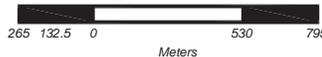
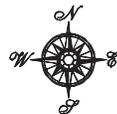
ANALYSIS AREA: Thurston & Pierce Counties, Washington	
Date: 7/14/2009	File: Ft. Lewis Figures.dwg
Prepared By: ETC	Layout: 003



Source: USACHPPM 2009

Legend

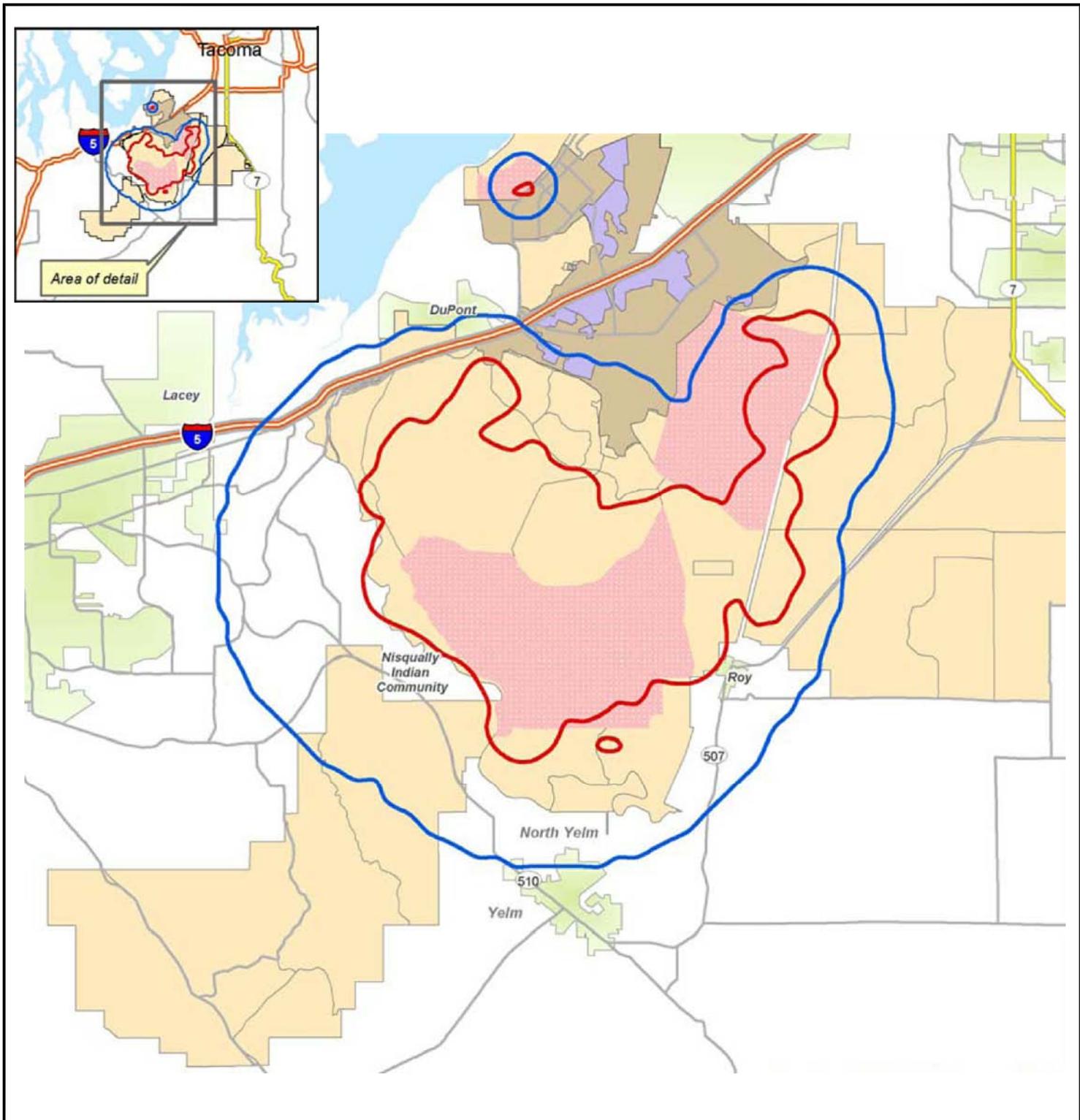
-  Zone II [87 dB PK15 (met)]
-  Zone III [104 dB PK15 (met)]
-  Impact Area
-  Range Footprint Utilized in the Small Caliber Noise Contours
-  Family Housing
-  Cantonment Area
-  Fort Lewis



FORT LEWIS GTA EIS

*Figure 3-10
Fort Lewis Small Caliber
Operational Noise Contours*

ANALYSIS AREA: Thurston & Pierce Counties, Washington	
Date: 7/14/2009	File: Ft. Lewis Figures.dwg
Prepared By: ETC	Layout: 004



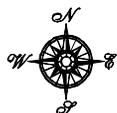
Source: USACHPPM 2009

Legend

-  Impact Area
-  Cantonment Area
-  Housing Area
-  Fort Lewis
-  115 dB PK15 (met)
-  130 dB PK15 (met)

Complaint Risk Guidelines

Risk of Complaints	dB PK15 (met)
Low	< 115
Moderate	115 - 130
High	> 130



FORT LEWIS GTA EIS

*Figure 3-11
Fort Lewis Contemporary Operating
Environment Complaint Risk Contours for
Demolition and Large Caliber Operations*

ANALYSIS AREA: Thurston & Pierce Counties, Washington

Date: 7/14/2009

File: Ft. Lewis Figures.dwg

Prepared By: ETC

Layout: 002

The moderate complaint risk contour PK15 (met) 115 dB extends beyond much of the boundary and into DuPont, Lacey, and Yelm. The high complaint risk contour PK15 (met) 130 dB extends beyond the boundary into the Nisqually Indian Reservation and near the city of Roy.

3.9 LAND USE CONFLICT/COMPATIBILITY

The ROI for the land use conflict and compatibility analysis includes lands within Fort Lewis potentially affected by the proposed activities, as well as lands adjacent to or surrounding the installation. The current land uses (including non-military uses, such as recreation), current conflict and encroachment issues, as well as pertinent federal, state, and local land use regulations, policies, and plans for the ROI are described in the following subsections. The proposed project activities will primarily be located on land owned by the federal government. The proposed project activities are subject to the federal authorities, but are not required to conform to state, county, municipal, or other plans and policies or related land use documents.

One issue related to land use conflict/compatibility at Fort Lewis — temporary and permanent land use effects from implementing GTA actions — was identified through public scoping, and provided the context for the development of the affected environment.

3.9.1 Land Use Planning

Fort Lewis has a Real Property Master Plan (RPMP) dating from 1995. The plan describes 11 different uses on Fort Lewis and 11 slightly different uses for YTC. The plan includes objectives and planning factors. It also makes general comments on present and future land use in different areas. It does not, however, include ADPs nor have any of the details that the proposed ADPs have. Consequently, Fort Lewis is in the process of updating its RPMP.

For the updated RPMP, Fort Lewis adopted a planning model that focuses on compact, walkable development in identifiable neighborhood districts (Urban Collaborative 2009b). Subsequently, planners divided Fort Lewis and YTC into geographically distinct districts. ADPs were then created to address the unique mission and facility requirements for each geographic area on Fort Lewis and YTC. Through the ADPs, the RPMP helps guide, program, and confirm priorities and long-range capital improvement projects.

As discussed in **Section 2.2.5** and shown on **Figure 2–11**, 13ADPs were developed for the cantonment area in Fort Lewis. The North Fort ADPs are North Fort, American Lake, and Greene Park. The Main Post ADPs are Historic Downtown, East Division, Logistics Center, Madigan, Jackson, Old Madigan, Hillside (Rainier Village), Miller Hill, Gray Army Airfield, and 3rd Brigade.

The ADPs represent the fulfillment of the design vision as a snapshot in time; however, the Army's needs will grow and change, so the ADPs will need to grow and change as well. Thus, each ADP identifies the current conditions in the ADP area, including the manmade and natural environments. Information about current vehicular circulation, parking, airfield, historic districts, environmental restoration sites, munitions storage, topography, hydrology, and biological resources is included.

Each of these elements is considered when identifying opportunities and constraints to better define the task of siting new facilities. **Section 2.2.5** summarizes the information for the 13 Fort Lewis ADPs and the YTC ADP.

Major land uses within the Fort Lewis boundary include the cantonment area (approximately 10,600 acres [4,290 ha]) and training and impact areas (approximately 62,600 acres [25,300 ha]) for

TAs and 12,900 acres [5,220 ha] for impact areas) (Army 2007d). **Figure 3–12** illustrates the distribution of these major land uses within the boundaries of Fort Lewis. Fort Lewis also accommodates multiple nonmilitary uses, including commercial timber harvests; recreational uses, such as hunting, fishing, horseback riding, and other outdoor activities; and Native American traditional cultural practices followed by the Nisqually Tribe. Timber harvests take place within the various forested TAs. Recreational activities may take place anywhere throughout the non-restricted areas of the Post, depending on scheduled training exercises.

Certain portions of Fort Lewis are designated as Controlled Use Areas, in which certain land use activities are restricted either seasonally or year-round. Most Controlled Use Areas are located in environmentally sensitive areas in which land use restrictions are necessary to protect natural and cultural resources.

3.9.2 Cantonment Area

The cantonment area serves as the center for most activities at Fort Lewis other than field training. Land uses in the cantonment area (listed in order of greatest extent of land used to lowest) include housing, open space, industrial and maintenance, medical and community services, administrative uses, aviation (GAAF), training, reserve component support facility, and deployment facility. Land is also reserved for future development. The distribution of these land uses in the cantonment area is shown on **Figure 3–13**.

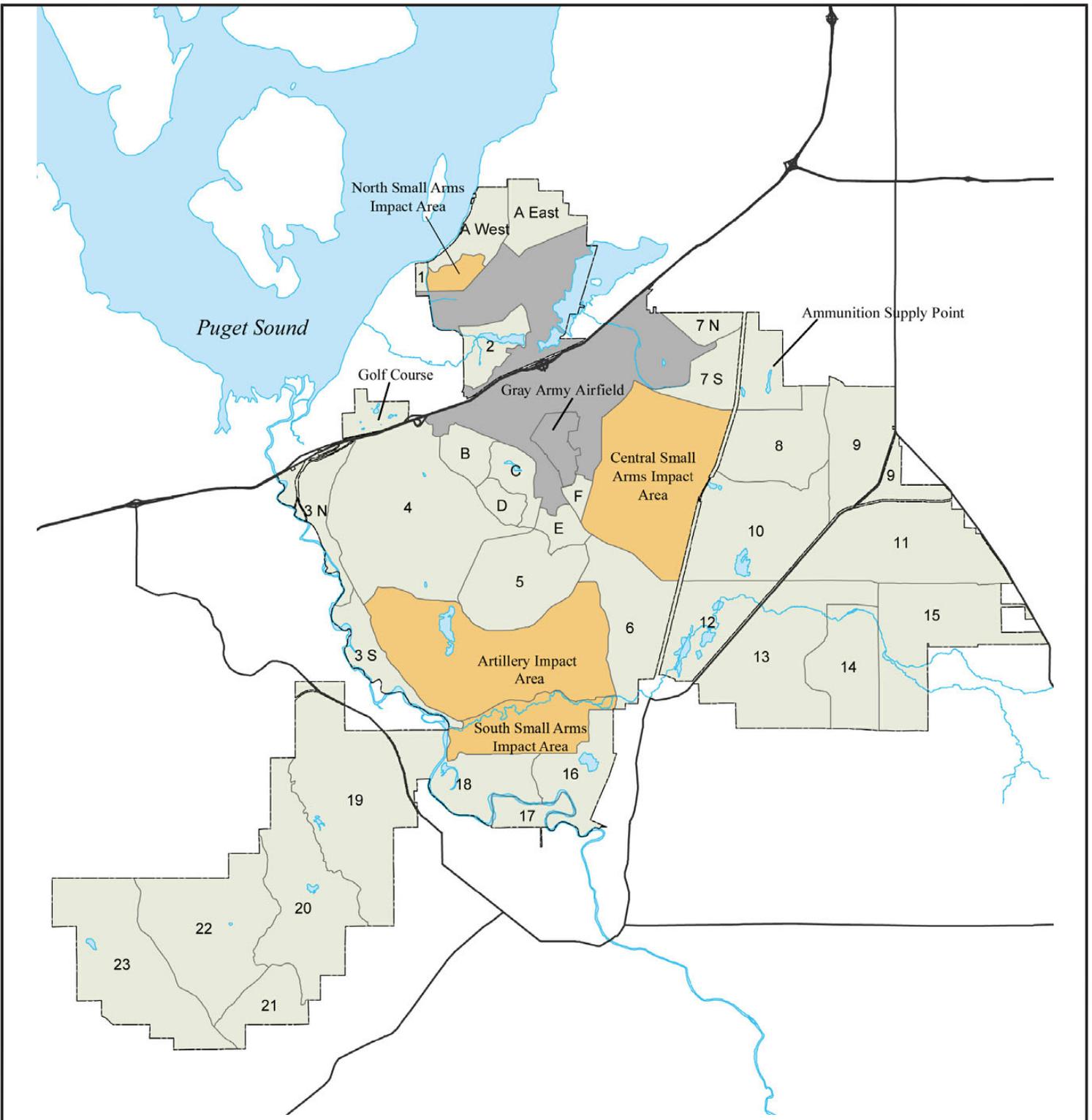
There are approximately 5,000 buildings at Fort Lewis, including the MAMC. The majority of these buildings provide housing for Soldiers and their Families (Army 2007e). Housing facilities, some of which are multiplex buildings, include single-family units, bachelor officer quarters, and barracks that provide housing for enlisted personnel. Family housing units, barracks, and bachelor officer quarters are found on the Main Post and North Fort.

3.9.2.1 Training Areas

The 32 designated TAs on Fort Lewis encompass forestland, wetlands, prairie, brush, and marine environments. TAs are delineated into maneuver, impact, range, and other TAs. Other TAs include airborne training sites, ammunition storage areas, and urban combat areas. Training activities that characterize land use at Fort Lewis include off-road tracked vehicle movement, wheeled vehicle movement, gunnery practice, digging activities (tank ditches, vehicle positions, and foxholes), unit assembly areas, and unit deployment exercises. **Figure 3–12** shows the locations of TAs on Fort Lewis. These delineated TAs are established to facilitate their management, which is the responsibility of Range Control.

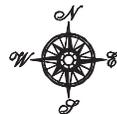
Although the TAs are largely undeveloped, there are developed training facilities that are used by troops to complete training missions. These are located in impact areas, which include the NSAIA, CSAIA, and the SSAIA. These facilities include 67 marksmanship and live-fire ranges and more than 30 non-firing facilities, such as observation posts, drop zones, Combined Arms Collective Training Facilities (CACTFs), and amphibious sites.

In addition to working through Range Control, commanders coordinate training plans with the DPW. Fort Lewis maintains a staff of resource managers at the DPW to help training commanders preserve sensitive areas, while providing realistic training exercises.



Legend

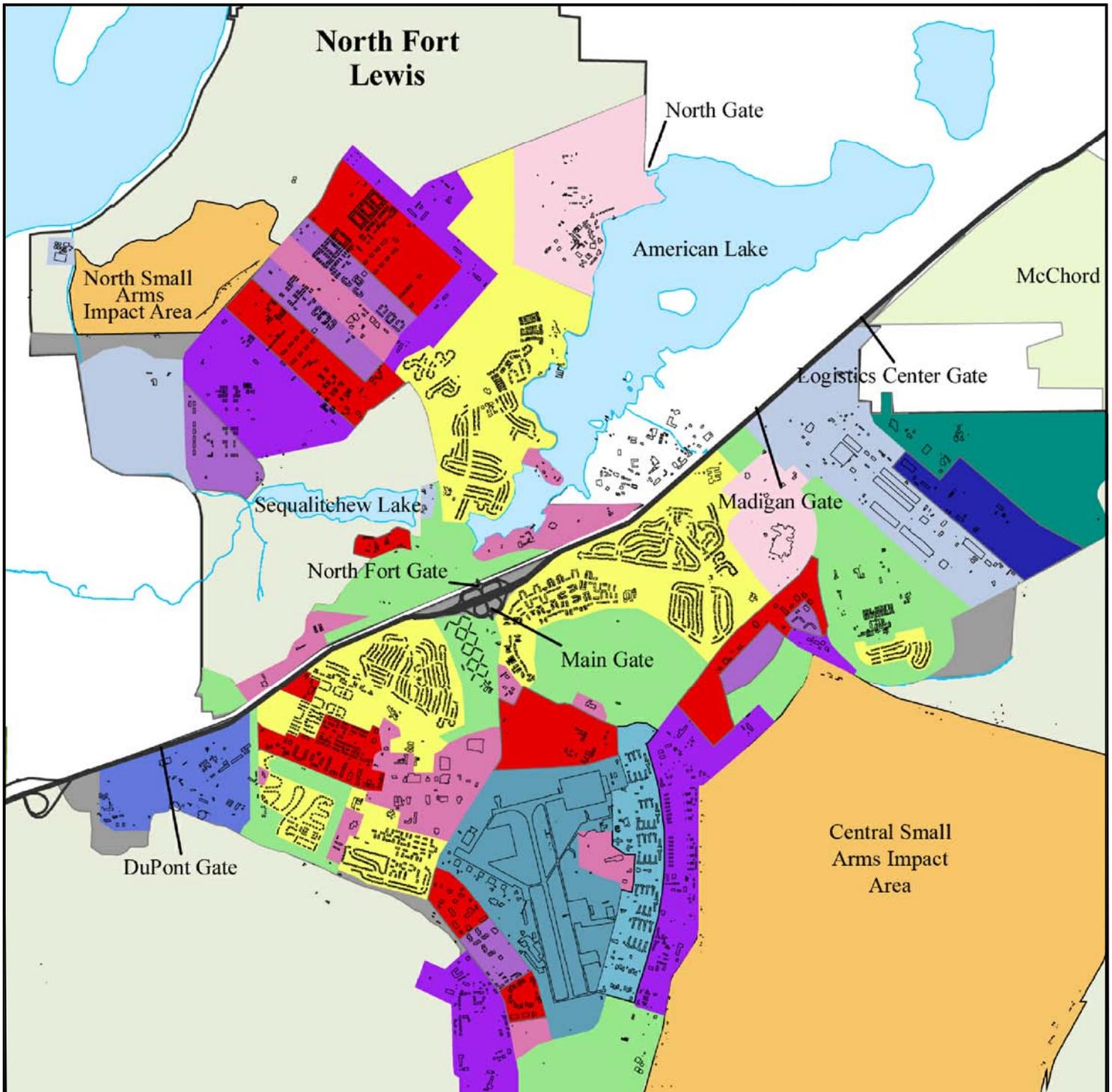
- Cantonment Area
- Impact Areas
- 5 Training Areas



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*Figure 3-12
Major Land Use Areas on Fort Lewis*

ANALYSIS AREA: Thurston & Pierce Counties, Washington	
Date: 7/14/2009	File: Ft. Lewis Figures.dwg
Prepared By: ETC	Layout: 005



Legend

- | | |
|---|--|
|  Training |  Rainier Park |
|  Troop Facility |  Reserve Component Support Area |
|  Administration |  Industrial |
|  Aviation |  Maintenance |
|  Community Services |  Medical |
|  Deployment Facility |  Open Space |
|  Family Housing | |



FORT LEWIS GTA EIS

*Figure 3-13
Major Land Use Areas within the
Fort Lewis Cantonment Area*

ANALYSIS AREA: Thurston & Pierce Counties, Washington	
Date: 7/14/2009	File: Ft. Lewis Figures.dwg
Prepared By: ETC	Layout: 011

3.9.3 Recreation and other Non-military Uses

Certain portions of the Fort Lewis TAs are available to military personnel and the public for outdoor recreation, provided these activities do not interfere with military training. The Outdoor Recreation Program staff, under the Directorate of Morale, Welfare, and Recreation, provides oversight for outdoor recreational programs on the installation, under the guidance of the Outdoor Recreation Plan (provided in Appendix K of the INRMP) and Fort Lewis Regulation 215–1. The mission of the Fort Lewis Outdoor Recreation Program is to provide outdoor recreational and skill development activities for all members of the Fort Lewis community.

Common recreational activities on Fort Lewis include hunting, fishing, boating, camping, hiking, picnicking, and shooting. Although there are numerous areas on Fort Lewis that are designated as recreational areas, recreational activities can occur throughout most of the installation, with the appropriate permits and permission from Range Division. The Outdoor Recreation Program manages the hunting and fishing programs on Fort Lewis, maintains designated facilities, and rents equipment. Access to Fort Lewis for recreational activities that do not require registration with the Outdoor Recreation Program is coordinated through Range Division, which issues area access permits.

3.9.4 Tribal Access

The Nisqually, Puyallup, and Squaxin Island tribes have an interest in TCPs of religious or other cultural importance, as well as in lands on which to hunt, fish, and gather. Continued access and healthy, sustainable resources are especially important for Nisqually tribal members who occasionally conduct hunting and fishing activities on Fort Lewis. Tribal needs for access are discussed in **Section 3.6.4**.

3.9.5 Land Uses Surrounding Fort Lewis

Land uses adjacent to Fort Lewis include urban, rural, and mixed residential areas; commercial districts and corridors; and recreational, agricultural, and other open space areas. McChord AFB is located adjacent to the Main Post at its northeast boundary.

Development to the north of Fort Lewis consists primarily of single- and multiple-family residential housing interspersed with commercial areas. The nearest off-Post residential communities and their associated commercial areas to the north are the cities of DuPont, Steilacoom, and Lakewood. In addition, the off-Post portion of American Lake and the associated recreational, commercial, and residential land uses are near the Fort Lewis cantonment area.

The areas to the east and south of the installation are characterized by urban unincorporated and rural unincorporated areas in Pierce County and several small communities, such as Roy. To the west, areas surrounding the installation are characterized by Puget Sound, the Nisqually National Wildlife Refuge, the Nisqually Indian Reservation, and the Lacey and Yelm Urban Growth Areas.

3.9.6 Land Use Conflicts

An objective of the Fort Lewis Master Plan is the recognized need to eliminate existing and developing land use conflicts, to coordinate with adjacent jurisdictions to maximize opportunities for mutual benefit, and to minimize conflicts and developmental incompatibilities.

Increasing population and an accompanying increase in development of land and intensity of land use activities can potentially result in the following conflicts:

- increase in environmental restrictions on land use;

- noise disturbances;
- competition for resources, such as air space and communications frequencies;
- demand for support of infrastructure and non-military uses; and
- sensitivity of use and management of military lands by neighboring residents.

All of these issues have affected military training, planning, and management of lands to some degree (Coe-Truman Technologies 1994).

The Land Use Deconfliction (deconfliction) process is a management tool that allows consideration of land use and natural resource issues when planning projects on the installation. The deconfliction process is used for land use planning in the cantonment area. During the deconfliction process, units, tenants, and Garrison staff attend organized meetings that focus on combining information sources with institutional knowledge to coordinate and integrate activities and projects related to Fort Lewis. The deconfliction process allows Fort Lewis representatives to ensure that the proposed project does not conflict with other land uses/restrictions/infrastructures (Army 2007d).

The primary Fort Lewis geographic information system (GIS) database, maintained and operated by DPW, is a repository of data layers that are used as inputs for planning and natural resource management purposes. All Fort Lewis personnel can access GIS database information, which makes deconfliction among programs possible. Fort Lewis intends to work on expanding the GIS and strengthening the deconfliction process. According to the 2007 INRMP, the deconfliction process will be incorporated into the Master Plan update to make it a requirement, and the process will be expanded to consider a wider range of actions, including large military training exercises.

3.10 TRAFFIC AND TRANSPORTATION

3.10.1 Study Area

Figure 2–1 shows the location of Fort Lewis and the surrounding region in Pierce County south of the City of Tacoma. Fort Lewis is bordered by McChord AFB to the northeast; the cities of Lakewood, Steilacoom, and DuPont to the north and northwest; Yelm to the south; and Spanaway to the east. **Figure 2–1** shows I–5 and other prominent landmarks surrounding the installation.

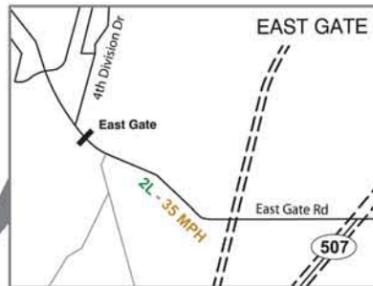
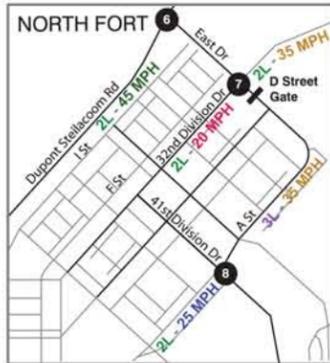
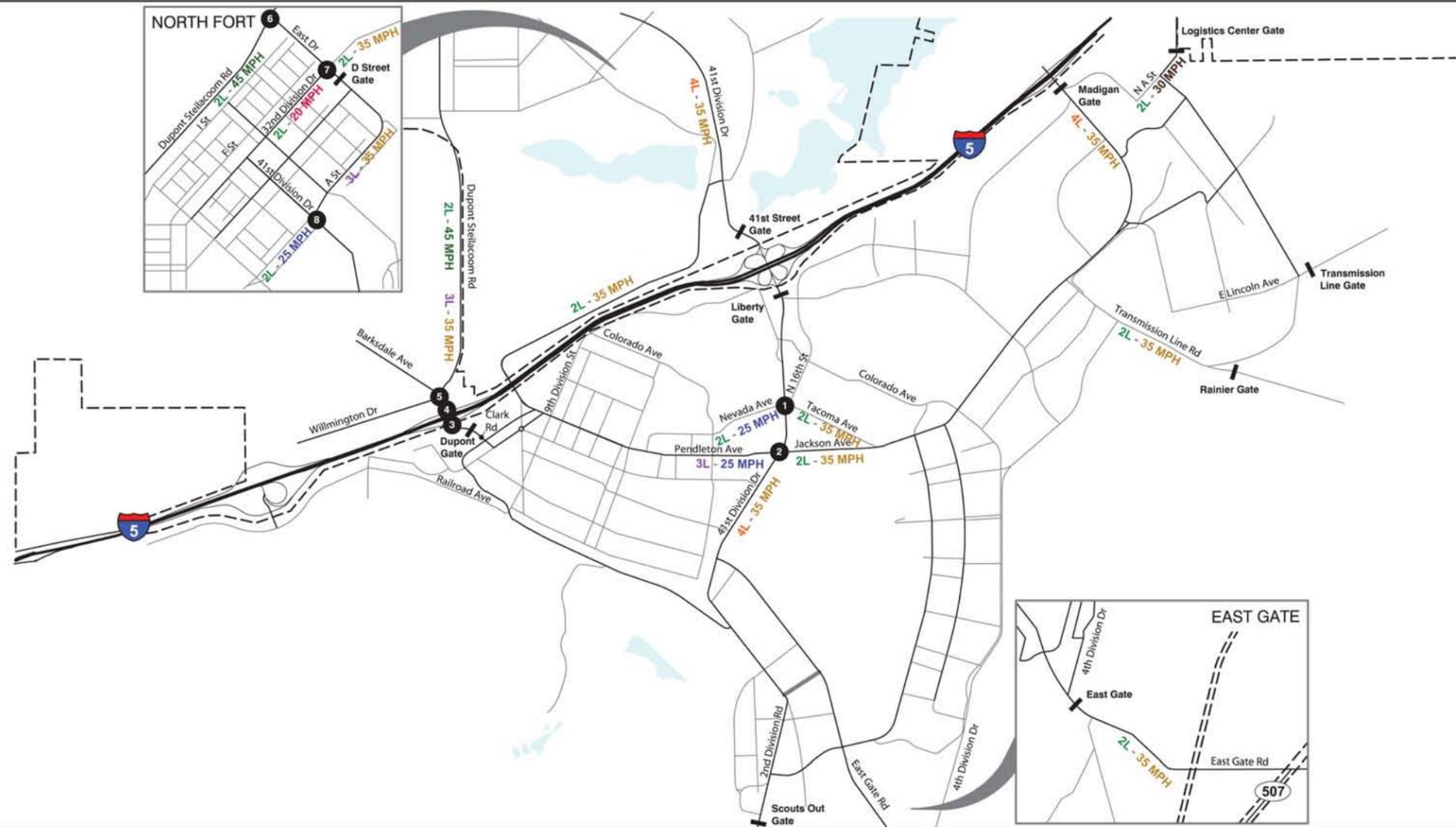
3.10.1.1 Study Intersections and Roadway Characteristics

Figure 3–14 shows the existing traffic control and geometry of the study intersections, and the number of travel lanes and posted speed limits on roadways in the study area. Large volumes of pedestrian and vehicle traffic occur at several areas on Fort Lewis. The Town Center area, which encompasses the I Corps Headquarters; PX and Commissary; Fort Lewis Lodge; Carey Theatre; and several other shopping, lodging, and recreational facilities, is one such location. Other areas include Madigan Hospital and North Fort.

Traffic volumes on Fort Lewis’s primary roadways were analyzed to determine current traffic conditions. The following three intersections were analyzed within the Post:

- 41st Division Drive/Nevada Avenue/Tacoma Avenue (Main Post)
- 41st Division Drive/Pendleton Avenue (Main Post)
- 41st Division Drive/A Street (North Fort)

These intersections have some of the highest traffic volumes at Fort Lewis.



Legend

- Turn Lane
- 2L Number of Lanes
- 35 MPH Posted Speed Limit
- Study Intersection
- Traffic Signal
- Stop Sign
- Installation Boundary
- Access Control Point (Gate)
- Restricted Access

1. Nevada Ave./41st Division Dr.	2. Pendleton Ave./41st Division Dr.	3. I-5 NB Ramps/Clark Rd.	4. I-5 SB Ramps/Clark Rd.
5. Wilmington Ave./Barksdale Ave.	6. Dupont Steilacoom Rd./East Dr.	7. 32nd Division Dr./East Dr.	8. A St./41st Division Dr.



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Figure 3-14
Fort Lewis Existing
Traffic Characteristics

ANALYSIS AREA: Thurston & Pierce Counties, Washington	
Date: 3/03/2009	File: fig3_2_ex_config.dwg
Prepared By: TR	Layout: fig3_2_ex_config.pdf

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The following intersections, located just outside the Fort Lewis gates, were also analyzed:

- I-5 Northbound Ramps/Barksdale Avenue/Clark Road (Exit 119)
- I-5 Southbound Ramps/Barksdale Avenue/Clark Road (Exit 119)
- DuPont Steilacoom Road/Barksdale Avenue/Wilmington Drive
- DuPont Steilacoom Road/East Drive
- North Gate Road/East Drive

On Post, the roadway network is classified into three main types of roads: primary, secondary, and tertiary roadways.

3.10.1.1.1 Fort Lewis Primary Roadways

Primary roadways function as arterials, serving as the major through routes within the installation and providing connections to I-5 and the surrounding major highways. The primary roadways are 41st Division Drive, Pendleton Avenue, Jackson Avenue, Stryker Avenue, East Gate Road, Railroad Avenue, Rainier Avenue, 2nd Division Drive, and 3rd Division Drive. The typical posted speed limit on these Primary roads is 35 miles per hour (mph) (56 kilometers per hour [kph]).

The main entrance and thoroughfare on the Main Post and on North Fort is 41st Division Drive. On the Main Post, 41st Division Drive has five lanes and a posted speed limit of 35mph (56 kph), and provides access to the Town Center area of the Main Post. The Town Center area, which is generally bounded by 41st Division Drive, Nevada Avenue, North Division Street, and Liggett Avenue, contains the PX and Commissary, bowling alley, movie theatre, and many other retail, office, recreational, and social support services. At the North Fort, 41st Division Drive south of A Street has four lanes and a raised, planted median with concrete curb and gutter on both sides of the roadway. There is a concrete sidewalk on the east side of the road, separated from the roadway by a planter strip, and signed and marked 4-foot-wide on-street bike lanes in both directions.

Pendleton Avenue, the primary east-west arterial in the Town Center area, is a three-lane arterial with a center two-way left-turn lane and a posted speed limit of 25 mph (40 kph). It is the only street in the Town Center with a continuous pedestrian walkway. The other nearby streets do not have continuous designated pedestrian facilities. Pendleton Avenue continues west under I-5, providing access to North Fort within the secured Fort Lewis boundaries.

Several streets in North Fort, including 41st Division Drive (north of A Street), have recently been improved and widened to 32 feet (10 m) (curb to curb) to provide 5-foot-wide (1.5 m) striped bike lanes on both sides. The streets also have new curbs, gutters, and sidewalks.

3.10.1.1.2 Fort Lewis Secondary Roads

Secondary roadways function as collectors, distributing traffic between the primary and tertiary roadways. Secondary roads provide functionality over mobility and typically have two travel lanes and a posted speed limit of 25 mph (40 km). The secondary roads on Post include Liggett Avenue, Bitar Avenue, Colorado Avenue, Nevada Avenue, Tacoma Avenue, Transmission Line Road, and A Street.

3.10.1.1.3 Fort Lewis Tertiary Roadways

Tertiary roadways function as local access roads and streets, providing driveway access to buildings, parking lots, and residential housing areas. These roads and streets typically have two travel lanes and low speed limits of 25 mph (40 kph) or less.

3.10.1.1.4 Off-Post Roadways

Several roadways off Post provide access to and from Fort Lewis to the surrounding area. I-5, a six-lane freeway with a posted speed limit of 60 mph (97 kph), is the main highway that provides access to and from Fort Lewis from the communities to the north, south, and west of the installation.

DuPont Steilacoom Road, on the west side of North Fort, is a two-lane arterial road with a posted speed limit of 45 mph (72 kph). This roadway provides access to the cities of DuPont and Steilacoom, and to North Fort via East Drive. East Drive connects North Fort to North Gate Road, providing access to the city of Lakewood. North Gate Road is a two-lane arterial road with a posted speed limit of 35 mph (56 kph).

Clark Road provides access to the Main Post for vehicles coming from the south and the city of DuPont.

East Gate Road and State Route (SR) 507 provide access to the Main Post from the east. SR 507 is a two-lane state highway with a posted speed limit of 50 mph (80 kph). East Gate Road has two lanes and a posted speed limit of 45 mph (72 kph) outside the cantonment area.

The other major state highways surrounding Fort Lewis are SR 512 to the north, SR 510 to the south, and SR 7 to the east.

3.10.1.2 Access Control Points and Operations

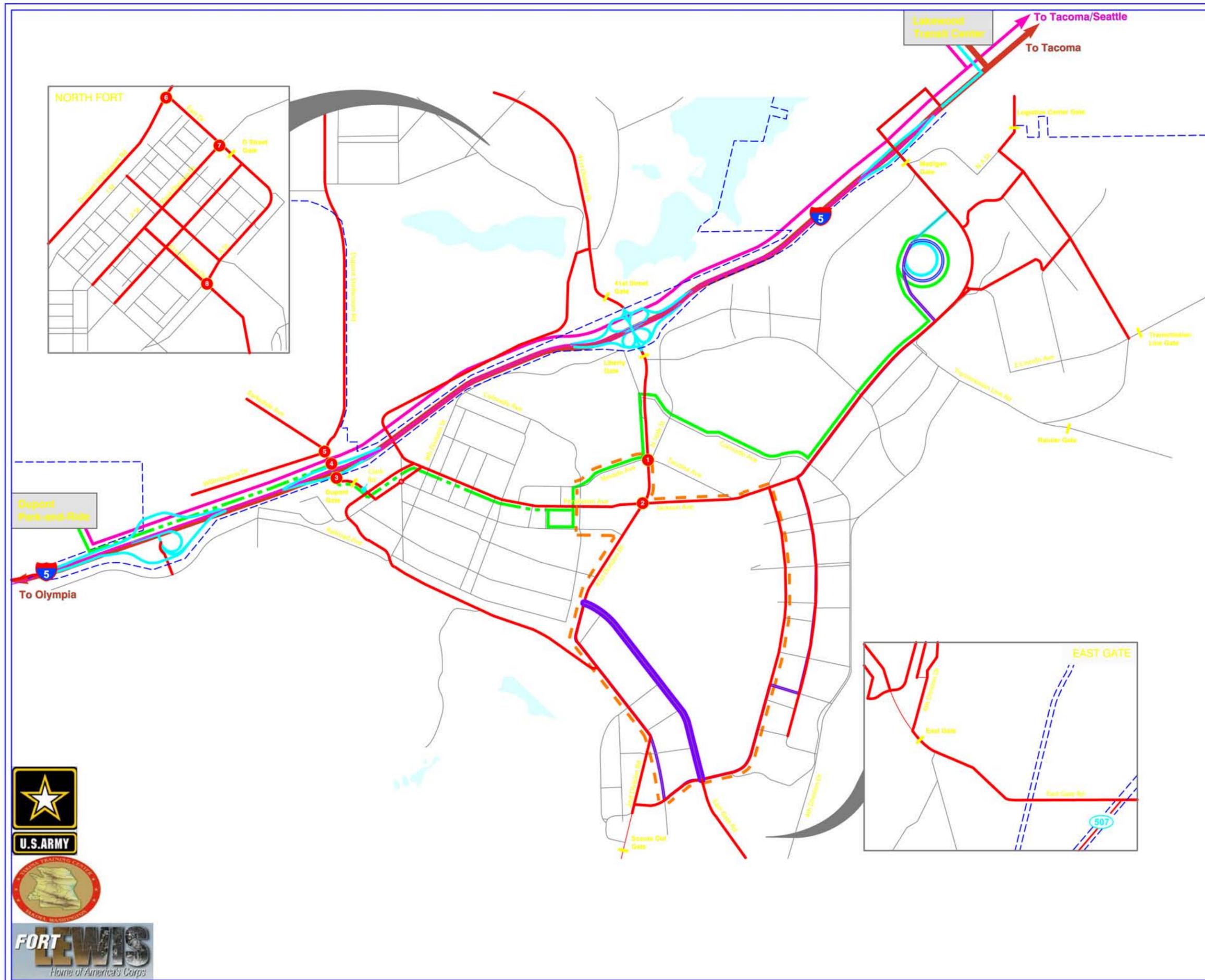
Access onto the Post is restricted to authorized personnel only and controlled via 10 Access Control Points (ACPs) or gates, as shown on **Figure 3–14**. The primary ACPs are the Liberty (Main) Gate, the Madigan Gate, the 41st Street (North Fort) Gate, and the DuPont Gate. The secondary gates serving Fort Lewis are D Street Gate, East Gate, Logistics Center Gate, Transmission Line Gate, Rainier Gate, and the Scouts Out Gate. Visitors to Fort Lewis are directed to use the Liberty Gate, where the Visitor's Center issues temporary passes for limited access onto the Post.

From I-5, the main exits to Fort Lewis are:

- DuPont Steilacoom Road (Exit #119), which provides access to the Main Post via the DuPont Gate and Clark Road;
- Fort Lewis/North Fort Lewis (Exit #120), which provides access to the Main Post via the Liberty (Main) Gate and the North Fort via the 41st Street Gate;
- Madigan Hospital/Camp Murray (Exit #122), which provides access to Madigan Hospital and Camp Murray (the adjacent National Guard center located on the north side of I-5); and
- Thorne Lane/Tillicum/Lakewood (Exit #123), which provides access to the Logistics Center Gate, via Murray Road.

3.10.1.3 Transit Service

Transit services accessible by Fort Lewis personnel are provided by Intercity Transit and Sound Transit, as shown on **Figure 3–15**. Pierce Transit provides bus service on Fort Lewis and to the surrounding communities. Transit route #207 provides service from the Fort Lewis Bus Depot, located at Building 2166 on 12th Street and Liggett Avenue in the Town Center of the Main Post, to Madigan Hospital. Route #207 buses run once per hour on weekdays.



Legend

- Study Intersection
- Installation Boundary
- Access Control Point (Gate)
- Daily Service
- Peak Hours Only
- Midday Service
- Olympia Express (Olympia to Tacoma)
- Pierce Transit**
- Route 206
- Route 207B
- Route 207G
- Route 207P
- Sound Transit**
- Route 592



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*Figure 3-15
Public Transit Service
to Fort Lewis*

ANALYSIS AREA: Thurston & Pierce Counties, Washington

Date: _____ File: _____
Prepared By: TR

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Transit route #206 provides service to on-Post and off-Post destinations, including the following:

- Madigan Hospital
- Logistics Center
- American Lake Gardens
- Tillicum
- Lakewood Transit Center
- Lakewood Towne Center
- Lakewood
- Employment Security Office
- Saint Clare Hospital
- Ponders Corner

Transit route #206 buses run every one-half hour on weekdays. North Fort has no transit service.

Intercity Transit provides both weekday and weekend “Olympia Express” service between Olympia and Lacey to Lakewood (SR 512 Park & Ride and Sound Transit’s Lakewood Station) and various points in Tacoma. Intercity Transit and Pierce Transit both operate the Express service under the same name, although operated independently of each other. Transfer connections are available from the Olympia Express to Pierce Transit Route 206 that serves Fort Lewis.

Sound Transit regional bus (Route 592) provides daily commuter service connecting the Lakewood station to Tacoma and Seattle. Commuter rail will eventually be provided to the Lakewood station with service to Seattle.

Additionally, Pierce Transit and Intercity Transit provide regular vanpools to Fort Lewis from surrounding cities. As of October 2009, there were approximately 36 vanpools operating to Fort Lewis from Pierce and Thurston Counties.

3.10.2 Existing Traffic Volumes

3.10.2.1 On-Post Volumes

Figure 3–16 shows the existing morning and evening peak hour and average weekday daily traffic volumes and count date for each study intersection. The existing peak hour volumes were obtained from two sources: 1) the manual turning movement traffic counts conducted during fall 2007 or in 2008 by the traffic volume counting firm Trafficount, Inc.; and 2) volumes obtained from the July 2008 Fort Lewis Comprehensive Traffic/Transportation Study. The firm conducted the counts from 0700 to 0900 and from 1600 to 1800, to correspond with the surrounding (off-Post) peak periods of traffic during a typical weekday.

Figure 3–17 shows the peak hour and average weekday daily traffic volumes at each of the 10 ACPs, as well as the roadway peak hour volumes at other key locations. Most of the gate traffic volumes are from recent machine-recorded traffic volume counts. These machine-recorded (tube) volume counts were taken for three consecutive weekdays (Tuesday to Thursday), from December 9 to 11, 2008, at the following locations:

- Murray Road SW, south of 150th Street SW (Logistics Center Gate)
- Jackson Avenue, south of I-5 (Madigan Gate)
- 41st Division Drive, south of I-5 (Main Gate)
- 41st Division Drive, north of I-5 (North Fort Gate)
- Clark Road, south of I-5 (DuPont Gate)
- East Drive, south of North Gate Rd. (North Gate)
- East Gate Road, west of SR 507 (East Gate)

The tube traffic counts at these gates show the start of the morning peak period is 0500. This corresponds to Soldiers arriving on Post for regular physical training, which typically occurs during

the morning hours before work. The typical workday on Post is from about 0700 to 1600. This is also consistent with the gate volume afternoon peak hour, which is from 1600 to 1700.

The entering gate volumes for the minor Rainier Gate, Transmission Line Gate, and Scouts Out Gate were obtained from the 2006 ACP throughput data provided by Fort Lewis DPW. The DPW staff also provided the most current gate volume data collected by the Fort Lewis Security Services Office. These data show that, in 2006, an average of 38,879 vehicles entered Fort Lewis each day (including weekends and holidays). Based on the estimated average weekday 2006 ACP volumes at the minor gates and the recent counts at the higher-volume gates, Fort Lewis currently has an average of 57,396 vehicles entering the Post during an average weekday and generates an average total (entering and exiting) volume of 114,805 vehicles per weekday. Note that this average weekday entering volume does not include or account for the lower traffic volumes generated during weekends and holidays. This is the reason the current average volume is significantly higher than the 2006 average daily traffic volume. The Transportation Study Report (Fehr and Peers 2009) provides all of the traffic volume count data summary sheets.

Figure 3–18, obtained from the July 2008 Fort Lewis Comprehensive Traffic/Transportation Study prepared by The Transpo Group, Inc., indicates that the average weekday traffic volume entering Fort Lewis was approximately 48,000 vehicles in 2007 and 2008. Note that the Rainier Gate is not included on this figure. The 2006 ACP throughput data shows that this gate had a daily average of 1,171 vehicles accessing this gate in 2006.

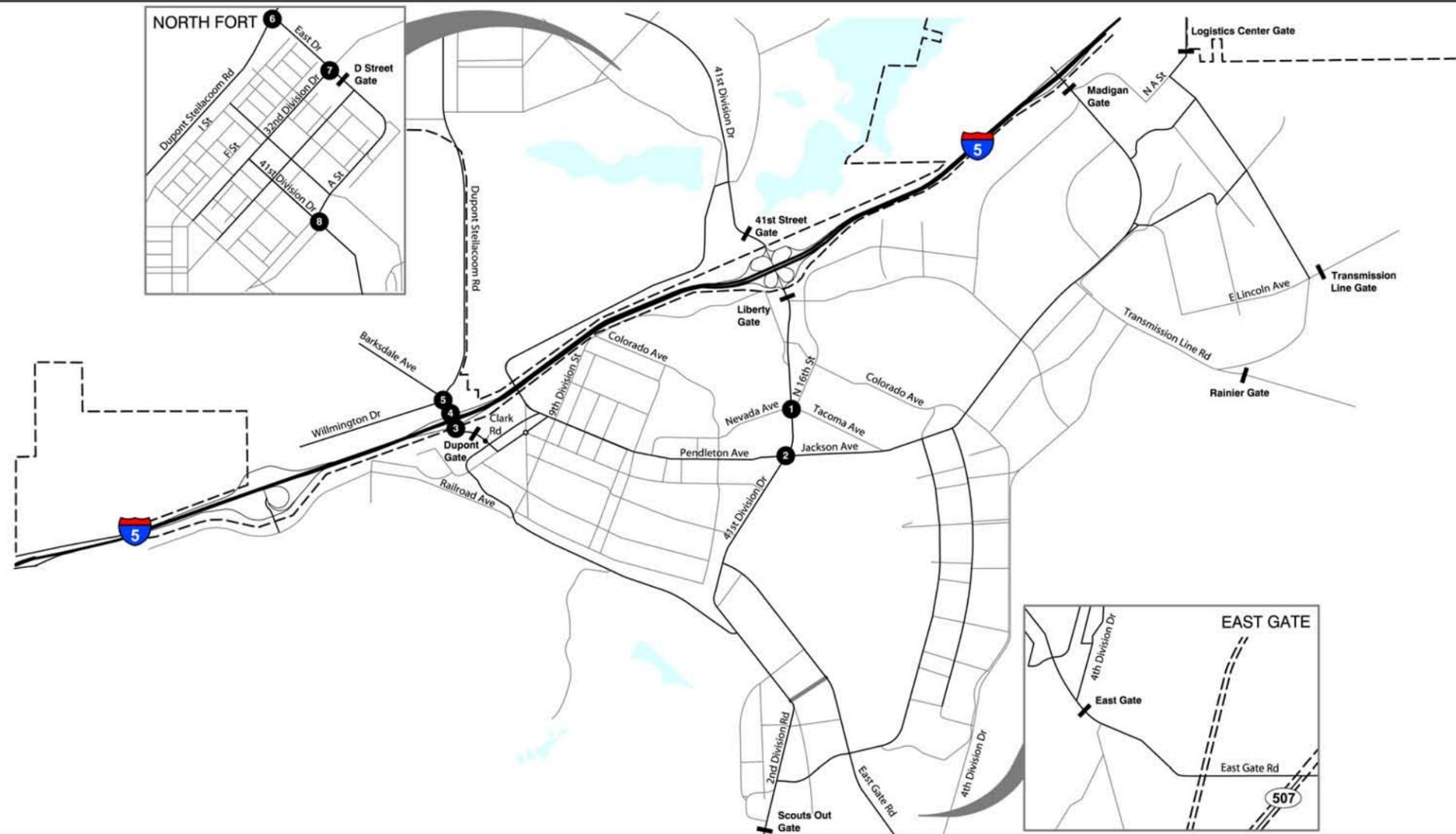
A comparison of the 2007 and 2008 Comprehensive Traffic/Transportation Study volume (including the Rainier Gate volume) to the recent (December 2008) gate counts suggests that there was a one-year traffic volume increase of 16.7 percent (from 49,171 vehicles to 57,396 vehicles) on Fort Lewis from late 2007 to late 2008.

Figure 3–19 shows an hourly breakdown of the average weekday traffic volumes at the four primary ACPs based on historical daily traffic volumes. The four primary gates, the Liberty (Main) Gate, the Madigan Gate, the 41st Street (North Fort) Gate, and the DuPont Gate, process 75 percent of the daily traffic generated on Fort Lewis. **Figure 3–19** and the recent gate counts show that the afternoon peak hour, from 1600 to 1700, is the highest hour of traffic volume, generating approximately 8.2 percent of the total average weekday traffic on Fort Lewis. The morning peak hour of traffic on Fort Lewis generally occurs from about 0600 to 0700 and generates approximately 7.4 percent of the total weekday traffic.

The gate volume counts and **Figure 3–19** show that the mid-day (lunchtime) period also generates a large percentage of the vehicles. The Town Center area experiences a large amount of traffic volume during the mid-day period, mostly due to the numerous exercise, recreational, shopping, and eating establishments located in this area of Fort Lewis.

3.10.2.2 Interstate 5 Volumes

The Washington State Department of Transportation (WSDOT) 2007 Annual Traffic Report shows that I–5 carries, on average, approximately 111,000 vehicles per day at the DuPont Steilacoom Road exit (#119). North of the Fort Lewis/North Fort Lewis exit (#120), I–5 carries an estimated average of 127,000 vehicles per day. Just north of the Thorne Lane exit (#123), I–5 carries, on average, 146,000 vehicles per day. Typically, the average weekday traffic volume on public roadways in metropolitan areas is approximately 10 times the volume during the afternoon peak hour. Therefore, during the afternoon peak hour, the volumes on I–5 are estimated to range from 11,000 vehicles at the south exit (#119) to more than 14,600 vehicles at the north exit (#123) to Fort Lewis. The Transportation Study Report (Fehr and Peers 2009) provides the WSDOT volume data.



Legend

- Turn Lane
- AM (PM) Peak Hour Traffic Volume
- Study Intersection
- Traffic Signal
- Stop Sign
- Installation Boundary
- Access Control Point (Gate)
- Restricted Access

1. Nevada Ave./41st Division Dr.	2. Pendleton Ave./41st Division Dr.	3. I-5 NB Ramps/Clark Rd.	4. I-5 SB Ramps/Clark Rd.
<p>Nevada Ave. 225 (180), 500 (310), 65 (10) Tacoma Ave. 25 (80), 95 (165), 85 (55) Nevada Ave. 100 (365), 65 (105), 15 (20) Tacoma Ave. 15 (45), 390 (765), 55 (55)</p>	<p>Pendleton Ave. 142 (55), 466 (241), 102 (76) Jackson Ave. 40 (67), 325 (451), 205 (215) Pendleton Ave. 83 (212), 341 (350), 14 (17) Jackson Ave. 41 (54), 327 (601), 210 (199)</p>	<p>I-5 NB Ramps 309 (164), 192 (337) Clark Rd. 303 (289), 0 (2), 512 (125) Clark Rd. 163 (676), 106 (141)</p>	<p>I-5 SB Ramps 226 (414), 339 (474) Clark Rd. 382 (196), 4 (1), 154 (30) Clark Rd. 47 (487), 436 (488)</p>
5. Wilmington Ave./Barksdale Ave.	6. Dupont Steilacoom Rd./East Dr.	7. 32nd Division Dr./East Dr.	8. A St./41st Division Dr.
<p>Wilmington Ave. 12 (22), 31 (73), 27 (25) Barksdale Ave. 37 (54), 49 (38), 427 (487) Wilmington Ave. 15 (19), 29 (87), 59 (156) Barksdale Ave. 196 (125), 79 (102), 599 (495)</p>	<p>Dupont Steilacoom Rd. 415 (390), 130 (25) East Dr. 355 (530), 170 (230) Dupont Steilacoom Rd. 106 (245), 55 (195)</p>	<p>32nd Division Dr. 166 (55), 134 (200) East Dr. 66 (170), 102 (78) 32nd Division Dr. 107 (270), 182 (375)</p>	<p>A St. 36 (19), 134 (216), 41 (27) 41st Division Dr. 37 (26), 95 (68), 338 (493) A St. 23 (23), 55 (122), 5 (21) 41st Division Dr. 52 (23), 112 (70), 270 (408)</p>



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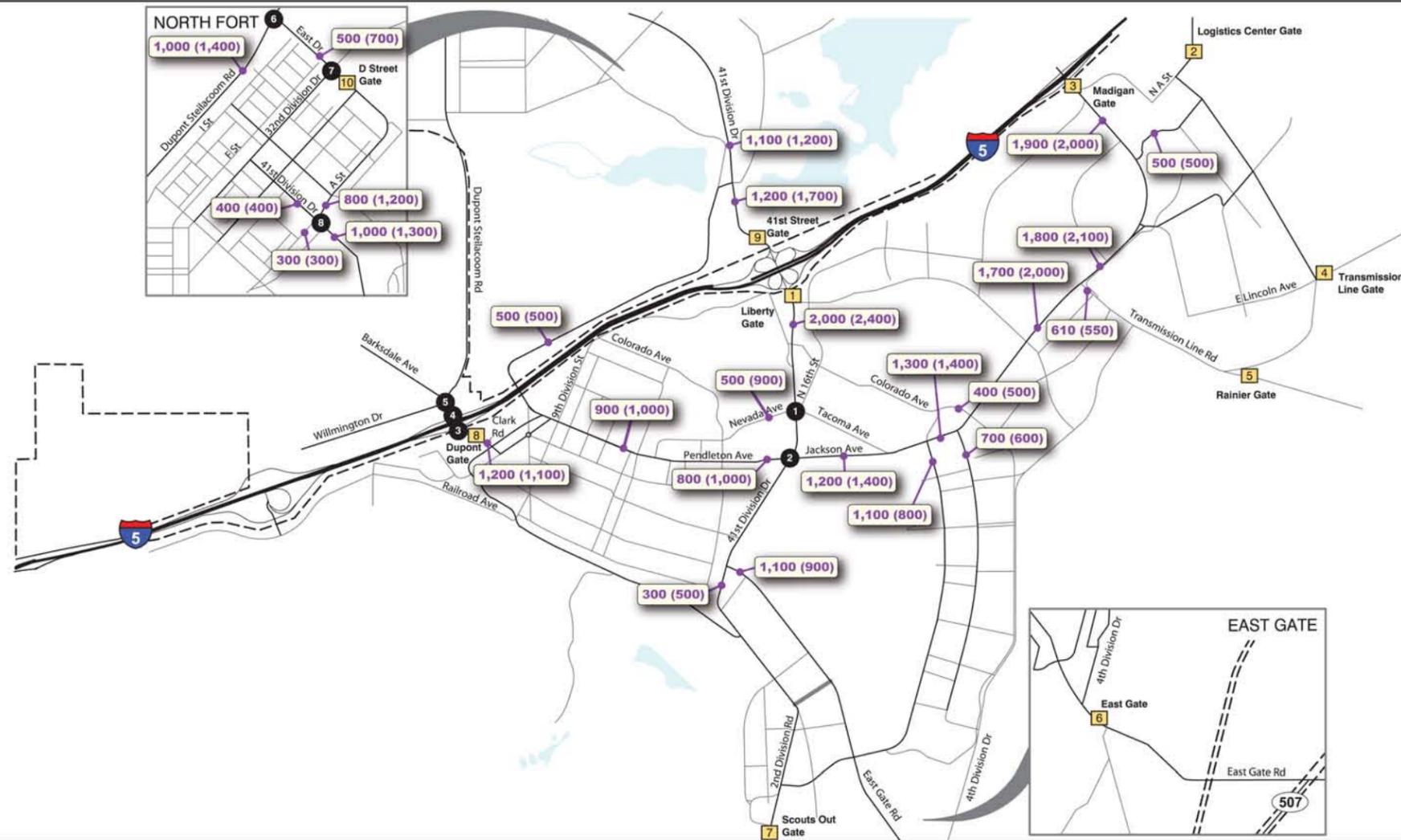


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Figure 3-16
Existing AM/PM
Peak Hour Traffic Volumes

ANALYSIS AREA: Thurston & Pierce Counties, Washington	
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Legend

- Turn Lane
- AM (PM) Peak Hour & Average Weekday Traffic Volume
- [610 (550)] Roadway Link Volume
- Installation Boundary
- Access Control Point (Gate)
- Restricted Access

Note:
Peak Hour Traffic Counts were collected in early December 2008.

Roadway link volumes obtained from the Transpo Group July 2008 Fort Lewis Comprehensive Traffic/Transportation Installation Study.

1. Liberty (Main) Gate	2. Logistics Center Gate	3. Madigan Gate	4. Transmission Line Gate	5. Rainier Gate
1,460 (730) [13,840] ↓ 41st Division Dr. ↑ 390 (1,720) [15,210]	480 (90) [3,850] ↓ N.A. St. ↑ 20 (620) [3,870]	1,440 (390) [12,210] ↓ Jackson Ave. ↑ 625 (1,860) [13,440]	← [800] E Lincoln Ave.	← [1,170] Transmission Line Rd.
6. East Gate	7. Scouts Out Gate	8. Dupont Gate	9. 41st Street (North Fort) Gate	10. D Street Gate
← 730 (135) [4,010] East Gate Rd. 10 (770) [3,990] →	↑ [120] 2nd Division Rd.	↓ 1,110 (215) [7,410] Clark Rd. ↑ 40 (950) [6,800]	↓ 525 (730) [8,320] 41st Division Dr. ↑ 675 (640) [10,010]	↓ 270 (130) [3,990] East Dr. ↑ 290 (645) [3,700]



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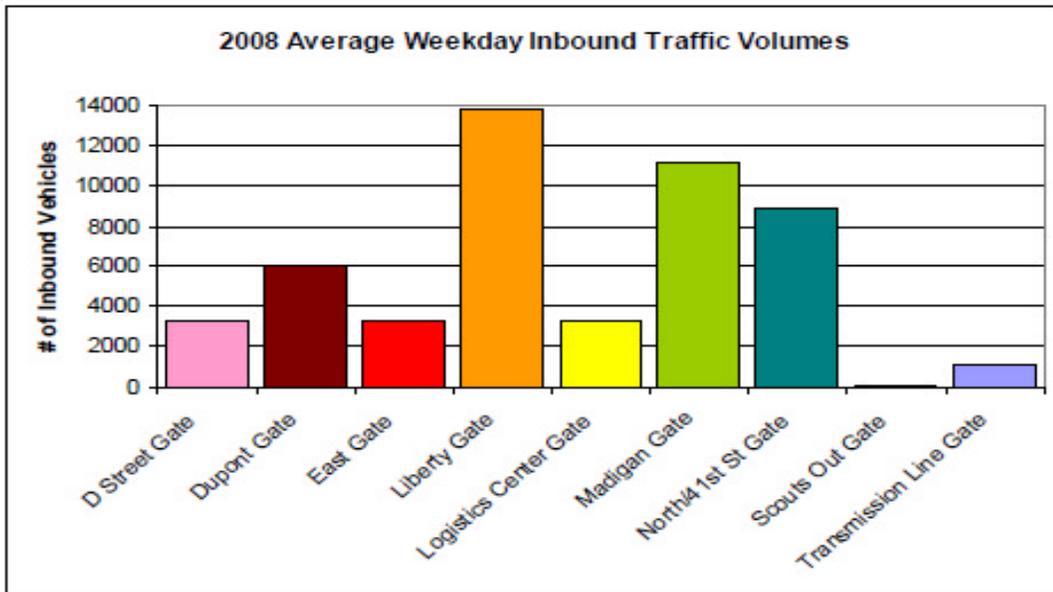


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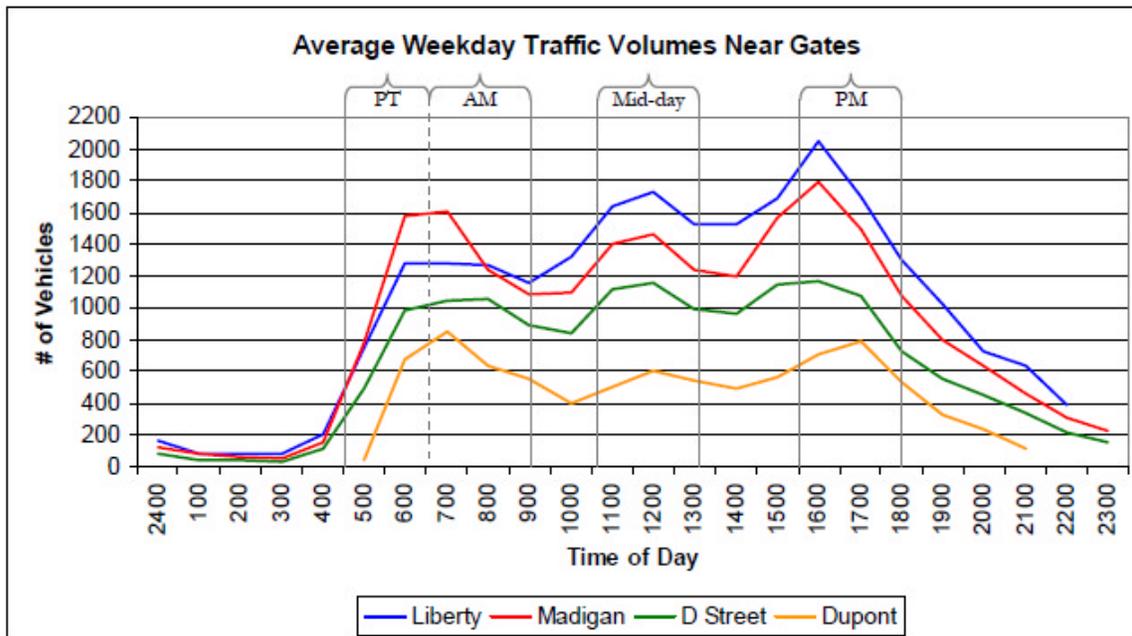
Figure 3-17
Existing Gate and
Roadway Link Traffic Volumes

ANALYSIS AREA: Thurston & Pierce Counties, Washington	
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Source: The Transpo Group, Inc. 2008

Figure 3–18 2008 Average Weekday Inbound Traffic Volumes



Source: The Transpo Group, Inc. 2008

Figure 3–19 Average Weekday Traffic Volumes near Gates

3.10.3 Existing Levels of Service

Level of service (LOS) is a qualitative measure describing operational conditions within a traffic flow, and the perception of these conditions by drivers or passengers. These conditions include factors such as speed, delay, travel time, freedom to maneuver, traffic interruptions, comfort, convenience, and safety. LOSs are given letter designations, from A to F, with LOS A representing the best operating conditions (free flow, little delay) and LOS F the worst (congestion, long delays). Generally, LOS A and B are high, LOS C and D are moderate, and LOS E and F are low. **Table 3–10** summarizes the relationship between control delay and LOS for signalized and unsignalized intersections. At signalized and all-way stop-controlled intersections, LOS is based on the weighted average control delay of all movements measured in seconds per vehicle. At side-street stop-controlled intersections, LOS is based on the control delay for each minor movement.

Table 3–10 Level of Service Definitions

Level of Service	Description of Traffic Conditions	Average Control Delay Per Vehicle (Seconds)
<i>Signalized Intersections</i>		
A	Insignificant Delays: No approach phase is fully utilized and no vehicle waits longer than one red indication.	≤10
B	Minimal Delays: An occasional approach phase is fully utilized. Drivers begin to feel restricted.	>10-20
C	Acceptable Delays: Major approach phase may become fully utilized. Most drivers feel somewhat restricted.	>20-35
D	Tolerable Delays: Drivers may wait through more than one red indication. Queues may develop but dissipate rapidly, without excessive delays.	>35-55
E	Significant Delays: Volumes approaching capacity. Vehicles may wait through several signal cycles and long vehicle queues form upstream.	>55-80
F	Excessive Delays: Represents conditions at capacity, with extremely long delays. Queues may block upstream intersections.	>80
<i>Unsignalized Intersections</i>		
A	No delay for stop-controlled approaches.	≤10
B	Operations with minor delay.	>10-15
C	Operations with moderate delays.	>15-25
D	Operations with some delays.	>25-35
E	Operations with high delays, and long queues.	>35-50
F	Operation with extreme congestion, with very high delays and long queues unacceptable to most drivers.	>50

Source: Transportation Research Board 2000

3.10.3.1 Study Intersections

Table 3–11 shows the existing LOS and average control delay for each study intersection. The LOS was calculated using the procedures in the Highway Capacity Manual (HCM). The *Synchro* computer software package, which is consistent with the HCM, was used to analyze all intersections. For side-street stop-controlled intersections, because two directions are free-flow and the other two directions are stop-controlled, both the overall intersection LOS and the worst-case stop-controlled approach LOS are shown and movement delays are provided for both. The Transportation Study Report (Fehr and Peers 2009) provides the LOS data summary sheets.

Table 3–11 Level of Service and Vehicle Delay for Study Intersections

Intersection	Traffic Control ¹	AM Peak Hour		PM Peak Hour	
		Delay ²	LOS	Delay ²	LOS
1 41 st Division Drive/Nevada Avenue/Tacoma Avenue	Signal	16	B	44	D
2 41 st Division Drive/Pendleton Avenue	Signal	38	D	50	E
3 I-5 NB Ramps/Barksdale Avenue/Clark Road	Signal	23	C	46	D
4 I-5 SB Ramps/Barksdale Avenue/Clark Road	Signal	12	B	46	D
5 DuPont-Steilacoom Road/Barksdale Avenue/Wilmington Drive	Signal	29	C	29	C
6 DuPont-Steilacoom Road/East Drive	SSSC	7	A	>50	F
		44	E - NB	>50	F - NB
7 North Gate Road/East Drive	AWSC	11	B	34	D
8 41 st Division Drive/A Street	Signal	29	C	35	C

Notes:

1. Signal = signalized, SSSC = side-street stop-controlled, AWSC = all-way stop-controlled, NB = northbound
2. Delay is recorded in seconds per vehicle.

All study intersections operate at LOS D or better for both the morning and afternoon peak hours, except one off-Post and one on-Post intersection. Off Post, the side-street northbound movement at the DuPont Steilacoom Road/East Drive intersection operates at LOS E during the morning peak hour. During the afternoon peak hour, the same intersection operates at LOS F. On Post, the 41st Division Drive/Pendleton Avenue operates at LOS E during the afternoon peak hour.

The July 2008 Fort Lewis Comprehensive Traffic/Transportation Study indicates that the 41st Division Drive/Pendleton Avenue intersection operates at LOS E during the mid-day peak hour. This is most likely because of the retail shopping and restaurants located just to the west of this intersection, in the Town Center.

The Fort Lewis Comprehensive Traffic/Transportation Study also identified other intersections on or around the Post that are currently operating at LOS E or F:

- West Way/Clark Road (morning and afternoon peak hours)
- Tacoma Avenue/Pendleton Avenue (morning and afternoon peak hours)
- N 23rd Street/Pendleton Avenue (afternoon peak hour only)
- 3rd Division Drive/Pendleton Avenue (morning and afternoon peak hours)
- N 20th Street/Colorado Avenue (afternoon peak hour only)
- East Gate Road/SR 507 (afternoon peak hour only)
- Stryker Avenue/41st Division Drive (afternoon peak hour only)

The unsignalized intersections of West Way/Clark Road, Tacoma Avenue/Pendleton Avenue, 3rd Division Drive/Pendleton Avenue, and DuPont Steilacoom Road/East Drive all operate at LOS F for all three peak time periods during an average weekday. Therefore, these are likely the worst operating intersections on or around Fort Lewis.

3.10.3.2 Gate Operations

The LOS and traffic throughput capacity at the Fort Lewis gates are not readily measurable due to the varying level of security maintained at these gates, affecting both the service capacity and extent of delay. The level of security changes with the level of threat and the amount of defense posture

needed at these gates. Therefore, gate operations are not only affected by traffic flow, but also by security levels.

Fort Lewis DPW staff previously indicated that the Liberty (Main) Gate has the longest delays due to the number of visitors and amount of vehicular traffic. The inbound vehicle queues can sometimes back up to the I-5 ramps, causing traffic congestion and worsening the LOSs.

During the morning peak hour, Madigan Gate also experiences heavy traffic congestion. Queues extend back along Jackson Avenue from the gate to the I-5/155th Street SW (Berkeley Avenue SW)/ Jackson Avenue interchange. The I-5 southbound off-ramp backs up onto the I-5 main line, with vehicles in the queue generally waiting on the paved shoulder of the freeway. This is an on-going problem during the AM peak hour. The other access gates to Fort Lewis are functioning satisfactorily.

3.10.3.3 Interstate 5 Operations

The I-5 Transportation Alternatives Analysis and Operations Model Study is being conducted by the City of Lakewood and WSDOT. This study focuses on developing an operations model and identifying potential transportation improvements for I-5 and adjacent arterials. The study year being used is 2030. The study started after the completion of the technical studies for the DEIS. However, relevant information has been extracted and summarized within the FEIS.

The I-5 study documented current (2009) levels of service along Mainline I-5. In the northbound direction, the mainline operates at LOS D or better to the south of the Berkeley Street Interchange (Exit 122). To the north of Exit 122, the merge and mainline operations are at LOS E or worse. North of Gravelly Lake Drive, an additional northbound lane exists and conditions improve until the SR 512 interchange. In the southbound direction, most of the mainline I-5 sections operate at LOS D or better during the PM peak hour with the exception of some slowdowns at the diverge to Thorne Lane.

The study also examined existing LOS at each of the I-5 ramp terminals. During the PM peak hour, the terminals at DuPont-Steilacoom Road (e.g. Barksdale Avenue) operate at LOS C or better (**Table 3-11**), whereas the ramps at Union Ave/Thorne Lane operate at LOS D. The Center Drive ramp terminals operate at LOS E/F. Field observations made at the Berkeley Avenue ramp also indicate poor operations due to the congestion spillback from the Union Avenue/Berkeley Avenue intersection. This interchange also operates poorly during the AM peak hour due to vehicle queuing on the southbound I-5 off-ramp.

3.10.4 Planned Roadway Improvement Projects

3.10.4.1 Pierce County

Pierce County's 2009 through 2014 Transportation Improvement Program (TIP) identifies numerous road improvement projects near Fort Lewis, primarily east of the installation in the Spanaway area. The relevant capacity and concurrency improvement projects include:

- Canyon Road E Widening – from 192nd Street E north to 1,000 feet (305 m) south of 176th Street E. This project would widen the existing roadway to provide additional lanes. Construction is not expected to start before 2014.
- Canyon Road E Widening – from 172nd Street E north to 160th Street E. This portion of Canyon Road E failed concurrency in 2005 and will be widened to provide additional lanes. Construction for this project is expected in 2011.

- Canyon Road E Southerly Extension – from 192nd Street E south to 260th Street E. This project will construct a new roadway as part of the new extension of the Canyon Road E corridor. Construction of portions of the extension is expected in 2011. However, completion is not expected before 2014.
- 176th Street E Widening – from B Street E east to 14th Avenue E. This portion of 176th Street E failed concurrency in 2005 and will be widened to provide additional lanes. Construction for this project could begin sometime in 2012 to 2014.
- 176th Street E Widening – from 14th Avenue E to Waller Road E. This portion of 176th Street E also failed concurrency in 2005. Widening will provide additional lanes, with construction completion anticipated in 2011.
- 176th Street E Widening – from Waller Road E to 500 feet (152 m) west of 51st Avenue E. This portion of 176th Street E failed concurrency in 2003. The project will widen the roadway to provide additional lanes, with completion of construction anticipated in 2011.
- Spanaway Loop Road S – from Military Road S to Tule Lake Road S. This road is expected to fail concurrency in 2012. The project will widen and reconstruct the road to provide additional lanes. Preliminary engineering for this project is expected in 2012 to 2014.

Additional Pierce County TIP information can be found on the internet version of the County's 2009–2014 TIP at <http://www.co.pierce.wa.us/xml/abtus/ourorg/pwu/tpp/tip/2009-2014%20TIP.pdf>.

3.10.4.2 Washington State Department of Transportation

Review of the WSDOT website identified the following transportation improvement projects near Fort Lewis:

- Cross Base Highway (SR 704) – WSDOT and Pierce County are planning a new four-lane limited access east-west highway between I-5 and SR 7. The highway will be 6 miles (10 km) long and will run from the I-5/N Thorne Lane/Murray Road SW interchange to the SR 7/176th Street E intersection. The design of this highway will accommodate future expansion to six lanes. The project will relocate the existing I-5/N Thorne Lane /Murray Road SW interchange 300 feet (91 m) southwest and reconstruct it to accommodate additional traffic and relieve congestion on I-5. The project will also build a connection to a new single lane southbound connector road from Gravelly Lake Drive SW to N Thorne Lane. At the east end of the project, modification to the SR 7/176th Street E intersection will include additional turn lanes. The Cross Base Highway will provide access via three signalized intersections: two in American Lake Gardens and one at Spanaway Loop Road South Extension. At American Lake Gardens, the two intersections will be at 150th Street SW and Woodbrook Road.
- 150th Street SW will provide access onto Fort Lewis via the Logistics Center Gate. The project will also provide another access onto Fort Lewis at approximately the midpoint of the project, at A Street. On Fort Lewis, a new overpass will be constructed over the Burlington Northern Santa Fe (BNSF) railroad line. Lincoln Road will be realigned to connect to the new A Street access onto the Post, and a new access road between Fort Lewis and McChord AFB will be constructed. The first phase of construction began in 2008 at the Spanaway Loop Road S/176th Street E intersection. Currently, the completion date for the Cross Base Highway project is unknown. It is possible that completion could occur by 2015, the horizon year for this study. An FEIS (dated September 2003) and a ROD (dated July 2004) for this project address the mitigation measures at the impacted Pierce County roads and intersections east of Fort Lewis.

- Tacoma/Pierce County High Occupancy Vehicle (HOV) Program – This program includes a series of region-wide projects intended to build HOV lanes on I-5, SR 16, and SR 167. These projects will widen the roadways to ease traffic congestion in Tacoma and the metropolitan areas north of Fort Lewis. Design and construction of six funded projects are scheduled for completion by 2016.
- Tacoma Rail Bypass of Point Defiance – This project will re-route passenger trains, including Amtrak Cascades to a bypass rail line to increase speeds and improve travel time. Most freight trains will continue to use the existing BNSF tracks in the Point Defiance area of Tacoma and along Puget Sound through Tacoma, Steilacoom, and DuPont.

Additional information on these WSDOT projects can be found in the Transportation Study Report (Fehr and Peers 2009) or at <http://www.wsdot.wa.gov/projects/?s=county-pierce,funding,location,route#listing>.

3.10.4.3 City of DuPont and City of Steilacoom

There are no known road improvement projects identified or proposed near Fort Lewis by the City of DuPont or the City of Steilacoom, at this time.

3.10.4.4 City of Lakewood

The City of Lakewood's Six Year Comprehensive TIP 2009–2014, identified one road improvement project near Fort Lewis. This project, on Union Avenue from Berkeley Street SW to N Thorne Lane, will widen the street to add a two-way left-turn lane, bicycle lanes, sidewalks, and street lighting. The expected year of completion for this project is 2014.

3.11 SOCIOECONOMICS

This section describes the affected environment for the following:

- demographics
- housing
- economic development
- public finance
- quality of life
- environmental justice in minority and low-income populations
- protection of children from environmental health risks and safety risks

The ROI for Fort Lewis comprises Pierce and Thurston counties. Fort Lewis, in which most of the construction activity would occur and where all new personnel and civilian employees would be located, is located entirely within Pierce County. The cities of Lakewood and Tacoma are located north of the installation; the cities of Lacey and Olympia are located to the south. The counties of Pierce and Thurston represent the functional economic region for Fort Lewis.

3.11.1 Demographics

3.11.1.1 Region of Influence

The estimated population of the ROI totaled 1,050,700 in April 2008, an increase of more than 15.6 percent since 2000 (Washington Office of Financial Management 2008a). Several large

communities are located in the ROI: the City of Tacoma, located north of Fort Lewis, with an estimated 2008 population of 202,700; the City of Olympia, located to the west-southwest of Fort Lewis with an estimated 2008 population of 44,800; the City of Lakewood, located west-northwest of Fort Lewis with an estimated 2008 population of 58,780; and the City of Lacey, located west-southwest of Fort Lewis, with a 2008 population of approximately 38,040 residents (Washington Office of Financial Management 2008a).

More than 10,200 civilian workers are employed at Fort Lewis (Vista Technology Services 2008). Assuming each is a head of household, this would represent a population of approximately 26,520 persons (applying an average household size of 2.6 as contained in the 2000 Census). The 31,350 active duty military personnel are accompanied by approximately 46,142 Family members, which results in a total connected population of about 77,492 persons (Vista Technology Services 2008), or approximately 7.4 percent of the entire 2008 population of the ROI.

3.11.2 Housing

3.11.2.1 On-Post

Fort Lewis has on-Post housing units for both unaccompanied and accompanied personnel. There are currently 3,492 family housing units of various types for accompanied Soldiers.

According to the 2007 Joint Housing Market Analysis, there is a validated on-Post housing requirement for 6,093 family housing units by 2012 (Robert D. Niehaus, Inc. [RDN] 2008). With a current inventory of 3,492 family housing units, a housing deficiency exists on-Post that will continue to grow during the next 5 years. The analysis anticipates that another 2,601 units will be needed by 2012.

Unaccompanied personnel are accommodated in barracks. Several projects are planned or underway to provide more billeting for unaccompanied Soldiers (**Appendix B**). By 2013, an additional 1,743 barracks spaces will be needed at Fort Lewis (RDN 2008).

3.11.2.2 Off-Post

An estimated 370,306 housing units are located in the ROI (RDN 2008). The proportion of owner-occupied housing units is 62.2 percent.

The off-Post population in the Fort Lewis market area (within a 20-mile (32 km) commute of the installation's main work areas) is estimated at 901,488 persons, having increased at an average rate of 1.7 percent per year since 2000; population growth increased at an average rate of 1.9 percent per year from 1990 to 2000. The annual growth rate is projected to continue to slow to 1.4 percent through 2012, resulting in an estimated population of 966,384 in 2012.

Vacancy rates and rentals in all areas within the ROI are fairly stable through time. The rental vacancy rate was estimated to be 5.4 percent in 2007; which is lower than observed in 1990 and 2000 (RDN 2008). Of the overall rental housing stock, 30.9 percent is considered substandard and 28.8 percent of the non-mobile home rental inventory is classified as unsuitable by DoD criteria.

The increase in military personnel at Fort Lewis would lead to declining vacancy rates during the next 5 years; vacancy rates for 2013 are projected to be 5.3 percent in the rental market.

3.11.3 Economic Development

Characteristics of economic development include employment and its distribution across industrial sectors, unemployment, earnings and sources of income, and the contribution made to the regional economy by the military installations, their personnel, and retired service members.

3.11.3.1 Employment

In 2006, more than 3.8 million jobs in existed in the State of Washington, of which about 146,380 were military and federal/civilian jobs (Bureau of Economic Analysis 2008a).

More than 374,000 people were employed in the ROI in 2007, 73.4 percent of whom worked in Pierce County (Bureau of Labor Statistics 2008). In Pierce County, the largest share of employment is concentrated in the health care industry, with 12.5 percent of jobs. Local government employed 12.1 percent, the retail trade sector employed 11.9 percent, and construction accounted for an 8.6 percent of workers (Washington Department of Employment Security 2008). The largest employer in Pierce County is the Fort Lewis installation (Economic Development Board for Tacoma-Pierce County 2008).

The unemployment rate in both counties of the ROI gradually increased from lows of between 4.6 percent in Thurston County and 5 percent in Pierce County to an average 5.3 percent for the first 11 months of 2008 in Thurston County and 5.4 percent in Pierce County (Bureau of Labor Statistics 2008).

3.11.3.2 Earnings and Income

Total non-farm wage and salary earnings in the ROI totaled just more than \$35 billion in 2006, approximately 76 percent of which was contributed by Pierce County (Bureau of Economic Analysis 2008b). The contribution to total earnings by the military sector is higher in Pierce County (approximately 9.8 percent) compared to 2.4 percent for the state and 0.4 percent for Thurston County.

Two major military installations are located within the ROI: Fort Lewis and McChord AFB. These installations are important to the health and stability of the regional economy and support businesses and jobs through: 1) payroll expenditures by military and civilian personnel, 2) direct procurement of goods and services by the installations for operations and maintenance functions, and 3) government contract awards to private firms located in the region.

3.11.3.2.1 Payroll

Personal income associated with the military totaled \$2.66 billion in 2006 in Pierce and Thurston Counties (Bureau of Economic Analysis 2008b). Wages paid to personnel (active duty and civilian) at Fort Lewis totaled more than \$2.02 billion in 2007 (Piek 2009).

3.11.3.2.2 Procurements

Expenditures on grants and contracts by the installation can vary measurably from year to year. The value of grants and contracts let by the Army in FY 2006 in Pierce and Thurston counties, as reported by the DoD, was \$453.3 million (DoD 2008). The large majority (greater than 99 percent) of DoD prime contracts awarded to firms in the ROI have been made to companies located in Pierce County; these account for approximately 9.4 percent of all DoD awards statewide. The value of prime contract awards from the Army in Pierce County totaled more than \$449 million in FY 2006 (DoD 2008).

In 2007, expenditures at Fort Lewis that had the greatest effect on the local economy (after earnings paid to personnel) were contracts, services, and construction; military construction, and federal impact aid funding. During 2007, contracts, services, and construction accounted for approximately \$336.3 million in expenditures and military construction accounted for approximately \$312 million. Federal impact aid funding accounted for another \$13 million in expenditures at Fort Lewis.

3.11.3.2.3 Multiplier Effects

The injection of funds into a regional economy has what is referred to as a direct effect. This spending creates a demand for goods and services that, in turn, increases output and employment in numerous support industries. This is referred to as the induced effect, and the link between the two is the multiplier effect.

3.11.3.3 Public Finance

The primary sources of revenue for Pierce and Thurston counties are: 1) sales taxes, 2) property taxes, 3) transfers from the state government, and 4) transfers from the federal government. In 2008, property taxes and intergovernmental transfers are the largest sources of revenue for both counties (Pierce County 2008, Thurston County 2007). Property taxes accounted for 19.2 percent of Pierce County’s revenue 22.7 percent of Thurston County’s 2008 revenue. Intergovernmental transfers accounted for 21.6 percent of Pierce County’s revenue 11.3 percent of Thurston County’s 2008 revenue. Charges for services and fees make up 14.9 percent of Pierce County’s revenues and 12 percent of Thurston County’s revenues (Pierce County 2008, Thurston County 2007).

The major operating expenditure categories for the counties are: 1) public safety, 2) health and social services, 3) utilities, 4) capital expenditures, and 5) transportation. The provision of health and social services consumes approximately 14 percent of operating expenditures in Pierce County and 21 percent in Thurston County. Expenditures on public safety comprise approximately 19 percent of the operating expenditures for each county (Pierce County 2008, Thurston County 2007).

3.11.4 Quality of Life

3.11.4.1 On-Post

Numerous facilities and services located on Fort Lewis contribute to the quality of life of on-Post residents and military personnel and their families residing off-Post.

3.11.4.1.1 Child Care

Childcare programs at Fort Lewis are available for children ages 6 weeks to 12 years. These services are provided at five on-Post centers and in Family Child Care Homes. **Table 3–12** summarizes the current enrollment in Fort Lewis’s childcare programs.

Table 3–12 Summary of Current Enrollment in Fort Lewis Childcare Programs

Facility	Enrollment
Clarkmoor Child Development Center	248
Clarkmoor Hourly Child Development Center	92
Madigan Child Development Center	247
Madigan Infant and Toddler Development Center	56
Beachwood Child Development Center	269
Family Child Care Homes	400

Before and after school care for school-aged children is provided by the School Aged Services (SAS) program located at the North Fort SAS Complex. In the North Fort Outback School Age Center, 105 first graders are enrolled; 225 second through fifth graders are enrolled. Approximately 60 sixth through eighth graders are enrolled in the Teen Zone program.

Between 2009 and 2011, seven additional child and student care facilities are slated for construction, and three existing facilities will be expanded. **Table 3–13** summarizes the increases in enrollment projected with the new and expanded facilities.

Table 3–13 Summary of Planned Future Childcare Programs, 2009–2011

Facility	Future Enrollment
MAMC Warrior Hourly Care Center	45
Cascade School Age Center	195
SKIES Center	135
North Fort Child Development Center	144
Hillside Child Development Center	232
Hillside Youth Center	140
Clarkmoor, Madigan, and Beachwood Child Development Centers ¹	180
Madigan 24/7 Child Development Home	20

Note:

1. These child development centers will be expanded to accommodate the additional children.

3.11.4.1.2 Health Care

MAMC has a 204-bed capacity (that can be expanded to 318 during a disaster) and houses 14 operating rooms and 15 x-ray rooms. MAMC contains outpatient clinics specializing in family medicine, internal medicine, and pediatrics. MAMC provides services to Soldiers, retirees, and their Families. Care is supplemented by dental clinics, veterinary services, and other medical offerings (e.g., blood bank, mental health).

MAMC houses 492 doctors, 475 registered nurses, 192 licensed practical nurses, and more than 120 residents and interns. MAMC hosts 19 residency programs and 8 fellowship programs. MAMC averages 3,882 outpatient clinic visits, 35 inpatient admissions, and 185 emergency room visits per day.

3.11.4.1.3 Public Schools

In addition to operating the public schools in the City of Lakewood (immediately adjacent to Fort Lewis), the Clover Park School District operates the schools on Fort Lewis and McChord AFB. There are 25 schools within the Clover Park School District. The five on-Post schools that are operated by the Clover Park School District are owned by the U.S. Department of Education, and the land on which the school facilities are located is owned by the Army. Most of the enrollment in the on-Post schools comes from on-Post and off-Post military dependents. Middle school students residing on-Post are bused to either Woodbrook or Mann middle schools; high school students residing on-Post are bused to Lakes High School. The five on-Post elementary schools have a capital capacity of 2,176; an inventory of these schools is presented in **Section 3.14**.

3.11.4.1.4 Other Facilities

There are a number of additional on-Post facilities that contribute to the quality of life for Soldiers and their Families. They include a PX and Commissary, recreational facilities, chapel, mini-mall, Golf Course, and various other support facilities.

3.11.4.2 Off-Post

The communities that surround Fort Lewis provide numerous recreational, medical, retail, food, and other community services and facilities. Of the wide array of off-Post services and facilities, public schools are highly important.

3.11.4.2.1 Community Public Schools

There are 23 school districts in the ROI, with a total combined student enrollment of 239,164 in 2008 (Washington Superintendent of Public Instruction 2008).

Personnel assigned to Fort Lewis may reside throughout the ROI, and their children make up noticeable portions of the student membership in some school districts. There can be substantial fiscal implications for school districts that have a high proportion of their student members residing on military installations.

School districts rely on several funding sources, especially local property tax assessments, funds from the state, and federal funds. Because military installations are exempt from local taxes, local school districts are eligible for federal impact aid funds. These payments are designed to offset the potential loss of property tax payments to affected school districts. The impact aid received is highly weighted in proportion to the students who reside on the military installations instead of in the communities.

The number of federally connected students, primarily the children of military and appropriated fund civilian personnel in this area, is highly concentrated in the Clover Park School District, which serves the off-Post area immediately adjacent to Fort Lewis and operates the on-Post schools. For 2008, the Clover Park School District's average daily attendance was 11,229, of which 4,086 (36 percent) consisted of federally connected students (National Association of Federally Impacted Schools 2008).

Smaller, yet noticeable, concentrations are evident in the Steilacoom Historical School District (17 percent of average daily attendance) and Yelm School District (7 percent of average daily attendance). Although the share of average daily attendance that federally connected students comprise is noticeable, the impact aid contribution to the budget in these two school districts is small (4 percent for the Steilacoom Historical School District and less than 1 percent for Yelm School District). This is explained by the fact that the great majority of the enrolled students reside in the communities and not on Post; thus, less impact aid is directed to these school districts.

3.11.5 Environmental Justice

EO 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires each federal agency to identify and address any disproportionately high and adverse environmental or economic effects that its programs and policies might have on minority or low income populations. CEQ defines minorities as members of the following population groups: American Indian or Alaskan Native, Asian or Pacific Islander, or Black or African American (CEQ 1997). A minority population should be identified where the minority population of the

affected area either exceeds 50 percent or is meaningfully greater than the minority population percentage in the general population.

Minority populations within the ROI comprise approximately 24 percent of the overall population in Pierce County and 16.6 percent of the overall population in Thurston County. Sixty-four percent of the population on the Nisqually Indian Reservation is identified as American Indian and Alaska Native alone or in any combination (U.S. Census Bureau 2000), which indicates a minority population as defined by CEQ. The populations of the census tracts including and immediately adjacent to Fort Lewis have a higher percentage of minority population than across the ROI as a whole; the proportion of these minority populations, however, was less than CEQ's 50-percent threshold. Fort Lewis's residential population, as with other military populations, contributes to the higher minority percentage in the immediate area of the Post. Of the total U.S. Military population, 37.5 percent of active duty members identify themselves as minorities (Army 2007a).

Low-income populations are identified using the Census Bureau's statistical poverty threshold, which varies by household size and number of children. For example, the poverty threshold for a family of four with two children was \$17,463 in 2000 and rose to \$21,200 by 2008 (Department of Health and Human Services 2008). Nationwide, the proportion of people in poverty was 11.3 percent in 2000 and 12.5 percent in 2007. Pierce and Thurston counties have poverty levels below 20 percent: Pierce County poverty level is estimated at 11.4 percent for the years 2005 through 2007 and Thurston County's poverty level is estimated at 10.6 percent during the same period.

The Census Bureau defines a "poverty area" as a census tract or block numbering area where 20 percent or more of the residents have incomes below the poverty threshold (U.S. Census Bureau 2008c). The 2000 Census indicates that there were no "poverty areas" in Thurston County; however, 21 of 158 Census tracts in Pierce County met the definition of a "poverty area" (U.S. Census Bureau 2000).

3.11.6 Protection of Children

EO 13045, "Protection of Children from Environmental Health Risks and Safety Risks," seeks to protect children from disproportionately incurring environmental health or safety risks that might arise from government policies, programs, activities, and standards.

Children are present on Fort Lewis in many settings, including family housing neighborhoods, elementary schools, day care centers, and recreational areas. During the 2007 through 2008 school year, 2,441 school-aged children were enrolled in the public schools on Fort Lewis.

3.12 HAZARDOUS MATERIALS AND WASTES

During public scoping, the public expressed concerns regarding the effects on the environment from a potential release of hazardous/toxic chemicals during operations or because of an accident at Fort Lewis. The ROI for the management of solid wastes and hazardous materials and wastes is the Army installation where the proposed activities would occur. Solid waste management and the storage, use and transport of hazardous materials and disposal of hazardous wastes at Fort Lewis are conducted in compliance with all applicable regulations. Specific regulations generally govern the use and storage of hazardous materials and disposal of hazardous wastes. In addition, the Fort Lewis Environmental Management Manual was developed as the part of an overall Environmental Management System (EMS) with the goal of full conformance with the International Organization for Standardization (ISO) 14001 standards by FY 2009. The EMS addresses organizational structure, planning activities, responsibilities, practices, procedures, processes, and resources for developing, implementing,

achieving, reviewing, and maintaining environmental policy. Finally, Fort Lewis complies with EOs and all federal and state laws, regulations, and requirements in its waste management efforts.

3.12.1 Solid Waste

Army solid waste policy is based on the concept of Integrated Solid Waste Management (ISWM) planning and development of an ISWM Plan. The ISWM Plan is designed to minimize the initial input into the waste stream. The Fort Lewis Environmental Division (ED) coordinates solid waste management and planning with DPW, Directorate of Family and Morale, Welfare and Recreation (DFMWR), DRMO, Army Contracting Agency, Fort Lewis Resource Management Office (RMO), MAMC, Residential Communities Office (RCO), and other installation organizations, tenants, and activities as required. Fort Lewis's solid waste management program includes separate operations for collection and disposal of municipal solid waste, construction and demolition waste, and regulated medical waste. Non-hazardous solid waste is landfilled off-Post only or recycled. The Army has mandated goals regarding waste reduction and recycling, including a requirement to divert at least 50 percent of construction and demolition waste and 40 percent of other non-hazardous solid waste by 2010.

Waste varies from common household to commercial and industrial sources. Approximately 12,864 tons (11,670 metric tons) of solid waste were generated at Fort Lewis in 2007, more than one-third of which (4,511 tons [4,090 metric tons]) was recycled (Army 2008b). Non-hazardous solid waste is landfilled, either on- or off-Post, or recycled. Waste generated on Fort Lewis is collected by a private contract provider, and taken to the 304th Landfill in Graham, Washington for disposal. Until 2003, a small portion of the municipal solid waste generated on Fort Lewis was disposed of in a landfill on North Fort Lewis (cell No. 6 in Landfill No. 5); this landfill is now closed.

In April 2007, Fort Lewis opened a new, permanent recycling center. Since the opening, recycling has increased 20 percent. The facility also includes space for on-site training and education. Since the Recycle Center opened, it has had a recorded use of up to 140 customers per day. The new facility has six bays used to off-load heavy items such as recyclable wood, commercial refuse, and yard waste.

Fort Lewis is in the process of developing a plan to implement a Qualified Recycling Program (QRP) to further improve recycling activities installation-wide. Department of Defense Instructions (DoDI) 4715.4 outlines the requirements for the new QRP at Fort Lewis that will eventually end up serving both the environment and the financial bottom line.

Construction and demolition debris are also being recycled at Fort Lewis. In just 2 years, Fort Lewis diverted for reuse more than 20,000 tons (18,000 metric tons) of waste concrete, asphalt, and masonry generated at construction and demolition projects (Army 2008a). In FY 2007, Fort Lewis converted 28,253 tons (25,630 metric tons) of concrete and 8,417 tons (7,636 metric tons) of asphalt into an aggregate product for reuse in construction, road maintenance, and repair. As a result, Fort Lewis saved \$220,020 in disposal costs and approximately \$366,700 in cost avoidance for purchasing new materials (Army 2008a). Crushed concrete is used for road and parking lot applications as well as filler for sidewalk improvements. Recycled asphalt is mainly used for tactical vehicle trail surfacing as a road binder and dust palliative. This program is now an established business practice, with \$60,000 per year allocated for crushing waste concrete and asphalt.

In 2006, Fort Lewis and the U.S. Army Corps of Engineers (Seattle District) replaced the traditional approach to facility removal (by crush and haul techniques) with a combination of deconstruction

and material diversion. In the installation's first application of this new technique, 12 World War II-era wood buildings were removed rather than demolished, achieving 100 percent diversion of non-hazardous solid waste through reuse and recycling. Combined, the buildings covered 48,000 square feet (SF). Subcontractors recovered 215 tons (195 metric tons) of structural and non-structural materials for resale in local markets (Army 2008a). Material such as lumber, flooring, trusses, porcelain bathroom fixtures, aluminum, steel, brick, and siding were segregated on site before transport to reuse markets. The total estimated value of these products is \$207,000. Additionally, some of the products were reused for repair and improvements to training facilities, as well as for beautification projects around the Post. This project earned the 2006 Washington State Recycling Association Recycler of the Year Award and the 2006 Secretary of the Army Environmental Award for Pollution Prevention (Army 2008a).

Sewage sludge is another solid waste generated at Fort Lewis. The two primary means of managing sewage sludge at the Solo Point Wastewater Treatment Plant are on-site composting/treatment and off-site land application. The preferred method of sewage sludge management at Fort Lewis is composting/treatment. Currently, Fort Lewis is able to compost/treat a limited quantity of the total sewage sludge generated. The main benefit of on-site composting versus off-site land application is the elimination of contamination and potential clean-up liability. Composting of sewage sludge results in compost that can be used at Fort Lewis with a resulting cost benefit. Composting also achieves the installation sustainability goal of "zero net waste" with respect to sewage sludge.

3.12.2 Hazardous Materials and Wastes

Units and activities at Fort Lewis typically use hazardous materials such as fuels, paints, solvents, lubricants, coolants, sealers, adhesives, refrigerants, compressed gases, batteries, cleaners, and sanitation chemicals. Hazardous materials also include munitions; pesticides and herbicides; petroleum, oils, and lubricants (POLs); and petroleum storage tanks. In accordance with the Pollution Prevention Act (PPA) and Emergency Planning and Community Right-to-Know Act (EPCRA), source reduction, recycling, and treatment activities involving EPCRA Section 313 chemicals must be reported on Toxic Release Inventory (TRI) Form R. EPCRA Section 311 requires that facilities with chemicals stored above certain quantities must submit either copies of their material safety data sheets (MSDSs) or a list of MSDS chemicals. EPCRA Section 312 requires submission of an annual inventory report (Tier II report) for the same chemicals to the State Emergency Response Commission, Local Emergency Planning Committee, and local fire department.

Hazardous waste is generated because of facility and equipment maintenance, medical care activities, Soldier training, and motorpool maintenance operations. Hazardous wastes generated at Fort Lewis include medical and biohazardous waste; asbestos; lead-based paint (LBP); and polychlorinated biphenyls (PCBs). The management of hazardous waste at Fort Lewis is accomplished by using a centralized bar-coded container tracking system. This system monitors all waste from generation through disposal. This centralized approach includes technical specialists within DPW that assist units and activities with Resource Conservation and Recovery Act (RCRA) compliance and provide transport of all hazardous waste generated within the installation to the conforming storage facility. Fort Lewis operates as a state and federally permitted large quantity hazardous waste generator (RCRA ID# WA92 14053465). Fort Lewis currently operates 418 individual hazardous waste accumulation points located throughout the installation. Hazardous wastes are directed to the installation's storage facility. Contract services are used to collect, recycle, and/or dispose of hazardous wastes off site. During FY 2007, a total of 415,300 pounds (188,400 kg) of hazardous waste were generated on Fort Lewis (Smith 2009).

Specific regulations generally govern the use, storage, and transport of hazardous materials, and disposal of hazardous wastes. Management of hazardous materials and wastes at Fort Lewis continues to follow Army, federal, and state regulations in order to minimize potential impacts to human health or the environment. AR 200–1 governs all aspects of managing hazardous materials and regulated waste by military or civilian personnel and on-Post tenants and contractors at all Army facilities.

Programs used to manage hazardous materials and wastes at Fort Lewis include IRP, Military Munitions Response Program (MMRP), and Compliance-Related Cleanup (CC). Fort Lewis has several plans in place to help manage hazardous materials and waste including a Pollution Prevention (P2) Plan; Installation Contingency Plan (ICP); Facility Response Plan (FRP); IPMP; Hazardous Material Management Plan (HMMP); and Ozone Depleting Chemical Management Plan.

As outlined in Army Pamphlet 710–7 and the HMMP, Fort Lewis implements centralized hazardous materials management. Fort Lewis mandates the use of a Hazardous Materials Control Center (HMCC) to manage the purchase, storage, use, and recovery of hazardous materials. The HMCC controls procurement through the Authorized Use Lists (AULs), the Restricted Use List (RUL), and signature cards (Army Form 1687). The AUL and the RUL limit and reduce hazardous material use and substitute more environmentally preferable less toxic products. The signature cards identify personnel who are authorized to order, turn-in, and/or receive hazardous materials.

The Installation AUL lists all the hazardous materials authorized for general purchase on Fort Lewis. In addition, certain units have received Unit-specific AULs from the Pollution Prevention Program. Unit-specific AULs list specialized hazardous materials that a specific unit is authorized to use in addition to the hazardous materials on the Installation AUL. Purchasers can only order and use hazardous materials on the Installation AUL or their Unit-specific AUL.

There is also a Fort Lewis RUL issued by the Pollution Prevention Program. This list is periodically updated and includes various chemicals that are restricted from use on Fort Lewis. These chemicals include ozone-depleting compounds, banned and severely restricted pesticides, persistent bioaccumulative toxic (PBT) chemicals, and other chemicals of concern. Use of a product with a restricted chemical requires written approval from the Pollution Prevention Program.

Fort Lewis also has a new product review procedure in which products new to Fort Lewis undergo a health, safety, and environmental review before being authorized for use. This is coordinated by the Pollution Prevention Program.

The HMCC supplies facilities ranging in size from major industrial sites to individual motor pools. The HMCC serves a portion of every directorate and major subordinate command at 220 sites, providing centralized management and visibility of all hazardous materials stored and used on the installation. Delivery service started in 2003 and they assist in supporting the Pollution Prevention Environmental Advisors with the collection and transport of unused hazardous materials that qualify for entry into the Re-Issue Program and reduce costly waste disposal fees through redistribution to other organizations. For example, the availability of products entered through the Re-Issue Program resulted in a procurement cost avoidance of \$413,826 and a waste disposal cost avoidance of \$542,986, for a total savings of \$956,812 in 2008.

Delivery service has been the key to the success of the HMCC material disposition program that now serves 85 percent of Fort Lewis customers and 50 percent of McChord AFB customers (Army 2008a). The HMCC will expand the delivery program with two additional drivers and trucks to provide delivery service to all of Fort Lewis, McChord, MAMC, and Camp Murray.

Per EO 13423 guidance, Fort Lewis is in the process of developing a plan to implement a Green Procurement Program (GPP) to maximize the use of environmentally preferable products, such as the use of less toxic materials, and to reduce waste generation. The DoD Green Procurement Strategy and Army Green Procurement Guide outline the requirements for GPPs at Army installations.

The P2 plan encompasses activities that reduce the quantity of hazardous, toxic, or industrial pollutants at the source by changing production, industrial, or other waste-generating processes. The goal is to reduce the generation of hazardous wastes by significantly reducing the use of products containing hazardous material compounds. EOs, Army regulations, and state environmental laws have been enacted to provide the method and means by which federal facilities will prevent pollution and reduce wastes. Fort Lewis developed a P2 Plan in 1993, with the objectives of minimizing environmental impacts associated with facility operation, protecting human health from exposure to harmful hazardous substances, and reducing hazardous substance use and hazardous waste generation (Army 2008a). The P2 plan addresses hazardous substances listed in the Superfund Amendments, RCRA, Solid Waste Amendments, and the Washington Department of Ecology's Dangerous Waste regulations. The plan is updated annually to address changes in use of hazardous materials on the installation and to comply with the state-required P2 plan process.

The Fort Lewis ICP establishes procedures, responsibilities, and resources for the emergency response to accidental spills or releases of hazardous substances. FRPs are prepared for sites that have the potential to harm the environment substantially from release of significant quantities of petroleum, oils, or lubricants to surface waters supporting fish and wildlife, groundwater providing drinking water, and navigable waters of the United States. These plans are incorporated into one document identified as the Integrated Contingency Plan at Fort Lewis.

3.12.3 Munitions, Ranges, and Unexploded Ordnance

Ammunition, live fire, and UXO are of concern principally in TAs and ranges. Training exercises and testing activities at Fort Lewis expend a variety of ordnance. Ordnance is expended in a variety of grenades, mortars, howitzers, artillery, rockets, and missiles during training exercises and testing activities. DoD 6055.9–STD, *DoD Ammunition and Explosives Safety Standards*, defines UXO as “explosive ordnance that has been primed, fused, armed, or otherwise prepared for action, and that has been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material and remains unexploded either by malfunction or design or for any other cause” (AP1.1.1.95). Grenades, mortars, and artillery weapons used in live-fire training can produce UXO. Expended ammunition, although inert as an explosive, may constitute a hazardous material, such as lead contamination. Soils with lead contamination may be found at gun and artillery practice ranges where lead munitions are used.

Ordnance impact areas and buffer zones are off limits to unauthorized personnel. In addition, impact areas are posted with warning signs indicating the potential risks of UXO in the impact area. Although most UXO is found in designated impact and dud areas, which are well delineated and easily recognizable, UXO is routinely encountered outside these areas on the installation. The Fort Lewis explosives ordnance disposal (EOD) unit eliminates explosives hazards on ranges by detonation of UXO in place, or, if safe to do so, by removing the hazard to the EOD range and detonating it there.

3.12.4 Biohazardous Wastes

Medical wastes include wastes generated by hospitals, clinics, physicians' offices, dental offices, veterinary facilities, and other medical laboratories and research facilities. Biohazardous waste can

typically include human blood and blood products, cultures and stocks of infectious agents and associated biological wastes, isolation wastes, contaminated and unused sharps, animal carcasses, contaminated bedding material, and pathological wastes.

The Army follows the MEDCOM 40–35 Management of Regulated Medical Waste guidelines for the handling, use, and disposal of biohazardous wastes. All biohazardous waste is managed under the national contract with Stericycle. Other infectious waste is sterilized before being shipped to a landfill (Army 2005c).

3.12.5 Pesticides and Herbicides

Pesticides and herbicides are required for insect and rodent control and for the control of unwanted vegetation, including noxious weeds. Pest management on Fort Lewis is guided by the Fort Lewis IPMP developed in 2006. As mandated by AR 200–1, this plan is a comprehensive document that outlines the organization and implementation of all pest control procedures on Fort Lewis.

3.12.6 Asbestos, Lead-Based Paint, and Polychlorinated Biphenyls

Asbestos is a substance known to cause lung disease. Construction, demolition, or renovation of facilities may expose asbestos-containing material or LBP. In addition, during activities such as site scarification and grubbing, underground piping that contains asbestos may surface (Van Hoesen 2009a). When a building renovation, repair, or demolition project is planned, a detailed asbestos survey must be performed so that asbestos-containing materials are properly managed. Fort Lewis DPW presumes that asbestos is present in any building constructed before 1985. Such buildings include the credit union, mini-mall, Popeye's, and the roller rink. Even in the late 1980s and 1990s, after asbestos was banned in most building materials, small amounts of asbestos were still used in adhesives, glues, and roofing materials. Consequently, asbestos is potentially present in many buildings at Fort Lewis. Asbestos regulations stipulate that buildings are assumed to contain asbestos until proven otherwise, and relatively few of the buildings on the installation have been tested. Asbestos testing at the bowling alley revealed that the substance is present in the building, and a partial demolition and renovation has been scheduled to address the issue.

Lead, a heavy metal that is harmful to human health, may also be present in paints used in some buildings in the project site. Before 1978, LBPs were used extensively in homes and other structures, including those on Fort Lewis. Buildings constructed before 1978 are assumed to contain LBPs unless lead testing has proven otherwise. The credit union and mini-mall were constructed before 1978 and may contain lead-based paints.

There are no federally regulated PCBs at Fort Lewis (Smith 2009). All transformers that formerly contained PCBs have been drained and mineral oil was used to replace the PCBs. Some light fixture ballasts and communications equipment may still contain state-regulated PCBs (Smith 2009).

3.12.7 Radon and Low-Level Radioactive Waste

Based on a radon survey completed at Fort Lewis in 1998, radon mitigation systems were installed until funding ran out. The mitigation involved reducing the levels of radon gas below the EPA-recommended level for residential housing and schools of 4 picocuries per liter. The Family housing units identified as having radon in excess of the EPA-recommended level had mitigation systems installed before privatization of the housing (Rosacrans 2009). The remaining high-radon buildings are not used for housing or schools; however, they also will be mitigated when funding becomes available.

Small amounts of low-level radioactive waste are generated at Fort Lewis. The use of radioisotopes for medical purposes generates short-lived (half-life less than 90 days), low-level waste. Low-level radioactive waste is also generated from commodity items such as unusable compasses, dials, targeting devices, gauges, rocket sights, and chemical weapons detection equipment. These wastes include the radioactive isotopes tritium (H3), thorium 232, radium 226, americium 241, nickel 63, promethium 141, cesium 137, cobalt 60, and strontium 90. Current Army policy prohibits the use of depleted uranium (DU) ammunition for training worldwide (AR 385–62). The Installation Safety Office manages low-level radioactive materials program and MAMC manages the low-level radioactive medicine program.

3.12.8 Hazardous Waste Spills and Contaminated Sites

POLs are used at Fort Lewis, including engine fuels (gasoline and diesel), motor oils and lubricants, and diesel and kerosene heating fuels. All underground and aboveground storage tanks are managed in conformance with applicable federal, state, and Army regulations. Fort Lewis has several plans in place to help manage POLs and other hazardous materials. These include the P2 and Integrated Contingency Plan plans that specify the proper storage, handling, and transport of hazardous materials; spill prevention procedures; and procedures to follow in the case of a spill or other accident. They also include the Spill Prevention, Countermeasure, and Control Plan (SPCCP).

The IRP is an ongoing DoD-administered program for identifying, evaluating, and remediating contaminated sites on federal lands under DoD control. The program was implemented in response to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requirements to remediate sites that posed a health threat. Section 211 of the Superfund Amendments Reauthorization Act (SARA) amended CERCLA and established the Defense Environmental Restoration Program (DERP), through which DoD funds and conducts its environmental restoration programs.

In 1996, Fort Lewis conducted a RCRA Facility Assessment that identified 81 sites representing potential environmental hazards, most of which were located in the cantonment area (Army 2008a). The identified contaminated sites include active and former landfills; solid and biomedical waste incinerators; hazardous waste treatment, storage, and disposal facilities; petroleum storage areas; maintenance areas; TAs; firing ranges; and areas containing UXO. One of these hazardous sites, a former Nevada Avenue waste pit, is located to the northeast of the PX. This site was used in the 1960s to dispose of an unspecified amount of material containing petroleum hydrocarbons and metals, and consequently has contaminated soils. A second potentially hazardous site, a former silver recovery unit, is located northwest of the Commissary. Various other potentially hazardous sites occur at Fort Lewis, including former refueling areas, weapons and tank ranges, pesticide rinse areas, and transformer storage areas. In 1989, the Logistics Center at Fort Lewis was designated as a NPL site based on soil and groundwater contamination. Additionally, Fort Lewis has 51 Defense Site Environmental Restoration Tracking System sites (Army 2005c).

Off-Post, the American Lake Gardens, located west of McChord AFB and north of Fort Lewis, was placed on the NPL in 1984. The groundwater at this site contained VOCs, which were believed to have come from former landfills at McChord AFB. A groundwater treatment plant has been in operation since 1993.

Fort Lewis is currently engaging in a master plan process for several subareas at the installation. ADPs for each neighborhood have been developed or are being drafted. These ADPs provide detailed information regarding contaminated sites within each area. This information is summarized in the following paragraphs.

The entire North Fort ADP area is an old World War I to pre-World War II artillery and mortar range and requires special awareness measures during construction. The MMRP site known as the former B Range encompasses all of the North Fort ADP area. Inert Stokes Mortars have been encountered during construction activities on North Fort Lewis that may be related to historic B Range usage (Van Hoesen 2009a). As a precautionary measure, the Fort Lewis MMRP has selected a land use control remedy to provide ordnance awareness during construction activities on North Fort. In addition, there is a landfill area to the south and southwest of the North Fort ADP area. Finally, several small IRP sites are located throughout North Fort (Urban Collaborative 2008f).

Very few IRP sites are located within the Historic Downtown ADP area. A drinking well restriction area and a voluntary cleanup site are located near the Historic Downtown ADP area, but do not affect the area. Arcs from ranges and explosives storage areas do not affect this area (Urban Collaborative 2008c).

The East Division ADP area has minimal environmental constraints, with an old munitions area located northeast of the site and several IRP sites located between the airfield and 2nd Division Drive. There are no dangers from explosives stored on or near the East Division ADP area (Urban Collaborative 2008a).

There are several concerns with past contamination in the Logistics Center ADP area. Underlying the whole area is a CERCLA site for contaminated groundwater (HDR Nakata Planning Group 2008a). The DRMO yard, by itself, has restrictions to prevent residential land use as does the old landfill site, number two. In addition, contaminated soils underlie the entire area.

The entire Madigan ADP area is an investigation site for the Logistics Center NPL plume of contaminated groundwater (Urban Collaborative 2008e). Monitoring wells are located in the area to assess the degree of contamination, if any. No new drinking water wells can be drilled in this area without EPA's approval. In addition, fill from over-excavation of the MAMC is located in the Madigan ADP area. Construction here will require investigation and possibly special measures to achieve a suitable soil substrate. The MAMC also has an emergency septic system located underground in a field west of the facility. Arcs from ranges and explosives storage areas do not affect this area.

The area to the north and east of the Old Madigan ADP area is an investigation site for the Logistics Center NPL plume of contaminated groundwater (Urban Collaborative 2008g). Monitoring wells are located in the area to assess the degree of contamination, if any. No drinking water wells may be placed within these areas. The estimated timeline for cleanup of the groundwater plume is 30 years or more. In addition, a CERCLA site is located over much of the western SOF compound. This is a former range that has been remediated and requires no further action. Arcs from ranges and explosives storage areas do not affect this area.

Most of the Jackson ADP area was once the site of the Evergreen firing range. However, all remediation in this area has been completed and the old environmental cleanup sites have been closed. Hence, the Jackson ADP area is not heavily constrained by environmental contaminants (Urban Collaborative 2008d). Two locations, however, have potential groundwater contamination: the area to the southwest that was the former landfill and the area to the north that is located near the Logistics Center ADP area. In both of these areas, drinking water wells are discouraged and require EPA's approval before installation. Arcs from ranges and explosives storage areas do not affect this area.

Most of the Hillside ADP area is an investigation site for the Logistics Center NPL plume of contaminated groundwater (Urban Collaborative 2008b). Monitoring wells are located in the area to assess the degree of contamination, if any. Hence, no drinking water wells may be planned in the Hillside ADP area. A practice grenade range was once located in the center of the Hillside ADP area. However, this area has been remediated and requires no further action. Finally, a former skeet range is located in the northwest corner. This area requires further action and cannot be developed. Arcs from ranges and explosives storage areas do not affect this area.

There are currently no IRP sites in the Miller Hill ADP area (HDR Nakata Planning Group 2008b). Some past lead contamination from the historic rifle ranges is present on the southern slopes of the hill itself and access is restricted. This site is designated and controlled under RCRA guidelines. A lead abatement project is underway, and any future development must consider this constraint.

3.13 AIRSPACE

The Federal Aviation Administration (FAA) is responsible for the control and use of navigable airspace in the U.S. The definition of airspace includes vertical and horizontal boundaries and time of use. In addition to airspace, the FAA manages the air navigation system, equipment, airports, and the rules and regulations relating to powered flight. The FAA is responsible for managing the airspace for commercial airliners and air carriers, general aviation, and government agencies, including the U.S. military.

The FAA has designated six classes of airspace. Airspace designated as Class A, B, C, D, or E is controlled airspace. Class G airspace is uncontrolled airspace. Within controlled airspace, air traffic control (ATC) service is provided to aircraft in accordance with the airspace classification (Class A, B, C, D, or E). Aircraft operators are also subject to certain pilot qualification, operating rules, and equipment requirements. Within uncontrolled airspace (Class G), no ATC service to aircraft is provided, other than possible traffic advisories when the ATC workload permits and radio communications can be established. Essentially, the controlled airspace system protects instrument flight rules (IFR) aircraft from visual flight rules (VFR) aircraft during instrument meteorological conditions and in near busy airports.

In addition to the classifications above, airspace may also be identified as special use airspace (SUA). This term refers to airspace defined for a particular purpose and for the benefit of a particular user, usually the military. Some military flight activities are not compatible with civilian uses of airspace, and some military activities potentially conflict with other uses of military airspace. Airspace restrictions are needed around military installations to ensure safety and to avoid possible conflicts of airspace use. SUA classifications are not mutually exclusive; for example, a Military Operations Area (MOA) can underlie a Restricted Area.

Restricted Areas and MOAs are two examples of SUA used around military installations. Restricted Areas are defined to exclude non-participating and incompatible aircraft without the permission of the controlling agency. Operations within Restricted Areas would normally include artillery firing, aerial gunnery and bombardment, and high-speed and density aerial operations.

The purpose of MOAs is to authorize and disclose military operations that exceed the speed limit of 250 knots that would ordinarily exist below 10,000 feet (3 km) mean sea level (MSL). Civilian aircraft operating under VFR may operate within MOAs without a clearance or communication requirement; in practice, however, these areas are often avoided by civilian traffic. ATC will not issue a clearance to IFR traffic that crosses an active MOA because it cannot provide separation. Instead, the civilian IFR traffic will be routed around the MOA.

Fort Lewis has 55 square miles of FAA-designated SUA that includes Restricted Areas and MOAs. Restricted Area R-6703 extends up to 14,000 feet (4 km) MSL. Fort Lewis has access to the airspace in area R-6703, Subareas A, B, and D from 0700 to 2300 daily Monday through Friday (FAA 2009). Subarea C is scheduled by Notice to Airmen (NOTAM). The primary purpose for Restricted Area R-6703 is live-fire training with artillery, mortars, small arms, helicopters, USAF aircraft, and demolitions (Army 2007e).

In addition to Restricted Area R-6703, Fort Lewis's SUA includes three MOAs: Rainier 1, Rainier 2, and Rainier 3. Roughly, these MOAs extend from Fort Lewis and Lacey south to Rainier, east to Yelm, and north to McChord AFB. They include airspace from 2,000 feet (0.6 km) MSL to 9,000 feet (2.7 km) MSL, excluding the airspace of R-6703A, B, C, and D.

The airfield at Fort Lewis, GAAF, consists of one runway (15/33) oriented on a northwest/southeast axis, associated taxiways, and ramp space to support military aircraft operations. The runway is 150 feet (46 m) wide by 6,125 feet (1,867 m) long. GAAF's control tower can support VFR and limited IFR operations 24 hours a day (Army 1994). Approximately 100 aircraft operate out of GAAF, including four fixed-wing aircraft and 34 small, 36 medium, and 30 large helicopters (Clayton 2009b).

GAAF supports the 4th Squadron 6th Air Cavalry, 4th Battalion 160th Special Operations Aviation Regiment, Washington Army National Guard, Army Reserve, medical units, and private aircraft activities. Most of the helicopter operations are conducted within the limits of the Post under VFR conditions. Limited fixed-wing activity also occurs at GAAF. Most of the fixed-wing aircraft supporting missions conducted at Fort Lewis involve troop transport missions or low-level flights over the various drop zones for airborne training (**Figure 2-2**). Although most of these fixed-wing aircraft missions originate out of McChord AFB, limited operation of fixed-wing aircraft also occurs at GAAF.

McChord AFB is approximately six nautical miles (11 km) northeast of GAAF. The airfield at McChord consists of two runways. The primary runway (16/34) is oriented on a northwest/southeast axis and is 150 feet (46 m) wide by 10,108 feet (3,080 m) long. Runway 160/340 also is oriented northwest/southeast and is 60 feet (18 m) wide by 3,000 feet (914 m) long. Runway 16/34 is capable of handling the largest aircraft in the Air Force or civilian fleets. The McChord AFB aircraft control tower also has VFR and IFR capability 24 hours a day (Army 1994).

3.14 FACILITIES

Army real property (facilities) includes land, facilities, and infrastructure. Land includes Army-owned lands (real estate), leaseholds, and other interests in land. Facilities encompass all aspects of facilities management. Facilities include buildings, structures, and other improvements and appurtenances to support the Army's mission, such as cantonment areas, training ranges, housing, schools, and recreational facilities. Infrastructure is the combination of supporting systems that enable the use of Army land and resident facilities, primarily utility infrastructure. Utility infrastructure includes electrical, gas, steam, water, wastewater, and stormwater, and communications serving the Army installations.

Many of the Army facilities are addressed in other sections of this document. Existing land uses and recreational facilities are described in **Section 3.9**. Roadways and other ground transportation infrastructure serving the Army installations are described in **Section 3.10**. Housing is described in **Section 3.11**. Solid waste and hazardous material/waste facilities are described in **Section 3.12**. Energy is addressed in **Section 3.15**.

The following resources also guide facilities management at Army installations:

- Fort Lewis Regulation 200–1, Environmental Quality: Environmental Protection and Enhancement;
- Fort Lewis Regulation 350–2, Training Support;
- Fort Lewis Regulation 350–30, Fort Lewis Range Regulations;
- AR 200–1, Environmental Quality: Environmental Protection and Enhancement;
- AR 210–20, Installations: Real Property Master Planning for Army Installations;
- AR 350–19, Training: The Army Sustainable Range Program;
- AR 420–1, Facilities Engineering: Army Facilities Management;
- AR 420–49, Utility Services;
- AR 420–90, Fire and Emergency Services;
- 43 United States Code (USC) 1701, et seq., as amended, Federal Land Policy and Management Act;
- TC 25–1, Training Land; and
- TC 25–8, Training Ranges.

RPMPs provide the framework for facilities management, including design and construction activities for land development on military installations. There are several components to the RPMP: the Long-Range Component (LRC), Capital Investment Strategy (CIS), and Short-Range Component (SRC). The LRC establishes goals and objectives for future development of the installation. The CIS and SRC are continuously evolving mechanisms for implementing the overall objectives of the LRC. The existing and programmed facilities within the 13 ADP areas are summarized in the following subsections.

3.14.1 Real Estate

The Fort Lewis boundary includes approximately 10,603 acres within the cantonment area and 75,573 acres of TAs (Army 2007d). The Fort Lewis ADPs provide detailed additional information regarding the availability of developable land for expansion of facilities within each area. This information is summarized in the following paragraphs.

3.14.1.1 North Fort ADP Area

The North Fort ADP area is not heavily constrained and developable land is available (Urban Collaborative 2008f). The area is flat with elevation changes occurring in the lands surrounding the developable area.

3.14.1.2 Historic Downtown ADP Area

Much of the Historic Downtown ADP area is already developed; however, there is land available for development. The Historic Downtown ADP identifies proposed sites for new facilities to accommodate growth of the installation.

3.14.1.3 East Division ADP Area

The East Division area is not heavily constrained by natural features or environmental or airfield restrictions. However, the area is completely developed with World War II-era wooden facilities that require replacement (Urban Collaborative 2008a). The existing facilities and functions housed in this

area can be relocated and moved to allow demolition and reconstruction of the area and consolidation of associated facilities.

3.14.1.4 Logistics Center ADP Area

The Logistics Center ADP area is primarily flat with a prominent knoll to the east and a slope into the Murray Creek drainage. Natural constraints to development within the Logistics Center ADP area include the wetlands located south of the Logistics Center and Murray Creek to the west. These natural constraints limit expansion availability in their relative areas (HDR Nakata Planning Group 2008a). Because contaminated soils underlie most of the Logistics Center area, residential development is restricted and continuation of the industrial use represents the best use for the area.

3.14.1.5 Old Madigan ADP Area

Within the Old Madigan ADP area, Fort Lewis has created a partnership with EQR/Lincoln through a privatized housing initiative. As part of that agreement, land is leased to EQR/Lincoln for use for housing. The Madigan neighborhood in this area is one of these leased areas (Urban Collaborative 2008g). Murray Creek geographically splits the Old Madigan ADP area into east and west sections. A land use control is in place east of the Madigan ADP area that restricts housing in locations where contamination has been found. Within this area, there is a former range that has been remediated and requires no further action. This site can be developed.

3.14.1.6 Jackson ADP Area

The developed portion of the Jackson ADP area is relatively flat; however, substantial hills are present in the wooded areas to the northwest and southeast. Development should be minimal in these areas. The Jackson ADP area is largely undeveloped and new construction options are largely unencumbered by existing facilities (Urban Collaborative 2008d).

3.14.1.7 Hillside ADP Area

The Hillside ADP area is relatively flat and a high-voltage power line currently runs both north to south and east to west through the center of the area. A maintenance easement is in place 50 feet (15 m) to each side of the center of this power line. Future development within the Hillside ADP area will be restricted within this easement (Urban Collaborative 2008b).

3.14.1.8 Miller Hill ADP Area

The Miller Hill area encompasses approximately 523 acres (212 ha), most of which remain undeveloped. Miller Hill rises approximately 150 feet (46 m) above the surrounding cantonment area (HDR Nakata Planning Group 2008b). Subarea A represents the wooded hill proper; Subarea B represents the developable area near the Stone Education Center; APZ 1 is a Subarea considered undevelopable because of its location within the airfield accident potential area.

3.14.1.9 Gray Army Airfield ADP Area

The GAAF area encompasses approximately 550 acres (220 ha), the vast majority of which is developed to support the airfield operations (HDR Nakata Planning Group 2008c). The area around GAAF is encompassed by more than 635,000 SF of airfield-related facilities (HDR Nakata Planning Group 2008c). Within the airfield itself, there are very limited opportunities for additional development. Immediately outside the airfield fence line; however, there are constraints imposed by the airfield are the clear zone and approach-departure surface which impose height restriction

requirements. Height restriction requirements emanate from the runway in all directions, affecting development in the airfield area and past the fence line, prohibiting development of multi-story facilities within the zone itself. To the south, there is little development as the Fort Lewis TAs are entered from this area. In accordance with the Airfield Master Plan, there is room to extend the runway 3,000 feet (914 m) to the south without affecting ranges, with the concurrent additional space for hangars and ramp parking.

3.14.1.10 Madigan ADP Area

Overall, the existing facilities in the area are in good condition and should remain in a long-term planning process. The ADP area has a substantial acreage of buildable land.

Constraints in the Madigan ADP area include wellhead protection areas, oak preserves, wetlands, and airfield criteria. In addition, no new drinking water wells may be drilled in the area, because it is an investigation site for an NPL plume of contaminated groundwater. An emergency trauma helipad exists on the MAMC site east of the Madigan ADP. The clear zones and imaginary surfaces associated with the helipad are situated in the east portion of the ADP. Any development in this area must account for these restrictions. In addition, a large site that contains fill from the over-excavation of the MAMC is located on the MAMC site. Construction in this area would require investigation and possible special measures to achieve a suitable soil substrate. MAMC also has an emergency septic system located underground in a field west of the facility.

3.14.1.11 3rd Brigade ADP Area

The 3rd Brigade ADP area includes residential, administrative, commercial, light industrial, and open space uses. Residential areas consist of barracks buildings and administrative buildings. Other support facilities include a fitness center, dining facility, chapel, light industrial warehouses, motor pools, maintenance buildings, and recreational facilities that include a fitness center and open space.

Few constraints exist in the 3rd Brigade ADP area (Urban Collaborative 2009c). These include an old landfill and IRP sites located throughout the area.

3.14.1.12 American Lake ADP Area

Land uses in the American Lake ADP area are primarily residential, surrounded by open space on or near the northwest and southwest shore of American Lake. ADP plan options provide housing to help meet the existing housing shortfall in addition to GTA housing needs. Key constraints in the American Lake area consist of wetland buffers (Urban Collaborative 2009a).

3.14.1.13 Greene Park ADP Area

The Greene Park ADP area is located north of I-5 and south of the North Fort ADP area. The Greene Park ADP area contains TA 2 and the Sequalitchew Lake Recreation Area. Sequalitchew Lake is used for training as well as recreational fishing. Planned facilities within the Greene Park area include replacement housing, travel camp improvements, and expansion to park areas. Key constraints in the Greene Park ADP area include a landfill, a high-tension power line, and historic buildings (Urban Collaborative 2009a).

3.14.2 Buildings and Structures

Fort Lewis has facilities within two primary locations: the cantonment area and the TAs. The following subsections summarize the existing and planned facilities for both the cantonment area and the TAs.

3.14.2.1 Cantonment Area

The cantonment area serves as the support center for activities at Fort Lewis, other than field training. The cantonment area supports residential, administrative, commercial, and industrial activities, as well as GAAF and the MAMC. The cantonment area contains the PX, Commissary, services, a mini-mall, fast food restaurants, a welcome center, the library, and other facilities. The GAAF presently supports the Washington Army National Guard, Army Reserve, medical units, and private aircraft activities. The aircraft at GAAF include both fixed- and rotary-winged aircraft.

In FY 2008, there was approximately 18.1 million square feet of building space at Fort Lewis (Waehling 2009). There are approximately 4,400 buildings on Fort Lewis, about one-half of which are used for housing (Army 2007e). Family housing and barracks, which are located in the cantonment area, consist of units of varying ages and states of repair. Approximately 5,500 to 6,000 Soldiers are currently accommodated in the barracks. Fort Lewis has a projected housing deficit of approximately 2,000 units (Urban Collaborative 2008b).

The cantonment area contains five elementary schools; the age and condition of these schools is summarized on **Table 3–14**. The ‘Condition of Permanent Building’ rating reflects the results of a Building Condition Evaluation performed for the State of Washington’s Department of Education. The evaluation considers a building’s exterior, interior, mechanical systems, and safety; graded on a scale of 0 to 100, lower numbers indicate better building conditions.

Table 3–14 Schools in the Fort Lewis Cantonment Area

School	Year Built	Capacity	Significant Infrastructure Improvements (year)	Condition of Permanent Building ¹
Beachwood	1962	383	New classroom pods, library, playshed (1985 and 1989)	73.94
Clarkmoor	1956	248	Library, playshed (1985)	68.72
Evergreen	1991	763	None	60.50
Greenwood	1951	327	Classroom addition (1960); library and playshed (1985)	88.50
Hillside	1959	455	New classroom pods (1961 and 1985); library and playshed (1985)	85.96

Note:

1. Condition is graded on a scale of 0 to 100. Lower numbers indicate better building conditions.

Source: Lunde 2010.

The Fort Lewis ADPs provide detailed information regarding the currently planned and programmed facilities, as well as the facilities that are required but have not yet been programmed within each area. This information is summarized in **Section 2.2.5**.

3.14.2.2 Training Areas

The Fort Lewis TAs cover approximately 75,570 acres (30,600 ha) (Army 2007e) and consist of ranges, impact areas, drop zones, tank trails, and maneuver areas. The TAs are used 325 days per year to support military training.

The TAs at Fort Lewis include direct and indirect fire ranges support weapons qualification, artillery and mortar firing, and other live fire training requirements. In addition, TAs at Fort Lewis include ammunition storage areas, urban combat areas, drop zones, landing strips, and amphibious training sites. TAs are currently available at Fort Lewis for off-road vehicle movement, wheeled vehicle movement, gunnery practice, digging (tank ditches, vehicle positions, and foxholes), unit assembly areas, and unit deployment exercises. There are 80 firing ranges that support weapons qualification training activities; these ranges are located in four impact areas on the installation (Army 2005c).

3.14.3 Infrastructure

In 2007, an infrastructure system analysis was performed for Fort Lewis. The following subsections summarize the information on infrastructure from this analysis.

3.14.3.1 Water Supply

The Fort Lewis water system is classified as a Group A system, which is defined as a water system with 15 or more connections or 25 or more people per day for 60 or more days per year (John Gallup and Associates and AMEC Earth and Environmental Inc. [JGA and AMEC] 2007). The entire system is owned and operated by the Army.

A WaterCAD model was developed with scenarios for average day and maximum day, attempting to maintain the system pressures between 20 and 100 pounds per square inch (psi) along with velocities under 10 feet (3 m) per second. A fire flow analysis was also included to determine locations of concern. Because of the number of water tanks around the installation, there were three different iterations of each scenario all with different initial depth settings for the tanks, including: 1) tanks full, 2) tanks empty, 3) tanks at an average level that was determined by executing an extended day scenario, and 4) determining the depths of the tanks when they converged. It was determined that the system was unable to function with the tanks empty. Negative pressures were produced for all scenarios.

According to installation personnel, there were pressure issues in the area east of the airfield also known as the East Division Area. This was not supported by the model, but could be caused by closed valves or damaged pipes not considered by the model. The model indicated several areas that were not adequately looped to the system. The two major areas include North Fort and Davis Hill. There were also many cases of dead-end water mains that did not loop back to the system. These dead ends cause pressure issues throughout the system. The fire flow analysis determined that the system performs well with stresses at different locations within the system. There is little change in the system from average day to maximum day to fire flows. The low pressures and high velocities observed are a result of the dead ends and lack of supply loops to major areas in the system. The area of greatest concern is located proximal to fire flow analysis around junctions J-422 and J-269. This area includes Veterans Administration Hospital located to the northeast of North Fort and is supplied by an 8-inch water main with a demand of more than 150,000 gallons per day (gpd) (568,000 L per day).

Recommendations for the existing system include:

- replacing all the old and outdated pipe,
- looping dead ends within the system to help with available fire flows,
- performing normal updates and maintenance to the existing water storage facilities,
- replacing all fire hydrants to standardize the type and manufacturers of the various fire hydrants, and
- adding additional on-site water storage to meet the required demands.

3.14.3.2 Wastewater Treatment Systems

The sanitary sewer collection system at Fort Lewis comprises 47 miles of gravity sewers ranging in size from 4 to 30 inches (10 centimeters [cm] to 76 cm) in diameter (JGA and AMEC 2007). The portions of the sewer system east of GAAF include lift stations and approximately 6,300 feet (1,900 m) of force mains that range in diameter from 4 to 16 inches (10 cm to 41 cm). During recent years, new construction on North Fort has replaced a significant amount of older sewer trunk lines in that area. At present, the sanitary sewer system is divided into seven basins, A through F. Basins A through D are predominately on the Main Post and include the MAMC and the Logistics Center Area. Basins E and F are on North Fort and include the Beachwood Housing area. Historically, the system has been plagued with infiltration from groundwater and possibly some inflow from cross connections to the stormwater system. Flows fluctuate from approximately 2.2 mgd (8.3 million L per day) in the summer/dry season to 6 mgd (22.7 million L per day) in the winter/wet season (JGA and AMEC 2007).

The estimated flows for the sanitary sewer system at Fort Lewis were less than the pipe capacities (JGA and AMEC 2007). The sanitary sewer system at Fort Lewis was analyzed for future loading conditions using the same methodology as for existing loading conditions. Pipe segments with negative slopes identified as problems under existing loading conditions are anticipated to be problematic under future loading conditions.

Analysis of the existing wastewater loading at Fort Lewis identified several deficiencies with the existing sanitary sewer collection system. Most of the deficiencies were due to pipes set at negative slopes, according to the invert elevations provided. Analysis of Fort Lewis's sanitary sewer system for future loading conditions resulted in six potential problem areas, in addition to the problems identified under the existing loading conditions. The following three categories of improvements are recommended for the sanitary sewer system at Fort Lewis: 1) replacement of vitrified clay pipes, 2) improvements to resolve existing capacity problems, and 3) upgrades required for the future loading conditions (JGA and AMEC 2007). Before implementing capital improvements, a detailed master plan should be completed for the sanitary sewer system at Fort Lewis.

The Army discharges treated wastewater from the Solo Point WWTP to Puget Sound under its EPA NPDES permit. Over the 2004-to-2009 period of the previous permit, the Army exceeded the permit treatment requirements six times (EPA 2009c). The Solo Point treatment plant has sufficient hydraulic design capacity to handle demand. Given the past performance of the facility, however, it is expected that discharges will violate permit treatment requirements more frequently in the future as demand increases. Increased demand combined with more stringent requirements that EPA has identified for discharges under future NPDES permits will render the Solo Point WWTP insufficiently protective of Puget Sound water quality.

3.14.3.3 Stormwater Management

Fort Lewis is located adjacent to Puget Sound, with all stormwater draining toward Puget Sound via American Lake or Sequelitchew Lake. Several existing pipes and culverts currently appear to be undersized (JGA and AMEC 2007).

3.14.3.4 Telecommunications

The telephone system at Fort Lewis is government owned and is maintained by the 1115th Signal Battalion. Qwest provides outside telephone service to the Fort Lewis system. Communications facilities are divided into four major areas on the installation: the Main Post, North Fort, the TAs, and the MAMC. There are approximately 160 miles (260 km) of aerial cable and 34 miles (55 km) of

underground cable in the four areas. System improvements in the North Fort subsystem are planned in conjunction with programmed construction in that area.

3.15 ENERGY DEMAND/GENERATION

Energy consumption is perhaps the major infrastructure and budgetary challenge to the Army. Increased energy costs created an Army utility budget shortfall of \$93 million for FY 2001 and were estimated to require an additional \$218 million for FY 2002 through 2007. Increased energy costs are non-discretionary, which forces garrison commanders to take funds from other accounts to pay for utilities, placing other mission areas at risk. The Army developed an Energy Strategy for Installations to address the rising costs of energy and increased risk to other mission areas. This strategy is based on five major initiatives:

- eliminate energy waste in existing facilities;
- increase energy efficiency in renovation and new construction;
- reduce dependence on fossil fuels;
- conserve water resources; and
- improve energy security (Army 2005e).

Implementation of these initiatives will improve the working, training, and living environment at Army installations and save critical resources that can be used to support other Army missions, such as training and force deployment. The ROI for energy demand and infrastructure is defined as the service areas for the service providers.

In FY 2008, the combined total annual energy cost for Fort Lewis and YTC exceeded \$22 million (Waehling 2009). The following paragraphs describe Fort Lewis's ongoing energy saving programs and plans summarized from the report entitled "Sustainable Fort Lewis, 2007 Annual Progress Report" (Army 2008a).

In 2004, Fort Lewis purchased 12,000 megawatt hours (MWH) of energy from renewable energy sources, approximately 5 percent of the installation's energy needs. In 2007, Fort Lewis purchased 21 percent of its electrical needs from renewable sources. Under contract with the Western Area Power Administration, Fort Lewis will purchase the equivalent of 52,364 MWH of renewable energy certificates annually through 2010.

In 2007, Fort Lewis partnered with Bonneville Power Administration (BPA) to execute a Utility Energy Savings Contract (UESC) for energy savings in structures on the installation. The first of several energy savings projects is underway and consists of upgrades to lighting, building insulation, and heating, ventilating, and air conditioning (HVAC) control systems that will result in more than \$5 million worth of energy savings within the first 3 years.

An Energy Engineering Analysis Program (EEAP) audit was conducted at Fort Lewis, McChord AFB, and YTC in August 2007. The final report is still in process.

The Army plans to construct all new facilities to meet the silver level in the Leadership in Energy and Environmental Design (LEED) ratings system, which is used by the U.S. Green Building Council, beginning with the FY 2008 military construction program (Army 2007h). LEED is a voluntary, consensus-based national standard for developing high-performance buildings, including water savings and energy efficiency.

3.15.1 Electricity

The electrical distribution system at Fort Lewis is supplied by Tacoma Power and consists of four substations located around the Post, each of which is fed from a 115-kilovolt (kV) pole line and collectively contain five 20-megavolt-ampere (mVA) transformers (JGA and AMEC 2007).

Each transformer is connected to secondary switchgear owned by Fort Lewis, which provides electrical service to the Post via 13.8kV overhead and underground distribution circuits. Based on utility billing information, peak demand for the installation was in January 2007 and was 39.4 megawatt (MW) or 41.1mVA (JGA and AMEC 2007). For FY 2008, 818,549 million British thermal units (MBTUs) of electricity were required at Fort Lewis (Waehling 2009).

Evaluation of the proposed project list indicates approximately 34.1 mVA of new connected load will be added. To accommodate the additional loads, the following electrical distribution system changes are required:

- new overhead or underground distribution circuits for the additional loads north of I-5; and
- improvements, as needed, to existing Post distribution circuits to handle proposed project load increases.

Based on the evaluation of the proposed project list, the following electrical distribution system changes are recommended to improve the electrical system reliability, flexibility, and future capability:

- New transformer, secondary feeder breakers, and bus tiebreaker at the Sequelitchew substation located north of I-5.

3.15.2 Natural Gas and Fuel Oil

Fort Lewis uses natural gas as its primary heat source. Natural gas is provided by Puget Sound Energy (PSE). PSE currently owns the major gas pipelines on the installation. Fuel oil is used as a backup when gas supplies are turned off, and is purchased by contract (Army 2008a). The total quantity of natural gas consumed on Fort Lewis in 2008 was 1,145,684 MBTUs (Waehling 2009).

No existing gas piping deficiencies have been identified (JGA and AMEC 2007). The existing main gas supply is sufficient to accommodate the gas requirements for all currently planned projects.

Any major expansion of the gas pipe system will require the involvement and design work of PSE. The cost of this additional work will be determined and be a part of a new gas supply contract. The following items must be considered for any potential future gas system modifications:

- New gas lines are expected to be hot-tapped to the existing lines in various places. Only experienced companies will be considered for hot tapping due to the critical nature of such approach.
- Lines will be pressure tested and all leaks will be fixed immediately.
- All underground steel gas piping will have cathodic protection.
- All aboveground steel gas piping will be insulated and heat traced.

3.15.3 Steam

The central steam for Fort Lewis is supplied by Building 3292 and is the major steam plant at Fort Lewis (JGA and AMEC 2007). This building also has hot water boilers to supply the north part of the East Division Area barracks.

According to installation personnel, the central boiler heating plant has spare heating capacity. AMEC requested additional information to quantify the excess capacity; however, the required information was not provided. Because of the low cost of electrical energy, it is currently recommended that new central heating steam plants are not part of the future energy plans as noted in the “Fort Lewis Energy Sustainability Roadmap” May 2004 (JGA and AMEC 2007). Fort Lewis used 117,013 MBTUs of steam in FY 2008 (Waehling 2009).