EXECUTIVE SUMMARY

This Engineering Evaluation/Cost Analysis (EE/CA) for the East Gate Disposal Yard (EGDY) and Logistics Center site (Site) at Fort Lewis, Washington, has been prepared for the Seattle District U.S. Army Corps of Engineers (USACE) by URS Greiner Woodward Clyde under Contract No. DACA67-95-D1001, Delivery Order No. 23, Modification No. 4. This EE/CA is being prepared in part as a response to the 1998 Explanation of Significant Difference (ESD) regarding the unconfined (upper) aquifer. An evaluation of potential remedial alternatives for contamination in the lower aquifer is not being conducted at this time due to insufficient characterization of the lower aquifer. The purpose of the EE/CA is to provide guidance on the direction of the development of remediation efforts at the Site and to assist in long-term program costing. As such, the EE/CA should be updated, as necessary, because developments in the understanding of Site conditions or the status of innovative technology development may significantly impact the cost analysis such that decisions on remediation approach and/or allocation of funding would be affected.

The overall objectives of this document are to develop and evaluate remedial alternatives to accelerate cleanup of the upper aquifer and enable potential shutdown of the existing groundwater pump-and-treat systems at EGDY and the Logistics Center within a reasonable timeframe, in lieu of operating and maintaining the systems for an indeterminate, long time for hydraulic containment of the groundwater contaminant plume. More specifically, the EE/CA includes the evaluation of innovative technologies to remove, remediate, and/or control contamination in the vadose zone and upper aquifer at EGDY, which has been identified as the primary continuous source of groundwater contamination. The EE/CA also addresses innovative technologies to accelerate cleanup and/or control of the groundwater contaminant plume. Remediation of the lower aquifer is not part of the scope of work of this EE/CA.

A conceptual site model (CSM) is a schematic representation that shows chemical sources, chemical transport mechanisms, environmental transport media, and affected media. The CSM for the Site is divided into two areas: (1) the source area (EGDY), where NAPL has been detected, and (2) the downgradient area (Logistics Center), which includes a groundwater contaminant plume approximately 2 miles long and 1 mile wide. The primary sources of chemical release at the Site are light nonaqueous-phase liquid (LNAPL) petroleum, oils, and lubricants (POL) and dense nonaqueous-phase liquid (DNAPL) trichloroethene (TCE) generated from equipment cleaning and degreasing activities conducted at Fort Lewis. NAPL, drums containing NAPL, and debris were disposed of in trenches and pits in EGDY. Accumulations of NAPL and product in drums and the subsurface in EGDY represent the major current and future sources of contamination to groundwater at the Site. The contaminant groundwater plume includes both the upper and lower aquifers. Contamination in the lower aquifer may be due to permeable “window(s)” and discontinuities in the aquitard in EGDY and downgradient of

EGDY. The extent of contamination in the lower aquifer and pathways of contamination from the upper to the lower aquifer have not been adequately characterized. Physical and biological natural attenuation processes act to lower dissolved contaminant concentrations, but are not sufficient to achieve the maximum contaminant level (MCL) of 5 µg/L. Given the current concentrations of TCE in the groundwater and the presence of NAPL in the source area, natural attenuation alone cannot be considered a remedy. The solubility of TCE in groundwater in contact with DNAPL exceeds the attenuation ability of the system. DCE in the form of 1,2-cis-DCE may have been disposed of with TCE or may be a degradation product of TCE.

The preliminary remedial action objective (RAO) developed for the EE/CA is to remediate groundwater at the Site to achieve concentrations of contaminants that are below cleanup criteria at the Site.

Remedial options were initially screened for effectiveness and implementability for the source area and downgradient area. In most cases, effectiveness and implementability provided sufficient rationale for screening to provide a reasonable number of remediation process options without consideration of cost. Because several vertical barrier options and NAPL mobilization/dissolution options were retained for further evaluation, a second phase of evaluation including financial considerations was conducted to select a representative remedial process option to develop into alternatives and evaluate in detail. The five alternatives, including a "no additional action" alternative, are presented in Table ES-1. They were assembled to represent a sufficient range of process options for the different media and remediation timeframes.

The conceptual designs of the five alternatives were then developed sufficiently to provide for a comparative evaluation and selection of alternatives based on the following criteria: technical feasibility, implementability, compliance issues and other institutional considerations, effectiveness, and cost. Based on this evaluation, Alternative 2 (Optimize [40 years] both groundwater pump-and-treat systems; remove drums; and treat hotspots by electrical resistance soil heating) is selected as the preferred alternative for the following reasons:

- Relatively effective groundwater pump-and-treat systems exist at the Site.
- Alternative 2 would utilize the current systems that already have invested capital and institute hotspot removal and treatment.
- Alternative 2 would be the most cost-effective approach evaluated, even in comparison to Alternative 1, which continues current system operations. Total estimated capital and operation and maintenance costs escalated for a 2.5 percent average annual inflation in descending order are Alternative 2 ($52 million),

Alternative 3 ($90 million), Alternative 1 ($200 million), Alternative 4 ($280 million), and Alternative 5 ($320 million).

- Alternative 2 would remove the largest mass of contaminant for the least cost.
- Use of an iron particle wall and bioremediation would require further development and "proof" of long-term effectiveness and potential cost-benefit prior to implementation.

The recommendation of Alternative 2 is made on the current knowledge of Site conditions and the current state of technology development. Many assumptions were made in order to develop the cost estimates. Further focused field investigations would be needed prior to implementation of the alternative or components of the alternative selected for implementation by the Army and the U.S. Environmental Protection Agency. The EE/CA should be revisited, as necessary, to evaluate potential cost impacts based on new information that may be obtained from further focused site investigations and/or innovative technology development that would affect decisions in implementation of an alternative. Nonetheless, an obvious first step is source removal while additional cost and performance data on innovative technologies for treatment of dissolved-phase contamination are made available.

Table ES-1
Alternatives for East Gate Disposal Yard and Logistics Center

Alternative	Description
Alternative 1: Continue O&M of both GW P&T systems	• Continue I-5 and EGDY P&T systems (100 yrs) • Maintain regulatory notifications (100+ yrs) • Continue environmental monitoring (100+ yrs)
Alternative 2: Optimize (40 yrs) both GW P&T systems; remove drums; treat hotspots by ERSH	• Dispose of drums using conventional excavation methods • Incinerate drums, NAPL, and incidental hotspot soils off site • ERSH for hotspot NAPL removal/recovery (1 yr) • Optimize existing I-5 and EGDY P&T systems (40 yrs) • Natural attenuation of groundwater after 40 yrs (10 yrs) • Institute access restrictions/maintain notifications (50 yrs) • Environmental monitoring (50 yrs)
Alternative 3: Optimize then discontinue I-5 (40 yrs) and EGDY (5 yrs) GW P&T systems; remove drums; treat hotspots by ERSH; contain source area by IPW	• Dispose of drums using conventional excavation methods • Incinerate drums, NAPL, and incidental hotspot soils off site • ERSH for hotspot NAPL removal/recovery (1 yr) • Optimize operation of EGDY P&T system (5 yrs), then shut down • Contain source area by IPW (40 yrs) • Optimize existing I-5 P&T system (40 yrs), then shut down • Natural attenuation of groundwater after 40 yrs (10 yrs) • Institute access restrictions/maintain notifications (50 yrs) • Environmental monitoring (50 yrs)
Alternative 4: Optimize (5 yrs) then discontinue EGDY GW P&T system; discontinue I-5 GW P&T system; remove drums; treat hotspots by ERSH; contain source and downgradient areas by IPW	• Dispose of drums using conventional excavation methods • Incinerate drums, NAPL, and incidental hotspot soils off site • ERSH for hotspot NAPL removal/recovery (1 yr) • Optimize operation of EGDY P&T system (5 yrs), then shut down • Shut down existing I-5 P&T system • Contain source area by IPW (40 yrs) • Contain downgradient area by IPW (40 yrs) • Natural attenuation of groundwater after 40 yrs (10 yrs) • Institute access restrictions/maintain notifications (50 yrs) • Environmental monitoring (50 yrs)
Alternative 5: Optimize (10 yrs) then discontinue both GW P&T systems; remove drums; treat source area by ERSH; bioremediate GW in source and downgradient areas	• Dispose of drums using conventional excavation methods • Dispose of drums, NAPL, and incidental hotspot soils off site • ERSH for hotspot NAPL removal/recovery (3 yrs) • Optimize operation of EGDY and I-5 P&T systems (10 yrs), then shut down • GW bioremediation in source area (7 yrs) and downgradient area (10 yrs) • Natural attenuation of groundwater after 10 yrs (10 yrs) • Institute access restrictions/maintain notifications (20 yrs) • Environmental monitoring (20 yrs)

Notes:
EGDY - East Gate Disposal Yard
ERSH - electrical resistance soil heating
GW - groundwater
I-5 - Interstate Highway 5
IPW - iron particle wall
NAPL - nonaqueous-phase liquid
O&M - operation and maintenance
P&T - pump and treat