The Oeser Company Superfund Site
Feasibility Study Report
Bellingham, Washington
TDD: 01-03-0016

Contract: 68-S0-01-01
August 2002

Region 10

START-2

Superfund Technical Assessment and Response Team

Submitted to: Loren McPhillips, Remedial Project Manager
United States Environmental Protection Agency
1200 Sixth Avenue
Seattle, Washington 98101

THE OESER COMPANY SUPERFUND SITE
FEASIBILITY STUDY REPORT
BELLINGHAM, WASHINGTON

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LIST OF ACRONYMS

Acronym	Definition
APC	air pollution control
ARARs	applicable or relevant and appropriate requirements
B(a)P	benzo(a)pyrene
bgs	below ground surface
BTC	Bellingham Technical College
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COCs	contaminants of concern
COPCs	contaminants of potential concern
cPAHs	carcinogenic polynuclear aromatic hydrocarbons
CULs	cleanup levels
DLs	detection limits
DOT	United States Department of Transportation
DW	Dangerous Waste
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
ERA	ecological risk assessment
ETA	East Treatment Area
FS	feasibility study
GAC	granulated activated carbon
HCl	hydrochloric acid
HHRA	human health risk assessment
HIs	hazard indices
HQs	hazard quotients
LDRs	land disposal restrictions
LNAPL	light nonaqueous phase liquid
LOAEL	low observed adverse effect level
MTCA	Model Toxics Control Act
NAPL	nonaqueous phase liquid
NCP	National Oil and Hazardous Substances Pollution Contingency Plan

LIST OF ACRONYMS (CONTINUED)

Acronym	Definition
NOAEL	no observed adverse effect level
NPDES	National Pollutant Discharge Elimination System
NPY	North Pole Yard
NTA	North Treatment Area
NWAPA	Northwest Air Pollution Authority
O&M	operation and maintenance
OCDD	octachlorodibenzo-p-dioxin
Oeser	The Oeser Company Superfund site
PAHs	polynuclear aromatic hydrocarbons
PCP	pentachlorophenol
pg/L	picograms per liter
RAOs	remedial action objectives
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
SO_2	sulfur dioxide
SPY	South Pole Yard
SVOCs	semivolatile organic compounds
TCDD	tetrachlorodibenzo-p-dioxin
TEQ	toxicity equivalent quotient
TPA	Treated Pole Area
TPH	total petroleum hydrocarbon
TSD	treatment, storage, and disposal
VOCs	volatile organic compounds
WSA	Wood Storage Area
WTA	West Treatment Area

EXECUTIVE SUMMARY

This feasibility study (FS) report describes the development and evaluation of remedial action alternatives for affected soil and groundwater at The Oeser Company Superfund site (Oeser) in Bellingham, Washington. The FS was conducted according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP; Title 40, CFR, Section 300.430) and United States Environmental Protection Agency (EPA) guidance (EPA 1988). As part of the FS process, remedial technologies appropriate for use at Oeser were screened then alternatives were developed and analyzed in detail against the site-specific remedial action objectives (RAOs) and criteria in the NCP. The following are the alternatives developed for Oeser:

- Alternative 1 - No Action
- Alternative 2 - Capping
- Alternative 3 - Soil Excavation
- Alternative 4 - Capping and Ex-Situ Groundwater Treatment
- Alternative 5 - Ex-Situ Soil and Groundwater Treatment

Under Alternative 1, no further remedial activities would be conducted. Alternative 2 would include installation of a cap over areas with contaminated soil exceeding the cleanup levels (CULs). Alternative 3 would include excavation and off-site disposal of all contaminated soil exceeding the CULs. Alternative 4 would include all the elements of Alternative 2, as well as extraction and treatment of shallow groundwater. Alternative 5 would include excavation and on-site treatment of contaminated soil exceeding the CULs and ex-situ treatment of shallow groundwater. Each alternative except Alternative 1 would include institutional controls consisting of groundwater pumping restrictions onsite in the deep zone, future use restrictions, operation and maintenance (O&M) requirements, and long-term groundwater monitoring.

A comparative analysis of the alternatives was conducted using the NCP criteria. Alternatives 2 through 5 would achieve the RAOs while Alternative 1 would not. Each alternative, except Alternative 1, would meet the NCP threshold criteria of overall protection of human health and the environment and compliance with applicable or relevant and appropriate requirements (ARARs). The comparative analysis of alternatives relative to the NCP primary balancing criteria is as follows:

- Short-term effectiveness associated with implementation of the alternatives is highest for Alternative 2, followed by Alternative 4, Alternative 3, Alternative 5, then Alternative 1.
- Long-term effectiveness and permanence are highest for Alternative 3 followed by Alternative 5, Alternative 4, Alternative 2, then Alternative 1.
- Reduction of toxicity, mobility, or volume through treatment is highest for Alternative 5 followed by Alternative 4, Alternative 2, Alternative 3, then Alternative 1.
- Implementability is highest for Alternative 1 followed by Alternative 2, Alternative 4, Alternative 3, then Alternative 5.
- Cost, as measured by total net present worth, is highest for Alternative 3 followed by Alternative 5, Alternative 4, Alternative 2, then Alternative 1.

The final two NCP criteria, state acceptance and community acceptance, are not evaluated formally until after the FS is complete and distributed for agency and public review.

1. INTRODUCTION

1.1 PURPOSE AND ORGANIZATION OF REPORT

The remedial investigation (RI)/FS process uses the methods that the Superfund program has established to characterize the nature and extent of risks posed by the release of hazardous substances into the environment and to evaluate remedial actions. In the RI component, data are collected to characterize site conditions including the nature and extent of contamination, and to assess the risks to human health and the environment. In the FS component, potential remedial actions are developed, screened, and evaluated to enumerate the actions most appropriate for the site.

The Oeser Company Superfund site FS has been conducted in accordance with the EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*, which outlines a dynamic process tailored to site-specific conditions and circumstances. Information gathered during the RI was used to guide the FS. The language and terms used in this report are consistent with those used in the guidance document. Remedial technologies or technology types are used to represent general categories of remedial actions. Process options are subsets of technology types and represent variants within each technology type. Technology types and process options are evaluated and screened as part of the FS process; those technology types that pass the screening are assembled into remedial alternatives that will satisfy the RAOs identified for the site.

This document consists of the following sections:

- **Section 1** contains background information about the site and includes a description of the site, its history, the nature and extent of contamination, the fate and transport of contaminants, and the baseline risk assessment summary.
- **Section 2** identifies the RAOs and general response actions for the site and identifies/screens technologies appropriate to the general response actions.
- **Section 3** describes the combining of technologies that passed the screening described in Section 2 into alternatives for site remediation. This section reports on the evaluation of the alternatives on the basis of effectiveness, implementability, and cost.
- **Section 4** presents the detailed evaluation and comparison of the alternatives that passed the screening described in Section 3. The alternatives are evaluated for: overall protection of human health and the environment; compliance with ARARs; long-term

effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost.

- **Section 5** provides references used in the preparation of this document.
- A discussion of proposed CULs, ARARs, and cost estimates and the assumptions used to develop the cost estimates are provided in Appendices A, B, and C, respectively.

1.2 BACKGROUND INFORMATION

This subsection provides a general site description and summary of facility operations of The Oeser Company (formerly known as the Oeser Cedar Company) facility. In addition, the nature and extent of contamination, contaminant fate and transport, and results of the baseline risk assessment also are summarized.

The topographic setting of the site is presented in Figure 1-1. The RI study area, which includes the site and background areas, is shown in Figure 1-2. Facility and off-facility areas of the site are shown in Figure 1-3. Figure 1-4 presents an aerial view of The Oeser Company facility and nearby areas. Figure 1-5 depicts the general operational areas of the facility. Figure 1-6 shows land use designations of the facility and the surrounding areas.

1.2.1 Site Description

The Oeser Company facility is an active wood treating plant located at 730 Marine Drive (formerly Marietta Road), in Whatcom County, Washington; a portion of the facility lies within the City of Bellingham. The facility comprises approximately 26 acres in the southwest quarter of Section 23, Township 38N, Range 2E of the Willamette Meridian, at 48°46'13" N latitude and 122°30'52" W longitude (Figure 1-3).

The facility receives raw logs which are stored in the Wood Storage Area (WSA)along the eastern portion of the site. The raw logs are then peeled, incised for certain clients, and transferred to the North or South Pole yards to dry (Figures 1-4 and 1-5). After drying for approximately 1 year, the logs are treated with a 5% pentachlorophenol (PCP) solution in a diesel-like carrier oil. After treatment, the poles are dried and stored in the Treated Pole Area (TPA) prior to inspection and shipment to customers. The paved wood treatment area covers an estimated 5.6 acres in the east-central portion of the facility. To be consistent with previous reports, the treatment area has been divided into three sections: the North Treatment Area (NTA), the West Treatment Area (WTA), and the East Treatment Area (ETA; Figure 1-5). The treatment areas comprise an array of aboveground tanks, retorts, drip pads, and underground piping. The pole storage areas and the WSA are not paved.

As an active wood treating facility, The Oeser Company is subject to a number of regulatory requirements, including but not limited to, the Resource Conservation and Recovery Act (RCRA) and the Clean Water Act. Among the RCRA regulations that apply to the facility is the requirement to have a permit unless the owner/operator of the facility holds treated wood on a drip pad until the wood creases dripping and immediately (within 24 or 72 hours) cleans up all incidental and infrequent drippage that occurs after the treated wood has been moved to the storage yard. The EPA has issued a notice of violation to The Oeser Company regarding its failure to comply with the RCRA requirements. In addition, an owner/operator that disposes of hazardous waste at its facility is required to perform corrective action and complete closure in compliance with the RCRA. These regulatory requirements apply to The Oeser Company, notwithstanding any proposed or final cleanup action under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

1.2.1.1 Land Use

The Oeser Company's facility is surrounded by a mixture of land uses, including other industrial operations and residential units (Figure 1-7). Immediately adjacent to the north boundary of the facility is the Birchwood neighborhood of Bellingham. Birchwood is characterized by low-density (two to four units per acre), single-family residential units, with large, long, narrow lots divided evenly between mature landscaping and open fields.

The eastern boundary of the facility is located adjacent to Morse Industrial Park (occupied by Morse Hardware Company, Inc.) and undeveloped property owned by the Washington State Board for Community and Technical Colleges.

The south boundary abuts a Burlington Northern and Sante Fe Railway line. To the south of the railroad are homes, additional industrial businesses, and undeveloped open space. Little Squalicum Creek flows along the southeast border of the open space. An old railroad grade, currently used as a walking trail, exists along the creek's west bank. Approximately 700 to 800 feet from the southern property boundary and across Marine Drive lies the Seaview Subdivision, composed of single-family residential units, many with views of Bellingham Bay.

Adjacent to the west boundary are additional heavy industrial facilities, including steel fabrication and fiberglass manufacturing facilities, warehouses, electrical and repair shops, storage facilities, and some vacant parcels and homes. The Tilbury Cement Company (formerly the Columbia Cement Company) is located farther to the west, on the opposite side of Marine Drive. The cement company has operated at this location since 1911; its property boundaries extend to Bellingham Bay.

1.2.1.2 Little Squalicum Creek

Little Squalicum Creek and approximately 30 feet on either side of the stream bed are located entirely within Whatcom County and are zoned as recreational open space, just north and west of the City of Bellingham. The creek is located at the base of a ravine with steep sides and a level bottom. The ravine runs west-northwest for about 550 feet, then doglegs to the southwest for about 700 feet, goes south-southwest for about 950 feet beneath the Marine Drive bridge, and ends at a narrow beach on Bellingham Bay (Figure 1-8). Whatcom County owns approximately 200 linear feet of shoreline in this area. The Tilbury Cement Company and the City of Bellingham Parks and Recreation Department each own narrow parcels approximately 50 feet wide between Marine Drive and the railroad along the shoreline. These parcels define the narrow, flatter slope at the base of the ravine that broadens north of Marine Drive. This broader slope area southeast of Little Squalicum Creek, both above and below Marine Drive, is owned by Whatcom County. The footpath/old rail bed west of the creek is owned by the Tilbury Cement Company (URS 1994; EPA 1997a). The City of Bellingham is negotiating purchase of an approximately 3-acre parcel located immediately south of the railroad right-of-way, along the south side of The Oeser Company, and west of the foot path (Wahl 1998a).

The ravine is bounded on the south and east by the bay, residential-multiple, residential-single, and public (Bellingham Technical College [BTC]) developed lands. The head of the ravine is bounded on the north by an undeveloped light impact industrial area. At the point where the ravine doglegs, the area is zoned heavy impact industrial (Morse Industrial Park) and is occupied by a warehouse owned by Morse Hardware Company, Inc. The area northwest of the ravine to the Marine Drive bridge is mostly undeveloped, but zoned as light impact industrial. This area is referred to as the South Slope in this report (Figure 1-8). The area south and west of the bridge is a developed urban residential zone (Figure 1-6; City of Bellingham 1982).

An active rail line associated with The Oeser Company operations runs east-west just north of the ravine. A second active rail line runs parallel to Bellingham Bay about 100 feet from the shore. A rail line existed along the west side of the creek in the past but has been removed. The old rail bed serves as a footpath and occasionally as a horseback riding trail. A second trail along the east side of the ravine runs from BTC to the bay. A short roadway into the ravine is located immediately north of the Marine Drive bridge. Signs describing the area are mounted on posts at the lower end of the ravine along the east side pathway.

Ravine side slopes are thickly vegetated by blackberry and alder and are relatively undisturbed. The ravine bottom is primarily open meadow with deciduous forest representing a relatively young riparian environment.

The City of Bellingham Parks and Recreation Department has prepared a conceptual master plan for creation of a park around Little Squalicum Creek. Plan elements include realignment of the creek and pond, wetlands, and meander construction. A picnic area is also planned (Wahl 1998b).

1.2.1.3 Groundwater Use

The Oeser Company receives its water from the City of Bellingham and has no on-site potable or industrial water supply wells. There are no known potable or industrial water supply wells downgradient of The Oeser Company facility. Two cross gradient wells are located on Tilbury Cement Company property, approximately 1,875 feet west-southwest of the retort on the facility. The Tilbury Cement Company pumps groundwater from two wells, identified in this report as TC-5 and TC-6 (Figure 1-9). Prior to the late 1980s, the Columbia Cement Company supplied drinking water to approximately seven employees and 14 nearby residences (Bratz 1987). The practice of supplying water service to nearby homes was discontinued in early 1988 and the Tilbury Cement Company personnel do not utilize the well water as drinking water. The use of two tapped springs located on the north side of Little Squalicum Creek was halted in the 1950s. Water flowing from the springs is released into Little Squalicum Creek (Bratz 2000).

The City of Bellingham supplies its customers with water from Lake Whatcom located about 6.5 miles east of the facility. There are no domestic wells located within 1 mile of The Oeser Company facility and only one well is located within a 2-mile radius of the facility (URS 1994).

1.2.2 Facility Operations

The Oeser Company facility has been and is currently used to treat wood for use as utility poles and fence posts. The facility currently includes both a retort and a butt tank (Figure 1-10). The pressure plant is comprised of an 8-foot-diameter retort that is approximately 180 feet long, a heat exchanger, and an oil/water separator. In the pressure-treatment process, whole poles are placed in the pressure retort in the NTA and treated using the Boultonizing process. Boultonizing involves heating poles in a cylinder while immersed in a preservative bath of oil and 5% PCP in oil. A vacuum is then drawn, causing water vapor to leave the wood. The vapor is condensed and discharged to the oil/water separator (Ecology

1993). This pressure-treating technique is called the “Empty Cell Treating Process.” The retort requires approximately 2,300 cubic feet (17,200 gallons) of preservative-laden oil for one cycle.

The thermal plant has two PCP butt tanks, three PCP storage tanks (40,000 gallons each), one stormwater storage tank (180,000 gallons), and an evaporator system (URS 1994).

PCP, currently the only preservative in use at the facility, is an EPA restricted-use product used to protect wood from insect attacks and decay. PCP also is used as an herbicide or fungicide. Both creosote and PCP in diesel oil are believed to have been used for weed control at the facility prior to 1962 (Oeser 1998). To form a 5% PCP solution, The Oeser Company uses 1-ton solid blocks of PCP mixed with a commercially available carrier oil similar to light diesel. Mixing is conducted within the pressure retort. Approximately four PCP blocks are added to 20,000 gallons of oil each time a preservative solution is mixed; approximately 130 pounds per day of PCP preservative are used (URS 1994). During calendar year 2000, The Oeser Company utilized 103,300 pounds (dry weight) of PCP and 258,235 gallons of P-9 Carrier Oil (Godfrey 2001). Average PCP usage at The Oeser Company’s facility ranges from 160,000 to 200,000 pounds per year (Oeser 1998).

There is no evidence that any type of water-based preservative, such as chromated copper arsenates were ever used at The Oeser Company facility.

1.2.2.1 Stormwater

Currently, The Oeser Company has three inputs to the storm drain (Figure 1-11). The first (upstream or northernmost) input is south of the PCP storage building. The immediate stormwater input at this point is the effluent from the paved storage depression. Besides surface runoff into the depression, three catch basins located in the North and East Treatment areas collect runoff and direct it to the depression. The ponded water flows under a metal hood designed to keep large and floating particulate matter out of the effluent. The stormwater then flows into a coalescing plate filter followed by an oil/water separator. These units are contained in an approximately 20- by 30-foot open concrete vault, which was sized to accommodate future downstream treatment system expansion. In the fall of 2000, The Oeser Company installed an 800-gallon surge tank and associated pump, two stainless steel 5-micron bag filters, and two Calgon Cyclesorb FP2 granulated activated carbon (GAC) filters. The Oeser Company has signed a lease agreement with Calgon Carbon Corporation for the maintenance of the GAC system. The treated stormwater flows directly south to a manhole, where the piping makes a 90-degree turn. From the manhole, the stormwater flows east to intersect the storm drain.

The second Oeser Company input into the main storm drain comes from a collection system on the west side of the facility in the North Pole Yard (NPY). A catch basin SDCB-1 collects runoff and directs it west, where it is released to a swale that is approximately 50 feet long. The Oeser Company constructed the swale in 1997 as a National Pollutant Discharge Elimination System (NPDES) compliance measure (Oeser 1998). The grassy swale slopes to an open catch-basin sump in a grassy depressed area between two sets of tracks. During storm events, the depression fills and stormwater is forced into an elbowed polyvinyl chloride pipe that drains to SDCB-2. The stormwater is then piped east to the storm drain.

The third and final Oeser Company input is from a catch basin, SDCB-3, which was installed in 1997 to accommodate flows in the unpaved northern part of the NTA. Modifications were made to the catch basin to minimize the amount of silt entering the storm drain; flows to the catch basin pass through a graveled area. (Godfrey and Durbin 2000; Durbin 2002).

These inputs meet the storm drain before any storm drain manhole is encountered on the 24-inch line within the facility boundaries. The first manhole, SDMH-1, is located in the NTA. SDMH-2 and SDMH-3 were installed during the 1997-1998 removal action and are located at the north and south ends of the ETA respectively. The manholes represent the transition between the existing concrete storm drain and the high-density polyethylene pipe that replaced the storm drain in the excavated area. SDMH-4 is sited in the WSA. Historically, there was a manhole in front of the retort tank, but it was removed when the drip pad was installed. Three catch basins on the site have been rerouted. Instead of being directly tied to the 24-inch storm drain, they are now pumped to the stormwater collection pond (Figure 1-11).

1.2.2.2 Removal Action Summary

On-site removal action work was conducted from September 1997 through November 1998. To protect workers and trespassers, caps were designed and placed over 4 acres of dioxin-contaminated soils (Figures 1-12 and 1-13). The most contaminated soils at the facility were excavated to a depth of 20 feet below ground surface (bgs) in the area of the former dry well located east of the ETA. Some 8,456 tons of contaminated soil wastes designated F032 - F034 were transported via rail for disposal at Envirosafe Services of Idaho, Inc., in Grand View, Idaho. A total of 26,948 gallons of F032 - F034 liquid waste were transported by vacuum truck to Burlington Environmental in Kent, Washington, for treatment and disposal.

1.2.3 Nature and Extent of Contamination

This section discusses the nature and extent of contamination found in the soil and groundwater at Oeser during the RI. The extent of contamination was delineated using proposed site-specific CULs for naphthalene, PCP, total petroleum hydrocarbon (TPH), carcinogenic polynuclear aromatic hydrocarbons (cPAHs) calculated based on equivalency to benzo(a)pyrene [B(a)P], and dioxin/furans calculated based on equivalency to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). The extent of contamination in the surface and subsurface soil at Oeser is discussed in Subsection 1.2.3.1 and 1.2.3.2, respectively, and depicted on Figures 1-14 through 1-17. Groundwater contamination is discussed in Subsection 1.2.3.3.

1.2.3.1 Surface Soil

Surface soil samples containing greater than proposed site-specific CULs were collected during the RI at locations in all subareas of the facility with the exception of the West and East Treatment areas (Figure 1-14). Surface soil samples were not collected from the WTA and ETA during the RI.

PCP was detected in surface soil samples throughout the facility; however, samples with PCP above CULs were detected in the TPA, the NTA, and the NPY. PCP often was detected at levels above the CULs in locations where dioxin was detected above the CULs.

Total cPAHs as B(a)P equivalents were detected in surface soil throughout the facility. Surface soil samples with cPAHs as B(a)P equivalents above CULs were collected from the TPA, NTA, WSA, and the South Pole Yard (SPY). The concentrations of the cPAHs did not correlate with other detected chemicals.

Dioxin was detected at concentrations exceeding CULs in surface soil in all subareas. As the majority of WTA and ETA subareas are covered with structures or asphalt, no surface soil samples were collected at these locations.

1.2.3.2 Subsurface Soil

Subsurface soil contamination was detected during the RI in all subareas at the site at depths up to 23 feet bgs (Figures 1-15 through 1-17). The nature and extent of contamination in each subarea is described as follows:

North Pole Yard Area. Total cPAHs as B(a)P equivalents were detected above CULs in the southwestern portion of the NPY. A relatively high concentration of dioxin (exceeding the CUL) also was co-located with this sample collected from the 2- to 4-foot bgs interval. PCP and dioxin above the CULs also were detected in a sample collected from the 0- to 6-foot bgs northern portion of the NPY.

South Pole Yard Area. An isolated section of the SPY Area contained concentrations of dioxin above the CUL in the 0- to 6-foot bgs interval. PCP above the CUL also was detected in the 6- to 12-foot bgs interval.

Wood Storage Area. No CULs were exceeded in this area.

Treated Pole Area. The CUL for cPAHs as B(a)P equivalents was exceeded at 2 to 4 feet bgs at a sampling location in the northeast corner of the facility.

North Treatment Area. Samples exceeding CULs for B(a)P equivalents, PCP, and dioxin were found in the 0- to 6-foot bgs interval, B(a)P equivalents and dioxin in the 6- to 12-foot bgs interval; and B(a)P equivalents and napthalene in the 12- to 23-foot interval.

West Treatment Area. The highest concentration of cPAHs as B(a)P equivalents was located under the concrete enclosure in the 0- to 6-foot bgs interval. cPAHs also were detected in the 6- to 12-foot bgs interval and along with naphthalene, in the 12- to 23-foot bgs interval. High concentrations of dioxin were found in the 3- to 4.5-foot intervals at borings located between the stormwater collection tanks and the PCP tanks. Dioxin also was found at 13 to 15 feet bgs, near the NTA, at a concentration of 3.61 nanograms per kilogram.

East Treatment Area. Subsurface soil samples have been collected from several locations throughout the ETA. The majority of the samples from this area were collected from the walls and base of the excavation during EPA’s 1997-1998 removal action. While the removal action was successful in significantly reducing the volume of source material, confirmation samples indicate that concentrations of contaminants remain around and below the excavation area.

The highest concentration of cPAHs as B(a)P equivalents in the ETA was detected at 5 to 7 feet bgs located in the southeast corner of the creosote enclosure. Concentrations of B(a)P equivalents exceeding CULs also were detected in the 6- to 17-foot interval near the south border of the large removal area; near the excavation adjacent to the evaporator; and in a sample collected north of the thermal tank. In addition, samples at the base of the excavation (approximately 20 feet bgs) also exceeded CULs.

1.2.3.3 Groundwater

Although contamination was detected in the deep aquifer during the RI, which occurs between 30 to 45 feet bgs, contamination occurs more consistently and at higher concentrations in shallow groundwater. The following discussion of the nature and extent of contamination focuses on contaminants PCP, cPAHs as B(a)P equivalents, napthalene, and dioxin. These compounds were selected because of their prevalence throughout Oeser in both soil and groundwater.

Deep Aquifer. As discussed in Section 3 of the RI report, the deep aquifer is composed of coarser, more permeable material and occurs as a continuously saturated aquifer. The lower extent of this aquifer is not known. Deep wells were completed in a “gravelly” zone. The deep aquifer is more transmissive than the shallow aquifer and has higher rates of horizontal flow. Groundwater flow in the deep aquifer is to the southwest with a gradient of 0.009. There appears to be a groundwater mound near MW35-D as groundwater levels are consistently 2 feet higher at this well than at nearby adjacent wells.

RI sampling results suggest that the sources for PCP contamination found in on-site wells prior to the 1997-1998 removal action have been removed and/or that less PCP is leaching into the deep aquifer due to the capping that occurred during the 1997-1998 removal action. This contamination is therefore limited to a thin corridor south of the PCP enclosure and thermal tank. In summary, the northeastern extent of contamination in the deep aquifer is not definitively known; however, it is not suspected to extend northeast of the PCP enclosure. Previously, PCP contamination in the deep aquifer extended to at least MW02-D (Figure 1-9); however, currently it appears that the southwestern extent is at the northern edge of the WSA. PCP contamination above the CUL was detected in the deep aquifer with the highest concentration located at MW05-D.

Total cPAH as B(a)P equivalents follows the same general pattern as PCP contamination in the deep aquifer. In general, the extent of PCP in the deep aquifer is larger than the extent of cPAH contamination. Temporal variations in the distribution and extent of PCP and cPAH contamination have been noted; however, the results of the RI indicate that the distribution appears to have stabilized within an isolated area inside facility boundaries. It should also be noted that PCP and polynuclear aromatic hydrocarbons (PAH) contamination will bioattenuate to some degree, although dioxin will not significantly bioattenuate.

Dioxin analyses were conducted from 1999 through 2000. Dioxin is present in the deep aquifer wells with the highest concentration (0.703 picograms per liter [pg/L]) slightly above the CUL (0.583 pg/L) in MW01-D during the December 1999 sampling event; no other wells in the deep aquifer exceeded the CUL for dioxin.

Shallow Groundwater. Shallow groundwater occurs at depths ranging from 4 to 15 feet bgs. Shallow groundwater is perched on silt/clay lenses. As a result, the occurrence of shallow groundwater is discontinuous. Horizontal flow of shallow groundwater likely occurs over short distances, but in general, shallow groundwater is more likely to flow downward to the deep aquifer.

Consistently high concentrations of PCP (greater than 0.729 micrograms per liter) have been found in 9 of 19 wells, but concentrations of cPAHs as B(a)P equivalents were variable. These data confirm that the distribution of PCP and cPAHs extend from the NTA to the northern end of the WSA, but the variability in contaminant concentrations suggest that there may be multiple sources and not a single plume. The western edge of PCP contamination above the CUL has not been defined, but extends as far west as MW29-S (Figure 1-9). The southern extent appears to be near MW10-S.

Prior to the RI, the extent of shallow groundwater contamination appeared to extend from MW14-S to MW22-S and MW10-S because, in 1997 and 1998, the concentration of PCP and cPAH compounds decreased moving progressively southwest between these wells. However, in 1999 and 2000, free product was discovered in MW26-S. RI data indicate that the source of free product in MW26-S also may be the source of contamination at MW14-S. Historically, MW14-S has had higher concentrations of these contaminants than MW26-S.

Petroleum contamination was found in the shallow aquifer at various sampling locations from 1999 through 2000.

Free product was found in wells MW07-S, MW13-S, and MW26-S in 1999 and 2000. Wells MW14-S, MW15-S, MW22-S, and MW28-S contain petroleum hydrocarbons in excess of the Model Toxics Control Act (MTCA) Method A levels; however, most shallow wells contain detectable concentrations of petroleum hydrocarbons. The distribution of contaminant concentrations indicates that there are likely multiple sources of petroleum and that the shallow aquifer is discontinuous on the west side of the facility. On the east side of the facility, petroleum contamination appears to be centered around MW13-S and MW07-S, where free product has been found.

Dioxin analyses were conducted only during the 1999-2000 RI sampling events. The locations where the dioxin exceeded the CUL were MW08-S, MW09-S, MW14-S, MW15-S, MW22-S, and MW29-S. Napthalene consistently exceeded the CUL in MW15-S and MW22-S.

Free Product. This section summarizes free product (diesel with creosote-like components [lighter-than-water nonaqueous phase liquid]) recovery efforts made during the RI at The Oeser Company. Historically, three wells on the facility have had measurable levels of wood treating waste products: MW07-S, MW13-S, and MW26-S. Maximum measured product thicknesses are given below:

Well	Maximum Thickness (feet)	Date
MW07-S	0.21	10/15/98
MW13-S	0.33	9/1/99
MW26-S	1.63	4/8/99

Product was removed from MW13-S and MW26-S on September 2, 1999, using a peristaltic pump. Product removal volumes and product recovery times are as follows:

- Measurable product was observed in MW07-S prior to, but not during, the RI.
- In MW13-S, the measured thickness of product recovered to one-third of its original thickness within 30 hours following removal; however, after 11 days, only a sheen was measured.
- In MW26-S, product thickness recovered to approximately one-third of its original thickness after 11 days.

1.2.4 Contaminant Fate and Transport

Dominant factors affecting the nature and extent of contamination at Oeser include the following:

- Nonaqueous phase liquid (NAPL) pools serving as continuing sources of groundwater contamination;
- Soil contamination throughout the upper sandy zone;
- Retarded advection with slowly moving groundwater in the upper sandy zone;
- Possible degradation of organic compounds via oxidation and/or bioattenuation;
- Diffusion into fine-grained silt lenses; and,
- Possible migration of vapor plumes.

Contaminants in the subsurface soil partition among one or more of the following phases: NAPLs, air, water, and solids. This partitioning commonly occurs until an equilibrium distribution has been attained.

1.2.4.1 NAPL Transport

Results of the RI indicate that contaminants may be present as NAPL in the upper sandy zone at Oeser. Given the abundance of low permeability lenses in the upper sandy zone, it is reasonable to assume that if NAPL is present most of it would exist as pools perched on top of these lenses. The potential for the oil phase to continue migrating downward toward the gravelly zone and the continuous water table therein primarily depends on the likelihood that NAPL will either penetrate the low permeability clay and silt lenses; spread past the horizontal extent of the individual lenses and continue to finger downward; or both. As the NAPL pools are not expected to grow (the system is likely at or close to steady state), additional fingering probably will not be a pathway for contamination of the deep aquifer. Immobile residual NAPL in the vadose zone above the pools could be re-mobilized if conditions at the site are altered, for example by the addition of co-solvents or heat. The mass of NAPL potentially present in the vadose zone would be decreased by vaporization of the NAPL and dissolution by infiltrating water. In water-saturated areas, NAPL mass would be depleted as the NAPL dissolves into the surrounding groundwater.

Vapor plumes will exist in the unsaturated zone around any NAPL source and will spread as a result of molecular diffusion and gradients that exist in the gas phase. No quantitative measurements of vapors or pressure gradients in the vadose zone were conducted during the RI, but some qualitative observations were made. Diesel and creosote odors were noted in a few subsurface sample locations. These observations indicate that some volatilization is occurring in the subsurface, at least within naphthalene and diesel spills. Though naphthalene and diesel have higher vapor pressures than some of the other contaminants on the site, the possibility exists that other contaminants also are present in the vapor phase. Atmospheric pressure changes will result in pressure gradients within the vadose zone and vapors will tend to migrate in response to these pressure gradients. Currently, much of the site is paved, reducing the release of organic vapors to the surface. However, vapors could be released at locations where paving is damaged or non-existent. Vapors will accumulate in excavations.

Contaminants in the vapor phase can be transported to groundwater by infiltrating precipitation. Because part of the site is paved (prohibiting infiltration), and the dissolved concentration produced by water that does infiltrate through vapors is likely to be much more dilute than that of the oil phase, vapors are unlikely to pose a significant threat to the deep groundwater aquifer.

1.2.4.2 Air Transport

Ambient air samples on and around The Oeser Company facility were analyzed for phenols, PAHs, dioxins, and volatile organic compounds (VOCs). VOCs were detected in samples collected on the facility (primarily from sources in the treatment area), though benzene appeared to be the only VOC migrating off-facility at exceedence concentrations. The Oeser facility is the likely source of off-site PCP, dioxin, and non-carcinogenic PAHs.[1]

Mechanical transport of contaminants typically occurs through entrainment on surfaces of vehicles, equipment or, to a lesser degree, clothing. The site is partially paved, but it is possible that contaminants will migrate from the site by this pathway under existing site conditions. In the event that site remedial activities incorporate subsurface excavation, emissions can be expected to increase dramatically. Volatilization and mechanical transport would play increasing roles in contaminant transport. Controls may be required for air emissions and equipment decontamination during remedial activities.

1.2.4.3 Groundwater Transport

The dominant transport mechanism in the subsurface is advective transport by flowing groundwater. In the absence of chemical interactions and dispersion, dissolved constituents will move through the subsurface at average linear groundwater velocities. However, most organic contaminants will sorb to the soils they encounter, which will cause the dissolved constituents to advance at rates lower than the average linear groundwater velocity. The contaminants of concern (COCs) at this site will advance slower than the average groundwater flow rate, and for most of the COCs, much slower. Sorption may be a primary mechanism for reducing or preventing contamination of the water table in the gravelly zone at Oeser.

Dispersion is the process of small scale mixing caused by groundwater moving at slightly different rates in adjacent pore spaces. With a steady state and large source, dispersion has little effect on the maximum concentration in the center of the plume. However, it does cause spreading of contaminant both parallel and normal to flow directions. In the upper sandy zone at Oeser, saturation exists primarily as perched water on top of low permeability zones. In these zones, groundwater moves primarily in the horizontal direction, as the vertical extent of saturation is not extensive. Thus, the effects of dispersion on migration towards the deep aquifer likely is small.

Because flow rates in the upper sandy zone are not high, it is possible that molecular diffusion is a significant mechanism for transporting contaminants into the silt and clay lenses. Diffusion of contaminants into fine-grained lenses should not be confused with penetration of NAPL into the lens. After 15 years, it was estimated during the RI that diffusion will have advanced approximately 8 inches

[1]This determination was made by comparing contaminant concentrations in facility source samples to downwind perimeter, and upwind and downwind off-facility samples; if a downwind concentration gradient was found, then airborne contaminants were determined to be migrating off-facility.

into the silt and clay lenses. Because not all of the lenses are 8 inches thick, the possibility exists that diffusion alone will allow contamination to fully penetrate low permeability lenses. However, the actual concentration profiles in the silt will vary depending on the retardation factor of each compound.

Dissolved constituents will move with groundwater, volatilize into the vadose zone, and sorb to soils. As contaminants are transported with flowing groundwater, dispersion will cause the contaminant plumes to spread. If contaminant sources such as NAPL pools are removed, dispersion will result in a lowering of maximum concentrations within the plume, due to conservation of mass. However, if sources are not removed and processes to destroy the contaminants are not present, the plumes will increase in size without a corresponding decrease in concentrations.

Two destructive processes that may be occurring are oxidation and biodegradation. Oxidation of hydrocarbons is a commonly observed phenomenon that occurs under the aerobic conditions present in the soil at Oeser. Biodegradation also may be transforming COCs in the groundwater. The extent of bioattenuation is difficult to assess directly, though there are measurable indices that can reveal if biodegradation is occurring. Given that suitable organisms, optimal temperature, and nutrients exist in the subsurface soil, bioattenuation may be another mechanism capable of preventing downward migration of contaminants to the water table in the gravelly zone at Oeser.

1.2.4.4 Solid Transport

Because subsurface soils are stationary, sorbed contaminants are immobile in the subsurface as long as the soils are not moved. However, along with sorbing to soils, most contaminants will desorb from soils when the aqueous concentrations decrease. Sorbed contaminants can therefore act as a secondary source of contamination after NAPL sources have been removed. Because sorbed contaminants typically are not available for biodegradation, sorption can hinder the natural degradation of some contaminants (Pankow and Cherry 1996).

1.2.5 Baseline Risk Assessment

The following subsections summarize the human health risk assessment (HHRA) and the ecological risk assessment (ERA). A detailed discussion is provided in the RI document (E & E 2002).

1.2.5.1 HHRA Summary

The Oeser Company is an active wood-treating facility located in Bellingham, Washington, that has used organic treating solutions of creosote and PCP to preserve utility poles and pilings. The primary objective of the baseline HHRA was to evaluate potential adverse health effects attributable to site-related contaminants in the absence of remedial action. Contaminants from wood-treating wastes (PAHs [most compounds that make up creosote], PCP, and dioxins/furans [contaminants found in PCP treating solutions]) were the primary contaminants of potential concern (COPCs) in surface and subsurface soil, groundwater, air, surface water, and sediment. Current and future exposure scenarios were evaluated for on-site workers, on- and off-site residents, and off-site recreational visitors. Exposure to COPCs derived from facility surface soil was evaluated for the current on-site worker. The potential excess lifetime cancer risks and potential noncarcinogenic hazard indices (HIs) for the reasonable maximum exposure case are summarized below.

Current Exposure Scenario. For the current exposure scenario, potential excess lifetime cancer risks and potential noncarcinogenic HIs were determined for the on-site worker, off-site resident, and off-site recreational visitor.

The potential RME excess lifetime cancer risks for the on-facility worker (1E-03 to 5E-04) associated with exposure to currently exposed surface soils exceeded EPA levels of concern. Dioxins/furans were the main contributors to the risks. Noncancer HIs were below the EPA's acceptable level of 1. Most of the site is capped with either gravel or asphalt; therefore, exposure to surface soil under current conditions is limited to a few uncapped areas.

For the off-facility residents, potential excess lifetime cancer risks associated with exposure to surface soil were less than 1E-04 for all but one location. One location (an industrial property east of the site) had an estimated cancer risk of 2E-04. It is to be noted that several locations that were noted as "residential" in the HHRA currently are undeveloped or are developed for commercial uses. The COPCs contributing most to risk estimates were B(a)P equivalents and dioxin toxicity equivalent quotient (TEQ). The biased residential background sample and the open residential background sample were below EPA levels of concern.

For the off-site recreational visitor, potential excess lifetime cancer risks associated with exposure to surface soil were within EPA's range of acceptable risks. The only noncancer HI (0.5) associated with exposure to surface soil is less than the EPA acceptable level for the recreational visitor. This estimate is for potential exposures at the spoils piles and primarily is due to TPH contamination.

The potential excess lifetime cancer risks and potential noncancer HIs associated with exposure to sediment in Little Squalicum Creek were less than EPA acceptable levels for the recreational visitor.

The potential excess lifetime cancer risks associated with dermal exposure of the recreational visitor to the surface water of Little Squalicum Creek is 5E-04. The risk was attributed mainly to dioxins/furans, but B(a)P and PCP also contributed to risk. The risk associated with the background surface water location was 1E-04; however, this risk is based on one-half detection limits (DLs) for nondetected compounds. Potential noncancer effects associated with exposure to surface water were less than EPA acceptable levels.

The assessment of risks and hazards from dermal contact via water to very lipophilic molecules, such as TCDD, B(a)P, and PCP, is highly uncertain. Their dermal permeability coefficients are outside the effective predictive domain, and therefore the estimations of doses received from dermal contact are considered to be less than reliable, and probably leads to significant overestimates of risks and hazards. In addition, estimation of exposure point concentrations in surface water is inherently uncertain because the concentrations of COPCs in the creek are unlikely to be constant over time. Finally, the frequency and duration that the recreational visitor actually comes into contact with the creek water is probably highly variable. The values used to estimate frequencies and durations of exposures to the creek water in this risk assessment were based on best professional judgment and were intended to be conservative.

The potential excess lifetime cancer risks associated with inhalation of COPCs in air were within the EPA's acceptable range. Penta-, hexa-, and hepta-chlorinated dioxin congeners and benzene were detected at AS29, which had the highest risks (3E-05) for the off-site resident, but at similar concentrations as those detected at the background location. PCP was not detected at the background sampling location. Therefore, the estimated excess lifetime cancer risks at AS29 probably are attributable to operations of The Oeser Company. Noncancer HIs exceeded the EPA's acceptable level of 1 at sampling locations AS25 and AS29. These locations had HIs of 3 and 5, respectively, slightly above the background location HI of 2. The main COPC contributing to the elevated HI in AS25 was 1,2,4-trimethylbenzene. Increased concentrations of 1,2,4-trimethylbenzene; 2-methylnaphthalene; PCP; and dibenzofurans were the main contributors to the increased HIs at sampling location AS29. 1,2,4-Trimethylbenzene; 1,3,5-trimethylbenzene; and benzene were COPCs at the background sampling location that contributed to the elevated HI of 2. The increased HI associated with compounds detected at AS29 probably is due to facility operations. Sampling stations AS29 and AS25 were located at The Oeser Company's northeast fence line, which is located directly downwind of the facility. In addition, air concentration data derived from the air monitoring stations may not represent steady-state concentrations.

These concentrations can vary greatly depending on local atmospheric conditions such as wind speed, wind direction, and precipitation. Facility operations also may greatly influence contaminant concentrations. The increased potential excess lifetime cancer risks and HIs attributed to detected air concentrations may be overestimated or underestimated, depending on how close these values are to the actual average long-term (i.e., 30-year) air concentrations to which the off-site residents potentially would be exposed.

Potential excess lifetime cancer risks and HIs were within acceptable levels for air exposures for the recreational visitor.

The total cancer risk across all COPCs for the Tilbury Cement Company groundwater wells exceeded the EPA criteria for the current worker scenario. Dermal exposure to groundwater while showering contributed the greatest risk at TC-5 (4E-04) and TC-6 (2E-4). However, no COPCs were detected in these wells; the estimated excess lifetime cancer risks for on-facility worker exposure to groundwater is based solely on the use of one-half DLs for non-detected compounds. Consequently, actual risks to on-facility workers may be even less. No noncarcinogenic COPCs were identified.

Future Exposure Scenario. For the future exposure scenario, potential excess lifetime cancer risks and potential noncarcinogenic HIs were determined for the on-site worker, on-site resident, and off-site recreational visitor.

The potential excess lifetime cancer risks associated with surface soils exceeded EPA criteria for the on-facility resident (2E-03 to 7E-03) and the on-facility worker (6E-04 to 2E-03). The risks were attributed primarily to detected dioxins/furans. Noncarcinogenic HIs were below the EPA's acceptable level of 1. For this exposure scenario, it was assumed that all soil caps were removed; therefore, all surface soil samples were evaluated.

The potential excess lifetime cancer risks for the future on-site resident associated with exposure to subsurface soil exceeded EPA criteria for every subarea and multiple depth intervals. The upper depth intervals greatly exceeded EPA acceptable levels, with decreasing risks at lower depth intervals; however, the risks attributed to the subsurface soil of the East and West Treatment areas and the NTA exceeded EPA acceptable levels at every depth interval. In most cases, cPAHs and/or dioxins/furans were the main chemicals contributing to the risk, but PCP and TPH also were detected throughout the subsurface soil. HIs for all subarea subsurface soils for the future on-site resident generally increased with depth, with the highest HIs found in the 6- to 12-foot interval for all areas except the East and West Treatment areas and the NTA. HIs for all subareas exceeded 1 within this depth interval, except the

WSA. HIs for the East and West Treatment areas and the NTA exceeded 1 in all subsurface soil intervals. The increased HIs were attributed to naphthalene and 2-methylnaphthalene.

Similar to the on-site future resident, the potential excess lifetime cancer risks for the on-site future worker exceeded the EPA's acceptable risk range throughout subsurface depth intervals. The HIs for the on-site future worker generally increased with depth for each subarea, with the highest HIs across all areas found in the 6- to 12-foot interval, with the exception of the East and West Treatment Areas and NTA. All subareas exceeded 1 within this depth interval, except the NPY and the WSA. HIs for the East and West Treatment areas and the NTA exceeded 1 in all subsurface soil intervals.

The potential excess lifetime cancer risks for the potential future on-site resident exceeded EPA acceptable levels for all deep water groundwater wells and the background well. The COPCs that have contributed to risks for each well are the 2,3,7,8-TCDD TEQ and B(a)P equivalents. However, the concentrations of individual dioxin/furan congeners and cPAHs did not exceed their respective screening toxicity values, and the calculation of the 2,3,7,8-TCDD TEQ and B(a)P equivalents is based largely on the use of one-half DLs for nondetected compounds. Given that the risk levels in the background well exceed EPA acceptable risk levels and that primary COPC concentrations were calculated based on one-half DLs, the risks associated with use of groundwater likely are overestimated. HIs for the on-facility resident were less than 1.

Potential excess lifetime cancer risks and HIs for the future on-site worker were below EPA criteria for exposure to groundwater. Excess lifetime cancer risks ranges from 6E-06 to 1E-05 for on-site wells, while the excess lifetime cancer risk for the background well is 8E-06. At least one dioxin congener (octachlorodibenzo-p-dioxin [OCDD]) was detected in each well; however, the majority of risk calculated for groundwater exposure is due to use of one-half of the DLs for dioxin congeners and PAHs. It should be noted that OCDD is four orders of magnitude (i.e., 10,000 times) less toxic than 2,3,7,8-TCDD which is the reference congener for TEQ calculations.

1.2.5.2 ERA Summary

Numerous investigations conducted at The Oeser Company facility during the 1980s and 1990s identified facility-related chemicals, such as PAHs and PCP, in environmental media on The Oeser Company facility and in nearby off-facility areas. The RI Work Plan for the site presented a screening-level problem formulation and ecological effects evaluation based on existing site information. The evaluation identified Little Squalicum Creek and the south slope terrestrial area as natural areas attractive to wildlife. Also, the evaluation concluded that additional ERA work was warranted for two primary reasons: (1) levels of facility-related chemicals in creek sediment exceeded benchmarks for the protection of benthic life, and (2) insufficient data were available to evaluate risks to wildlife from facility-related chemicals. Specifically, no dioxin/furan data were available for Little Squalicum Creek and no data for dioxins/furans, PAHs, and PCP were available for the south slope terrestrial area. These data gaps and others were addressed by sampling conducted for the RI.

The specific investigations conducted to further evaluate ecological risks at Oeser were: (1) analysis of creek sediment and water for facility-related chemicals; (2) toxicity testing with creek sediment to evaluate effects of sediment contamination on the survival and growth of benthic life; (3) bioaccumulation testing with creek sediment to evaluate uptake of facility-related chemicals by benthic organisms; and (4) analysis of surface soil from the south slope and creek area for facility-related chemicals. The RI data demonstrated that facility-related chemicals were present in sediment and water from the creek and in soil from the south slope and creek banks. The data were used in a baseline ERA to evaluate the following assessment endpoints: (1) maintenance of a healthy creek aquatic community (i.e., benthic life and other aquatic biota) typical of a small stream with seasonally limited flow; (2) maintenance of healthy plant and soil-organism communities in the south slope and creek area; and (3) sufficient rates of growth, survival, and reproduction of songbirds and small mammals to sustain healthy populations in the south slope and creek area.

The baseline ERA concluded the following regarding the assessment endpoints for the site:

Creek Aquatic Community. The effects of sediment contamination on benthic life in Little Squalicum Creek were evaluated directly using 10-day sediment toxicity tests with *Hyalella azteca,* a freshwater amphipod. The 28-day amphipod/polychaete test was not available when the RI fieldwork was conducted; however, the 10-day amphipod toxicity test is an adequate measure of adverse effects in benthic organisms. The test results suggest that current levels of sediment contamination in the creek do not pose a threat to benthic life. Test organism survival in sediment from the creek was high (78 to 93%) and no different than control survival. In addition, test organism growth was not impaired.

Potential adverse effects from facility-related chemicals in surface water were evaluated by comparing measured water concentrations (from July and December 1999) to chronic water quality criteria or other chronic benchmarks. In July 1999, no chemicals in surface water were present in excess of the criteria or benchmarks. In December 1999, the criteria for PCP and dioxins/furans were marginally exceeded at selected locations, a result that is not surprising given that flow in the creek is largely comprised of stormwater during the rainy season. However, even in the absence of chemical contamination from The Oeser Company facility and City of Bellingham stormwater outfalls, it seems unlikely that the creek would support a diverse community of aquatic organisms given its shallow depth and current flow regime. Overall, facility-related chemicals do not appear to pose a serious threat to the community of aquatic organisms in Little Squalicum Creek.

Plant and Soil-Fauna Communities. No risks to plants or soil fauna from PCP were identified for the south slope terrestrial area or creek area. For PAHs, potential risks to plants and soil fauna appear to be restricted to a single sample location on the north bank of the creek, where the total PAHs concentration was approximately 960 milligrams per kilogram. However, the location was heavily overgrown by various species of grasses, shrubs, and vines and there was no visible evidence that the vegetation was stressed. Overall, facility-related chemicals do not appear to pose a widespread threat to plant and soil-fauna communities in the area of the creek and south slope.

Small Mammal and Songbird Populations. Risks were calculated for the American robin, short-tailed shrew, and barn swallow, three receptor that could derive a large portion of their food and habitat needs from the south slope and creek area. These receptors also were selected because they feed extensively on soil invertebrates (robin, shrew) and/or aquatic insects (swallow), which potentially could accumulate facility-related chemicals. Exposure estimates were calculated based on the sum of exposures from incidental ingestion of soil or sediment and consumption of contaminated prey (100% earthworms conservatively assumed for the robin and shrew; 100% aquatic insects [post-emergence] conservatively assumed for the swallow). Hazard quotients (HQs) were calculated based on both the no observed adverse effect level (NOAEL) and lowest observed adverse effect level (LOAEL).

For the swallow, only the NOAEL-based HQ for dioxins/furans exceeded the benchmark level of 1; however, the exceedence was minor (HQ = 1.2). Overall, it appears that risks to receptors such as the barn swallow, which feed on invertebrates from the creek, are minimal. For the robin, the NOAEL-based HQs for PAHs and dioxins/furans exceeded the benchmark level of 1, but the LOAEL-based HQs did not. The risk estimates were greatest for the shrew. For this receptor, the LOAEL-based HQs for PAHs and dioxins/furans exceeded the benchmark level of 1, and the NOAEL-based HQ for PCP exceeded 1. However, for dioxins/furans and particularly for PAHs, the level of soil contamination at a single sample location contributed most to the estimated risks for the shrew and robin. Consequently, because the soil contamination is restricted to a small area, it is unlikely to pose a threat to the populations of small mammals and songbirds feeding on soil invertebrates in the creek area and south slope, although a few individuals possibly could be affected if they were to forage only in the most contaminated area (a situation that seems unlikely). For PCP, the risk estimate for the shrew was influenced by the use of one-half the DL in several samples with elevated DLs. Consequently, risks from PCP to small mammals that consume soil invertebrates, such as the shrew, likely are overestimated. Overall, facility-related chemicals do not appear to pose a serious threat to the populations of small mammals and songbirds that use the creek area and south slope.

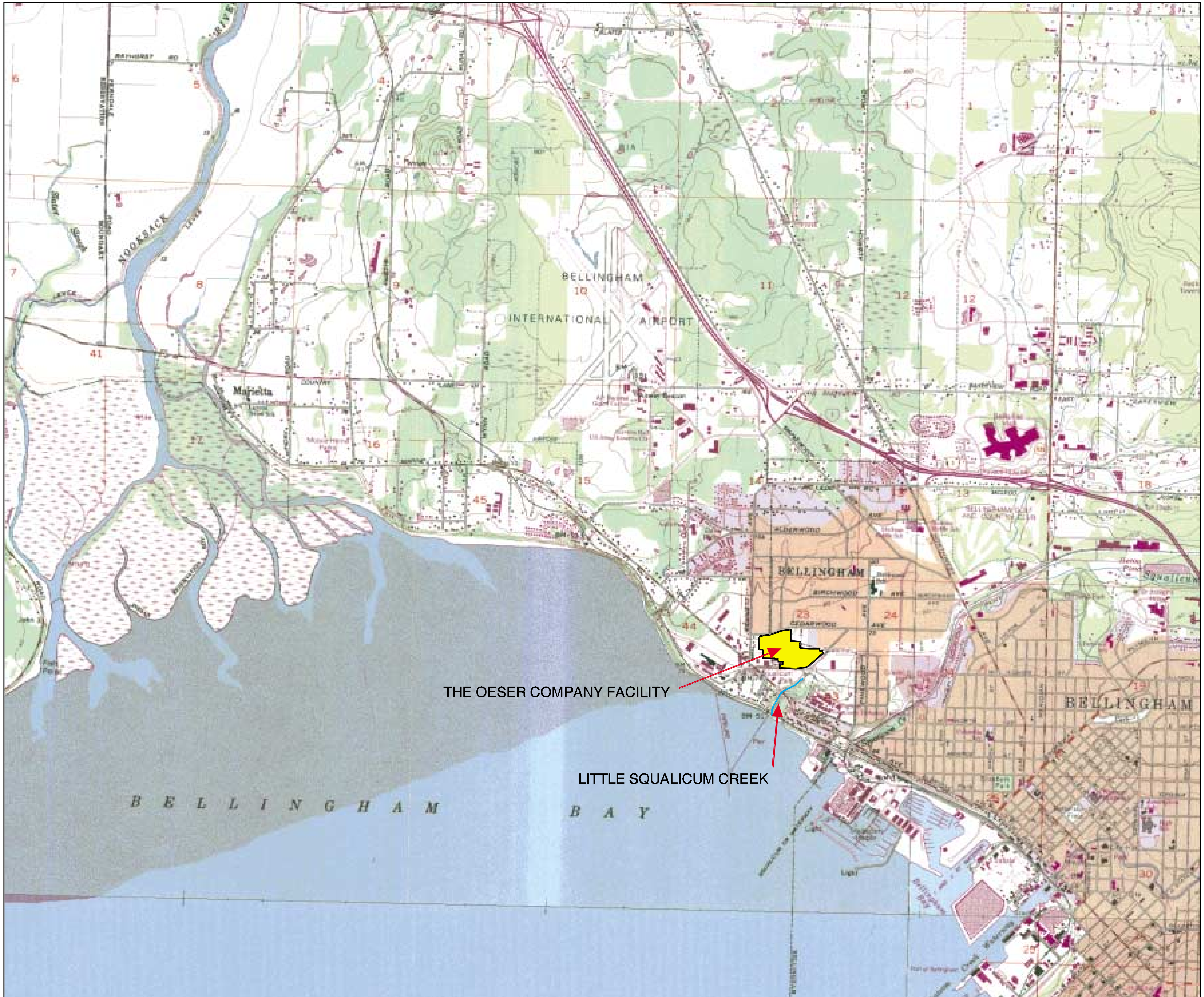

Figure 1-1

THE OESER COMPANY SUPERFUND SITE

Bellingham, Washington

Remedial Investigation

USGS Topographic Map
Area Coverage

N
W E
S

0 1500 3000 4500 6000
Feet

MAP SOURCE

USGS Topographic Maps. Scale 1:24000
Eliza Island Quadrangle, 1997
Bellingham South Quadrangle, [1954], 1972b
Bellingham North Quadrangle, [1954], 1972a
Ferndale Quadrangle, [1954], 1994

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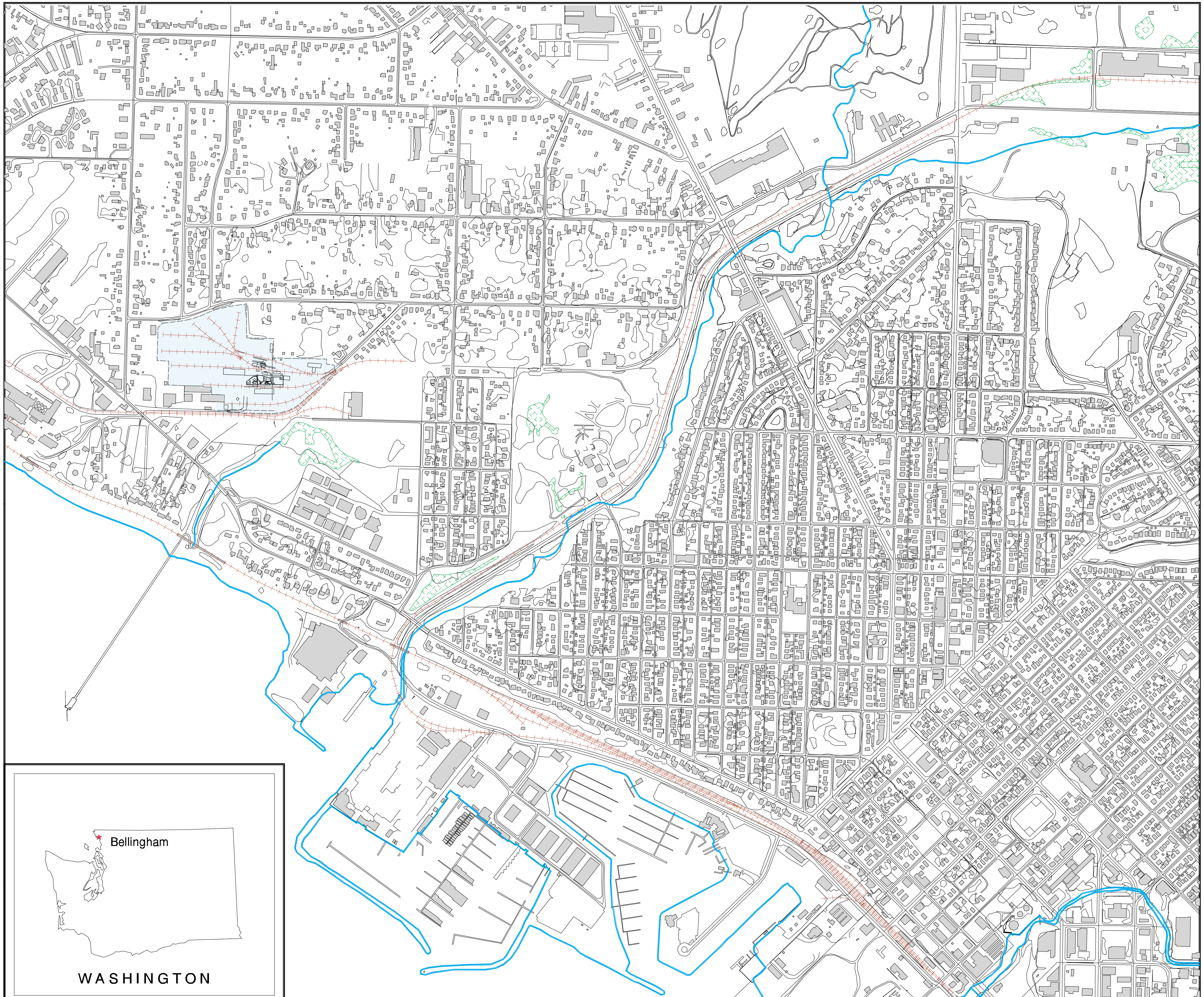

Figure 1-2

THE OESER COMPANY SUPERFUND SITE

Bellingham, Washington

Remedial Investigation

Study Area

Legend

- The Oeser Company Facility
- Wetlands
- Building/Residential Structure
- Shoreline and Waterways
- Railroad Line

N
W E
S

0 500 1000 1500 2000

Feet

MAP SOURCE

City of Bellingham - Department of Public Works
Topographic Data Date: 1988

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International Specialists in the Environment
Seattle, Washington

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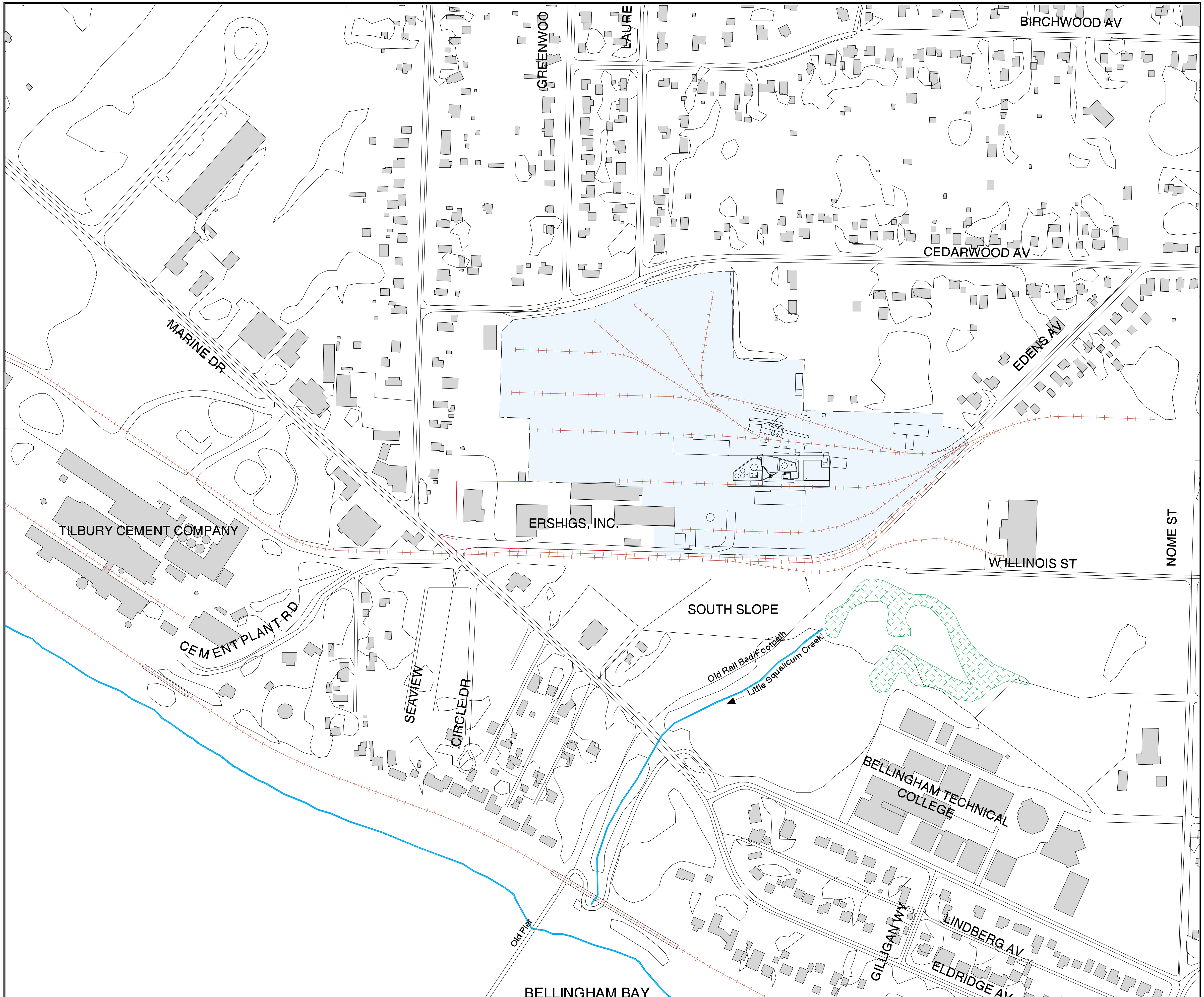

Figure 1-3

THE OESER COMPANY SUPERFUND SITE

Bellingham, Washington

Remedial Investigation

Site Map

Legend

- The Oeser Company Facility
- Wetlands
- Building/Residential Structure
- Shoreline and Waterways
- Railroad Line
- Flow Direction

N
W E
S

0 250 500 750 1000

Feet

MAP SOURCE

City of Bellingham - Department of Public Works
Topographic Data Date: 1988

Oeser Company Site Map
Larry Steele & Associates
Survey Date: 12/3/1997

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/data1/oeser/rifs/fig1-3.aml

ecology and environment, inc.
International Specialists in the Environment
Seattle, Washington

SOURCE: Walker & Associates, 1997.

Base Figure:
02: KJ0103_BH0701SRDO\Facility Areas.CDR 5/12/98

THE OESER COMPANY SUPERFUND SITE
REMEDIAL INVESTIGATION
Bellingham, Washington

Figure 1-4
FACILITY AREAS (AERIAL)

Date:	Drawn by:	TDD No.:	Pan No.:	Dwg.No.:	Pubs. No.
11/17/00	BUFF	09-00-09-0001	0566OCSTT0	0566 1-4	S567

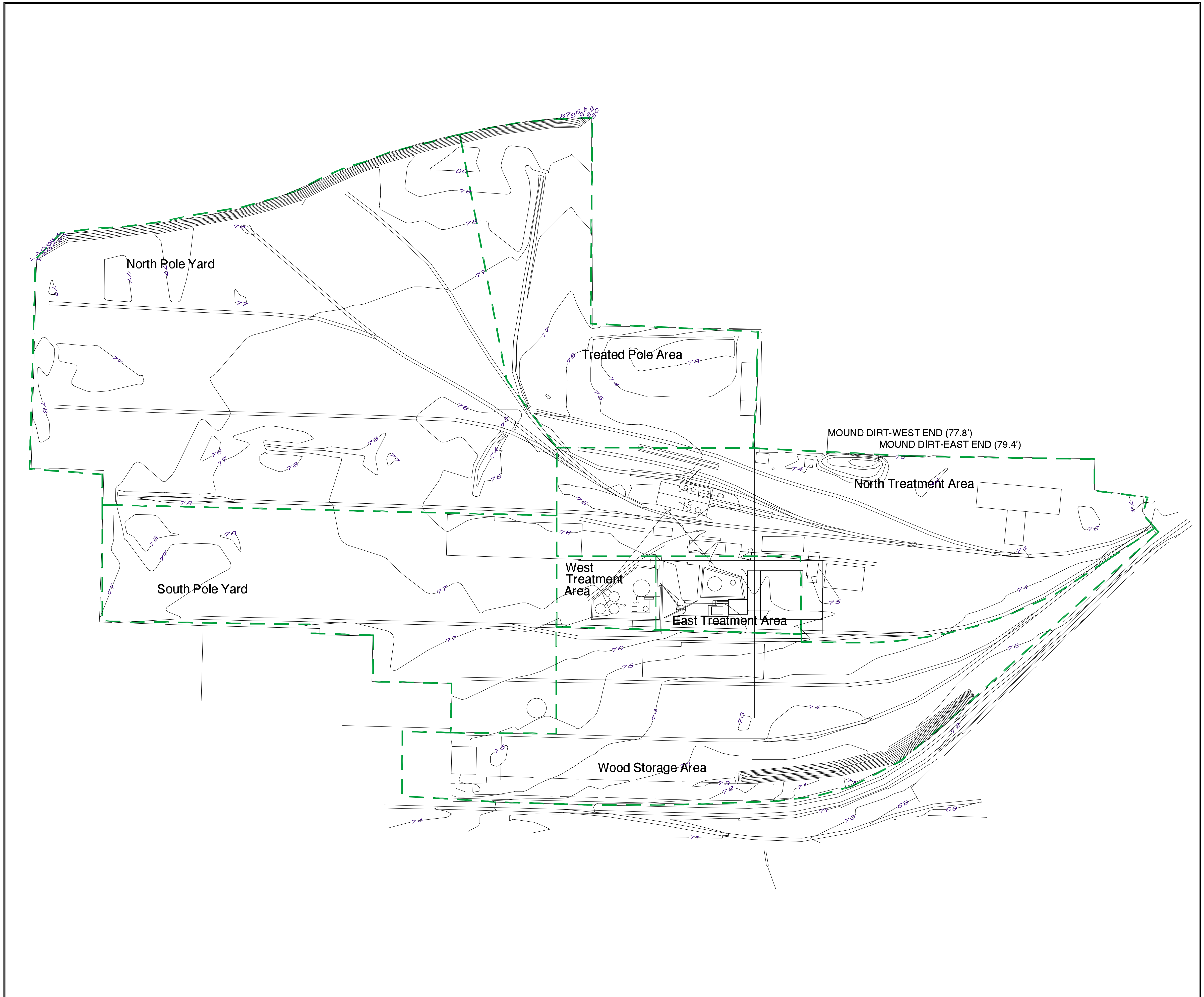


Figure 1-5

THE OESER COMPANY
SUPERFUND SITE

Bellingham, Washington

Remedial Investigation

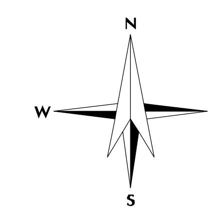
Facility Topographic and Subarea Map

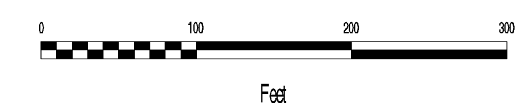
Legend

Subarea Perimeter

Contour Line

Contour Interval = 1 foot





MAP SOURCE

Oeser Company Site Map
Larry Steele & Associates
Survey Date: 12/3/1997

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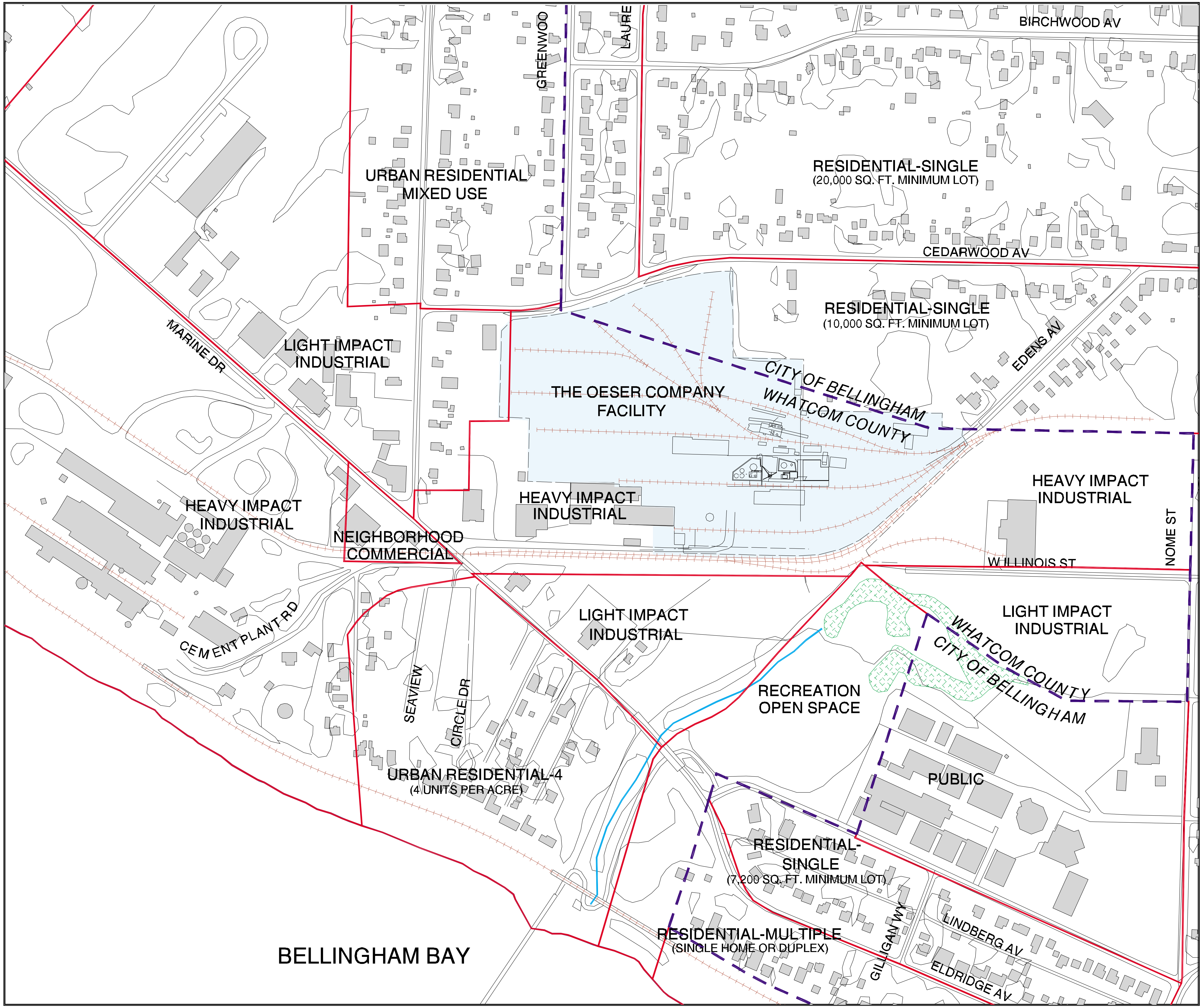

Figure 1-6

THE OESER COMPANY SUPERFUND SITE

Bellingham, Washington

Remedial Investigation

City of Bellingham and Whatcom County Zoning Designations

Legend

The Oeser Company Facility

City/County Jurisdictional Boundary

Zone Boundary

N W E S

0 250 500 750 1000

Feet

MAP SOURCE

City of Bellingham - Department of Public Works
Topographic Data Date: 1988

Oeser Company Site Map
Larry Steele & Associates
Survey Date: 12/3/1997

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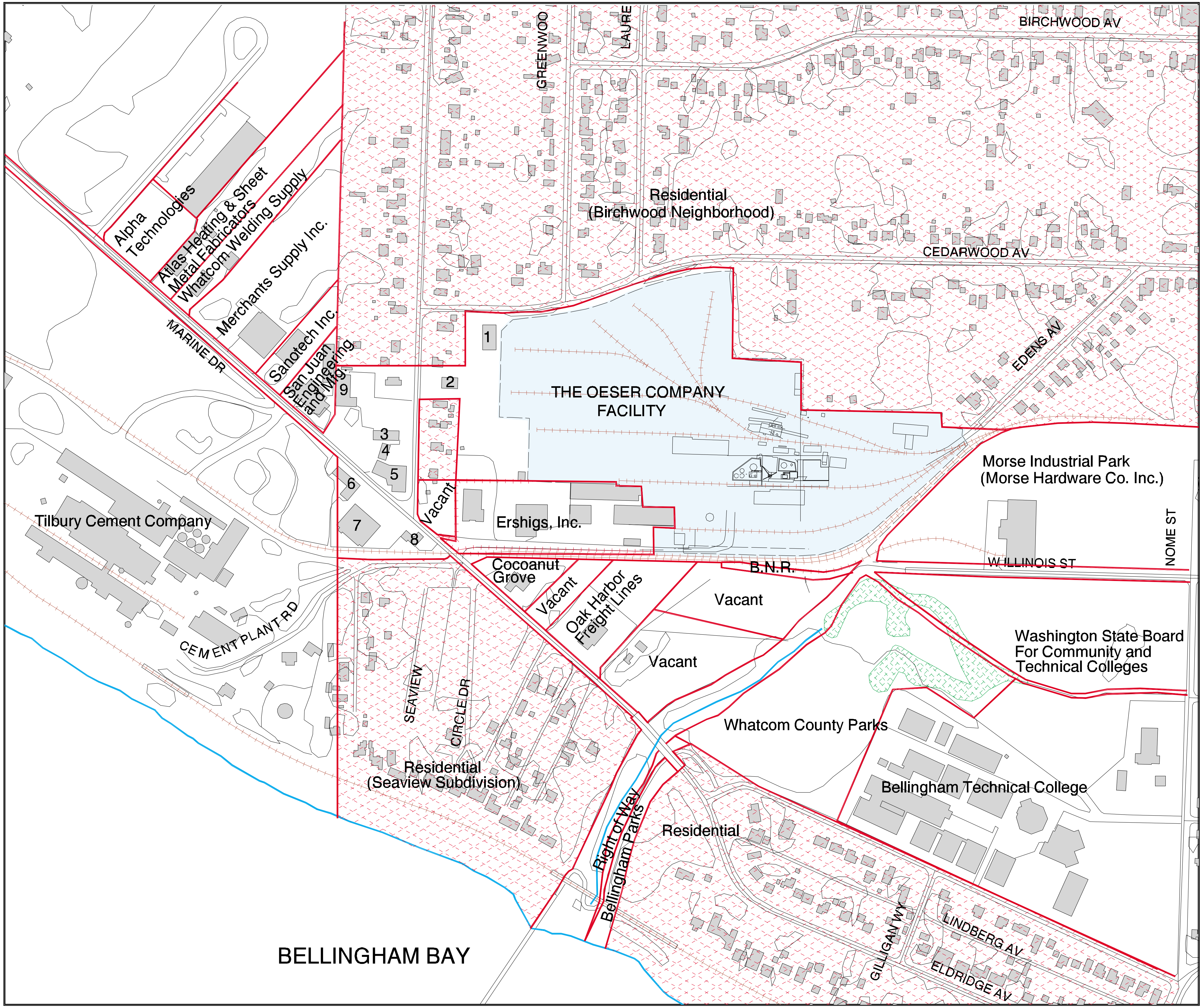

Figure 1-7

THE OESER COMPANY SUPERFUND SITE

Bellingham, Washington

Remedial Investigation

Land Use

Legend

- Landuse Boundary
- The Oeser Company Facility
- Wetlands
- Residential

1 Bennett Storage
2 B & B Paint Company
3 Headquarters-Whatcom Fire District #8
4 Interstate Batteries (Vacant for Lease)
5 Marine Drive Market/Echo Free Ad Paper
6 Northshore Student Center
7 Northshore Church
8 Marine Drive Auto Service
9 U.S. Customs

N W E S

0 250 500 750 1000

Feet

MAP SOURCE

City of Bellingham - Department of Public Works
Topographic Data Date: 1988

Oeser Company Site Map
Larry Steele & Associates
Survey Date: 12/3/1997

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International Specialists in the Environment
Seattle, Washington

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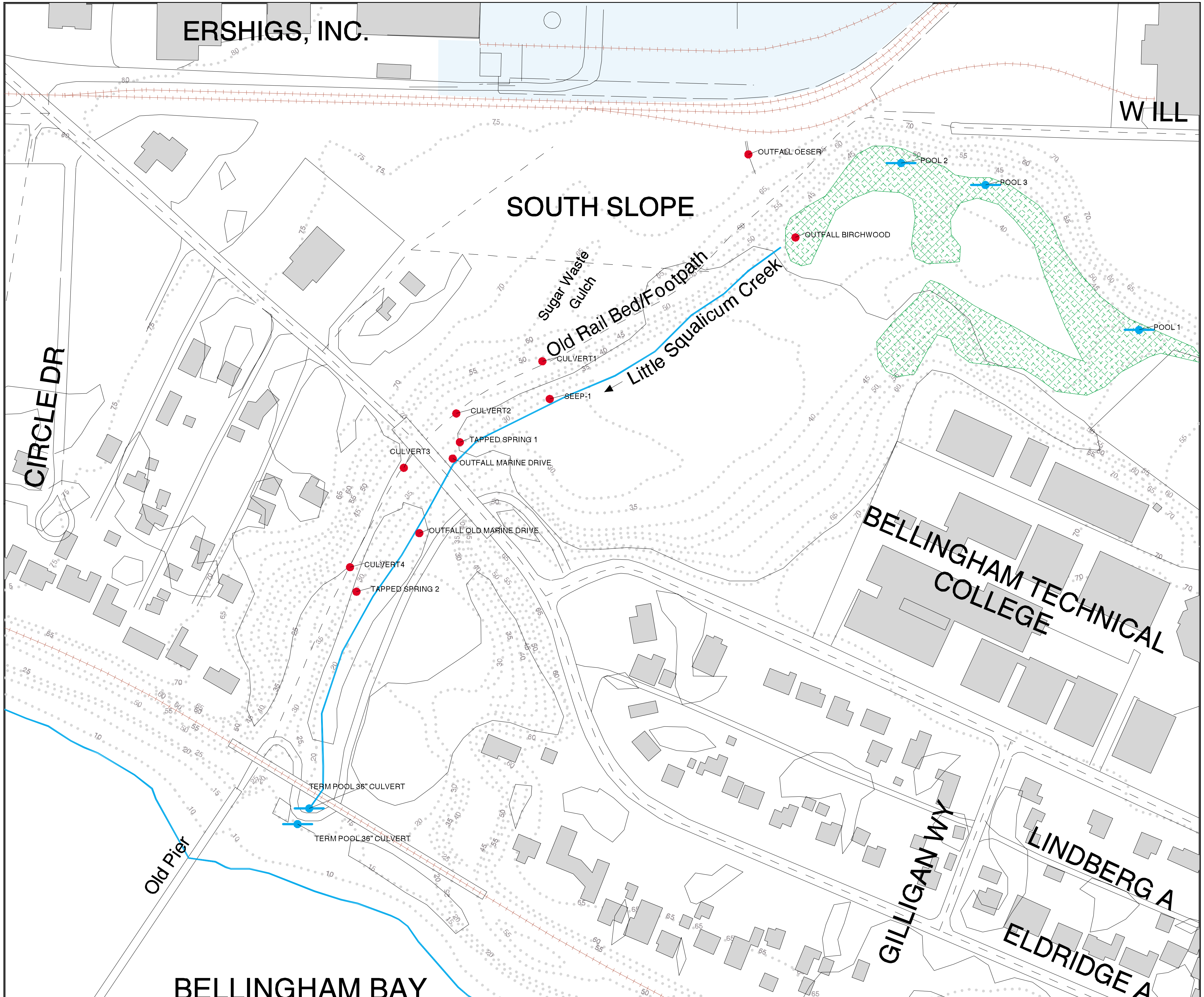
Figure 1-8

THE OESER COMPANY SUPERFUND SITE

Bellingham, Washington

Remedial Investigation

South Slope and Little Squalicum Creek



Legend

- The Oeser Company Facility
- Wetlands
- Building/Residential Structure
- Shoreline and Waterways
- Railroad Line
- Contour Interval
- Flow Direction

N W E S

0 100 200 300 400 500

Feet

MAP SOURCE

City of Bellingham - Department of Public Works
Topographic Data Date: 1988

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International Specialists in the Environment
Seattle, Washington

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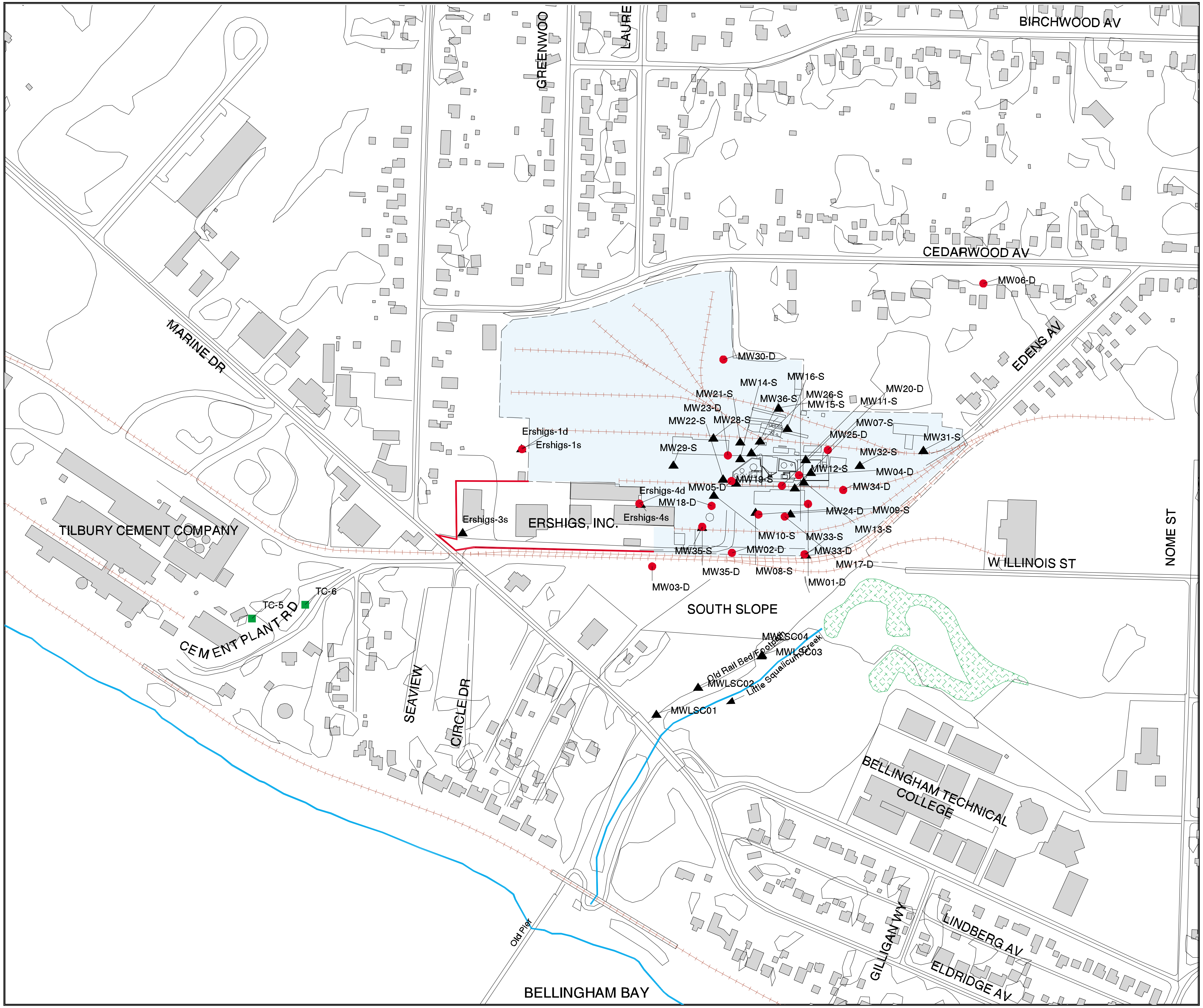


Figure 1-9

THE OESER COMPANY SUPERFUND SITE

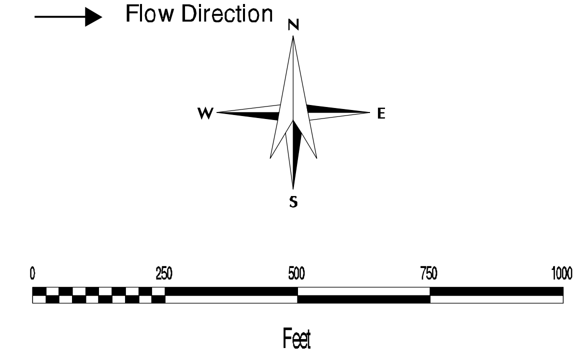
Bellingham, Washington

Remedial Investigation

Site Well Location Map

Legend

- The Oeser Company Facility
- Wetlands
- Deep Monitoring Well Location
- Shallow Monitoring Well Location
- Tilbury Cement Company Active Production Well
- Flow Direction



MAP SOURCE

City of Bellingham - Department of Public Works
Topographic Data Date: 1988

Oeser Company Site Map
Larry Steele & Associates
Survey Date: 12/3/1997

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/data1/oeser/rifs/fig1-9.aml

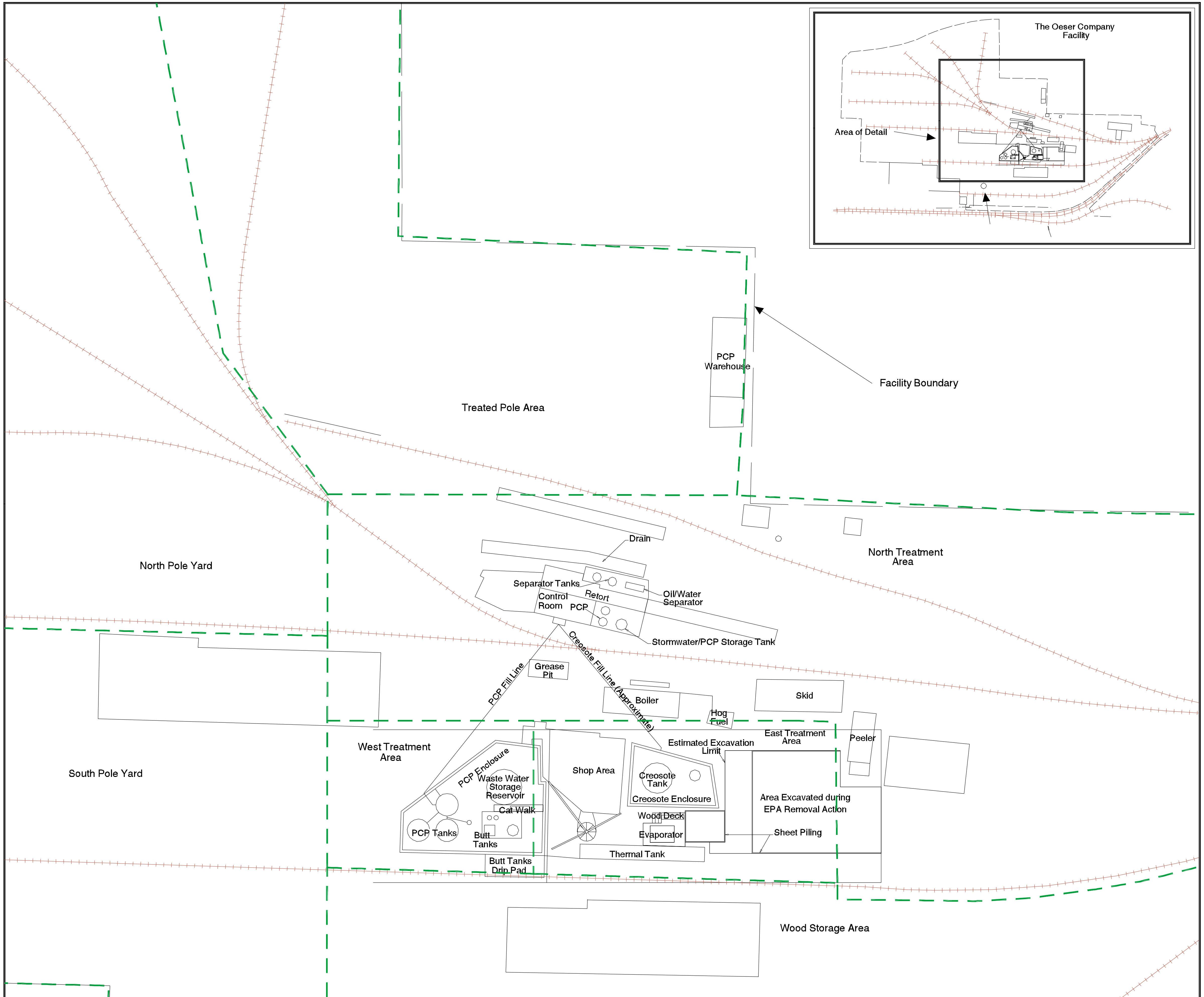
Figure 1-10

THE OESER COMPANY SUPERFUND SITE

Bellingham, Washington

Remedial Investigation

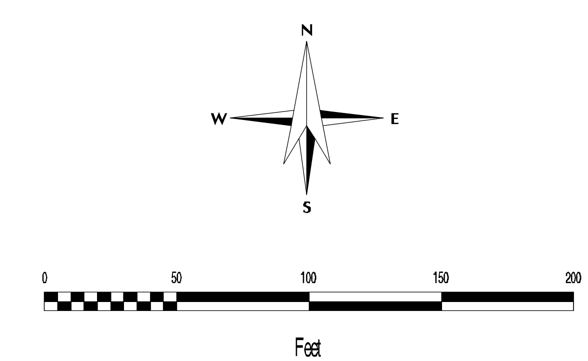
Facility Operations Layout



Legend

Subarea Boundaries

PCP Pentachlorophenol



MAP SOURCE

Oeser Company Site Map
Larry Steele & Associates
Survey Date: 12/3/1997

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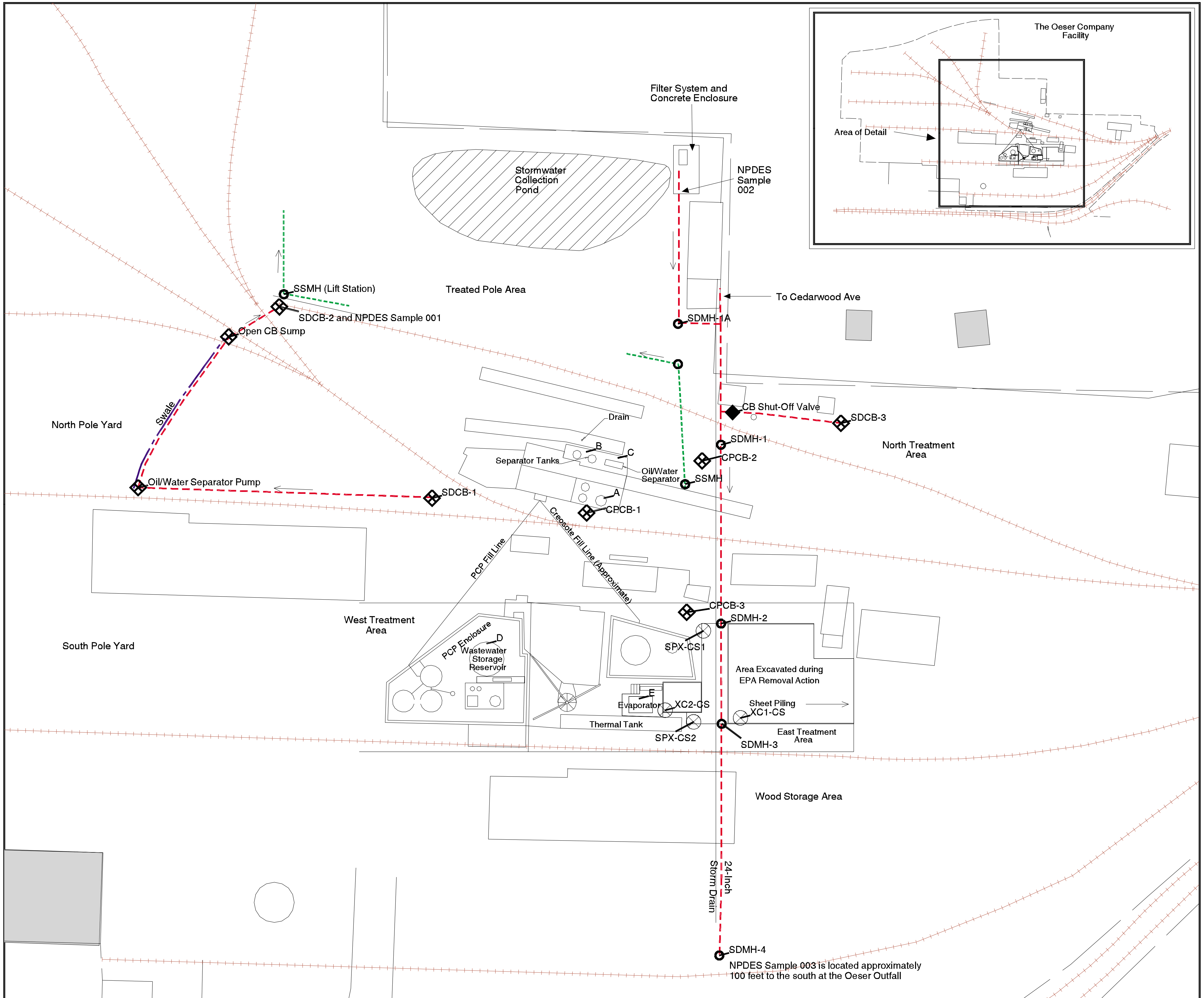

Figure 1-11

THE OESER COMPANY SUPERFUND SITE

Bellingham, Washington

Stormwater System

Legend

- Stormwater System
- Sanitary Sewer
- Manhole
- Catch Basin
- Dry Sumps in Removal Action Excavation

SDMH	Storm Drain Manhole
CB	Catch Basin
SD	Storm Drain
SSMH	Sanitary Sewer Manhole
CP	Collection Pond
CS	Collection Sump
NPDES	Natl. Pollutant Discharge Elimination System
PCP	Pentachlorophenol
A	Stormwater/PCB Storage Tank
B	Separator Tanks (2)
C	Oil/Water Separator
D	Stormwater Storage Reservoir
E	Evaporator

Notes:
1. A Through E = Process for Contact, Non-Contact, and Process Wastewater.
2. CPCB Discharged to SCP

MAP SOURCE

City of Bellingham - Department of Public Works
Topographic Data Date: 1988

Oeser Company Site Map
Larry Steele & Associates
Survey Date: 12/3/1997

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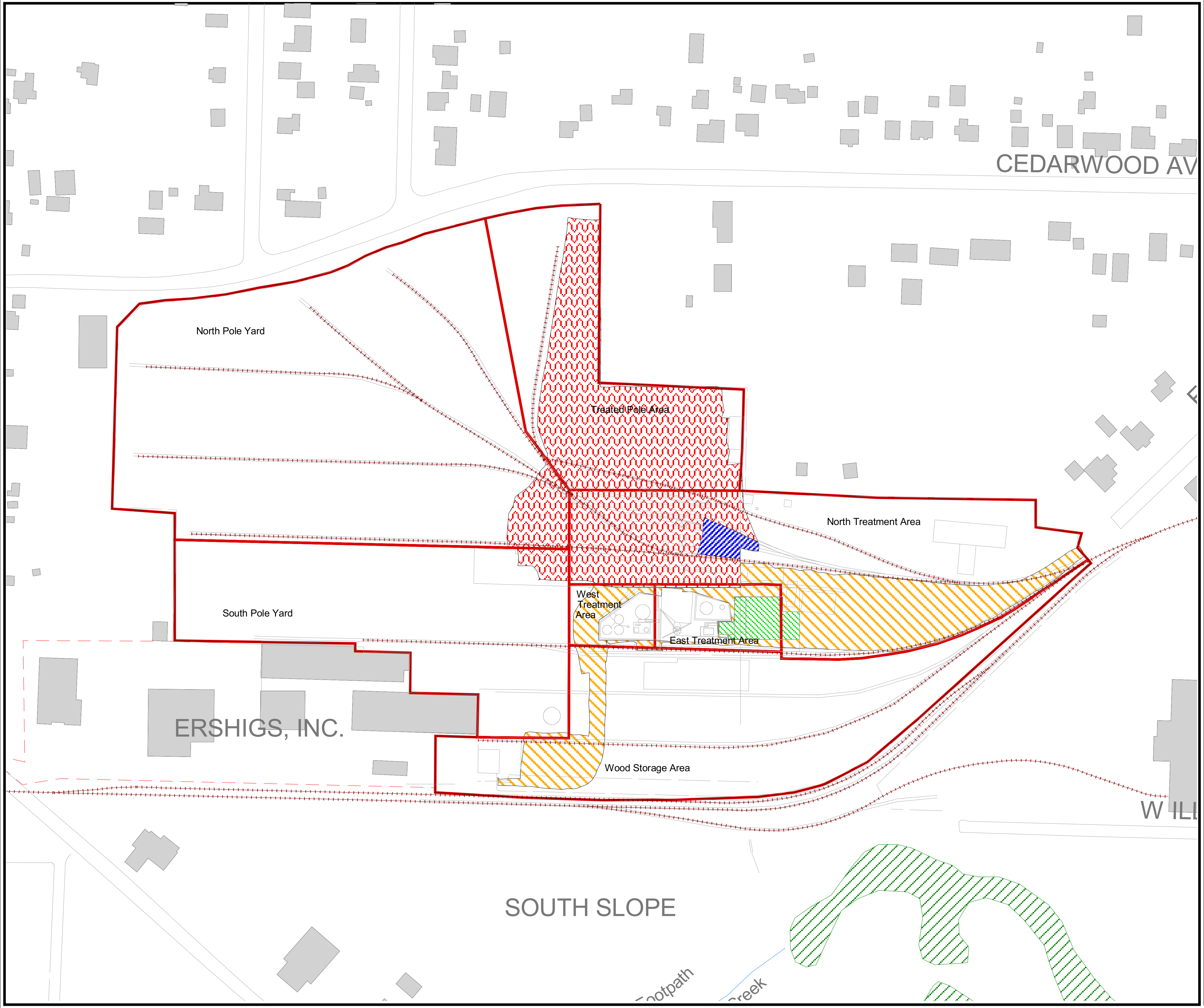

Figure 1-12

THE OESER COMPANY
SUPERFUND SITE

Bellingham, Washington

Existing Asphalt Capping

Legend

- Railroad
- Oeser Facility Layout
- Oeser Facility Areas
- Wetlands
- Buildings

Asphalt Cap

- 1995 Oeser Installed Cap
- Old Asphalt
- 1998 Removal Action Cap B
- 1998 Removal Action Cap A

N S W E

100 0 100 200 300 Feet

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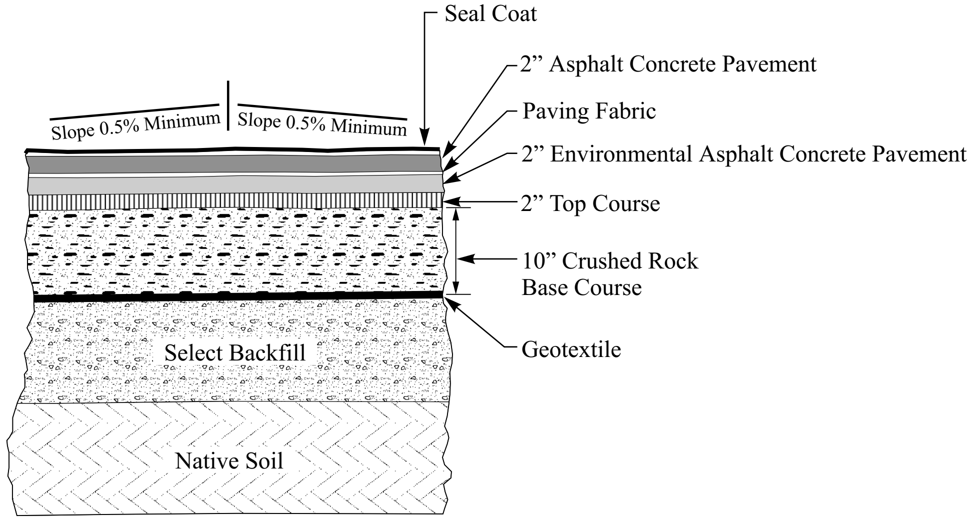
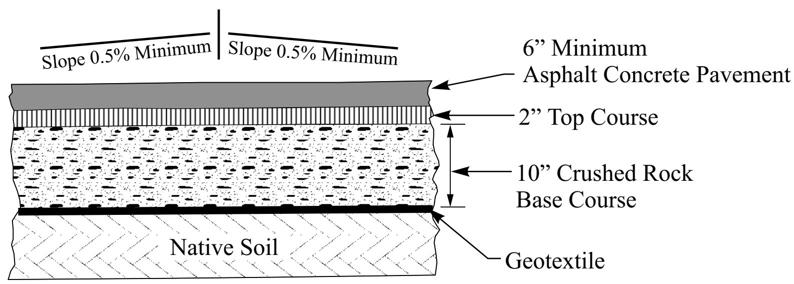


1998 Removal Action Cap A



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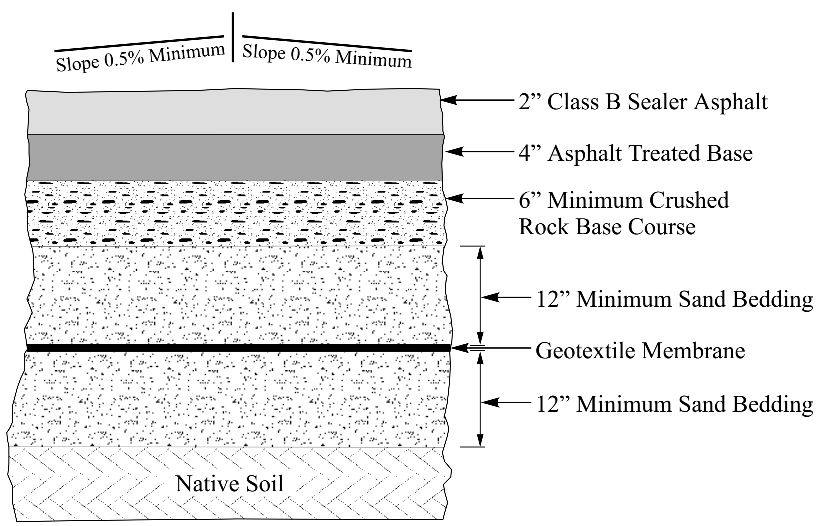

1995 Oeser Installed Cap

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THE OESER COMPANY
SUPERFUND SITE
DRAFT
FEASIBILITY STUDY REPORT
Bellingham, Washington

Figure 1-13

CROSS-SECTIONS OF CAP
CURRENTLY INSTALLED ON SITE

Date:	Drawn by:	
7-15-02	AES	10:START-2\01030016\fig 1-13

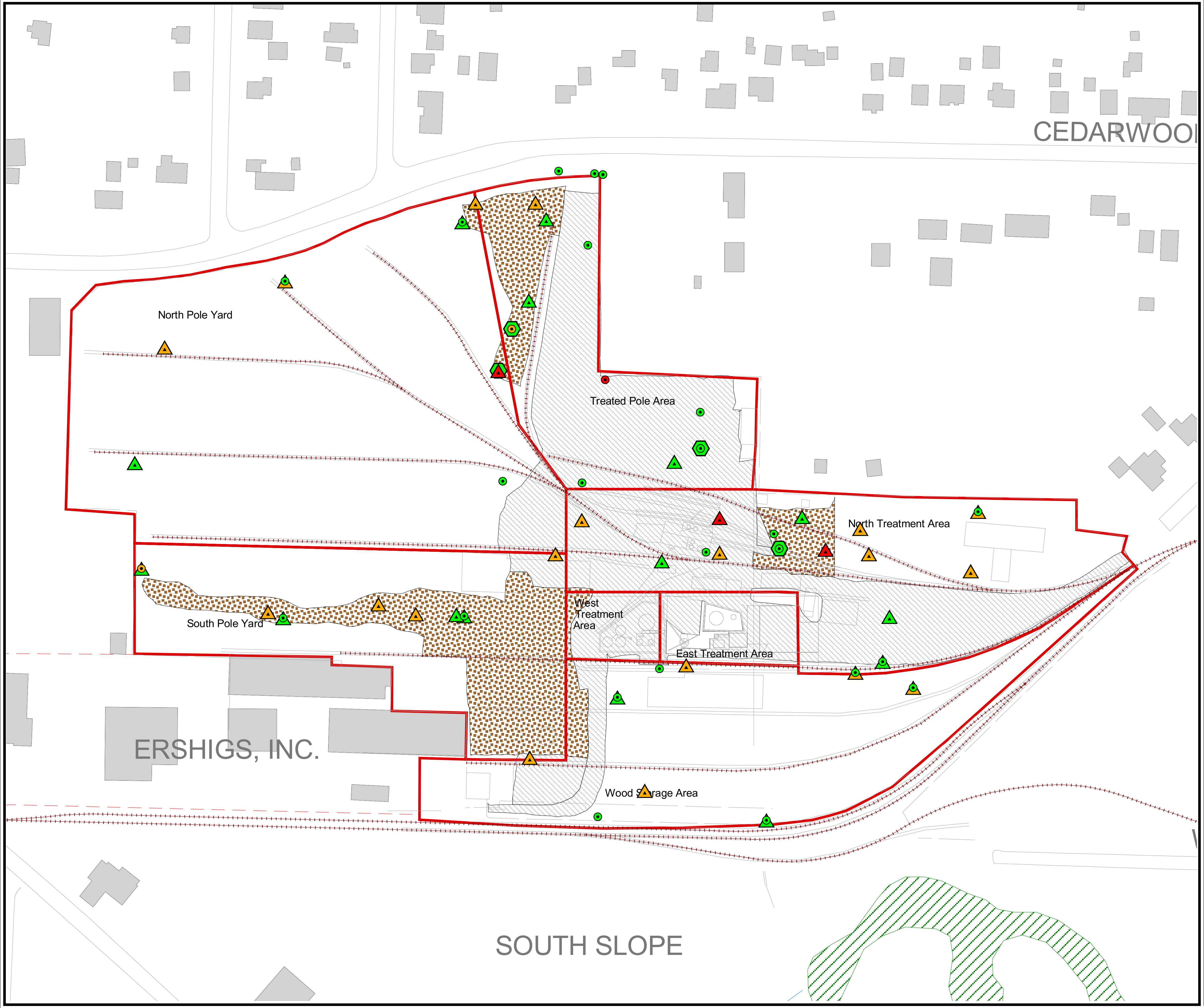

Figure 1-14

THE OESER COMPANY SUPERFUND SITE

Bellingham, Washington

Surface Soil Contamination Greater Than Proposed Cleanup Levels

Legend

B(a)P Sample Location
- 0 - 8.9 mg/kg
- 8.9 - 89 mg/kg
- >= 89 mg/kg

Naphthalene Sample Location
- 0 - 262 mg/kg
- 262 - 2620 mg/kg
- >= 2620 mg/kg

Dioxin Sample Location
- 0 - 875 ng/kg
- 875 - 8750 ng/kg
- >= 8750 ng/kg

Pentachlorophenol Sample Location
- 0 - 120 mg/kg
- 120 - 1200 mg/kg
- >= 1200 mg/kg

Railroad
Oeser Facility Layout
Oeser Facility Areas
Wetlands
Buildings

Surface Cover
Asphalt
Gravel Cap

N
W
E
S

100 0 100 200 300 Feet

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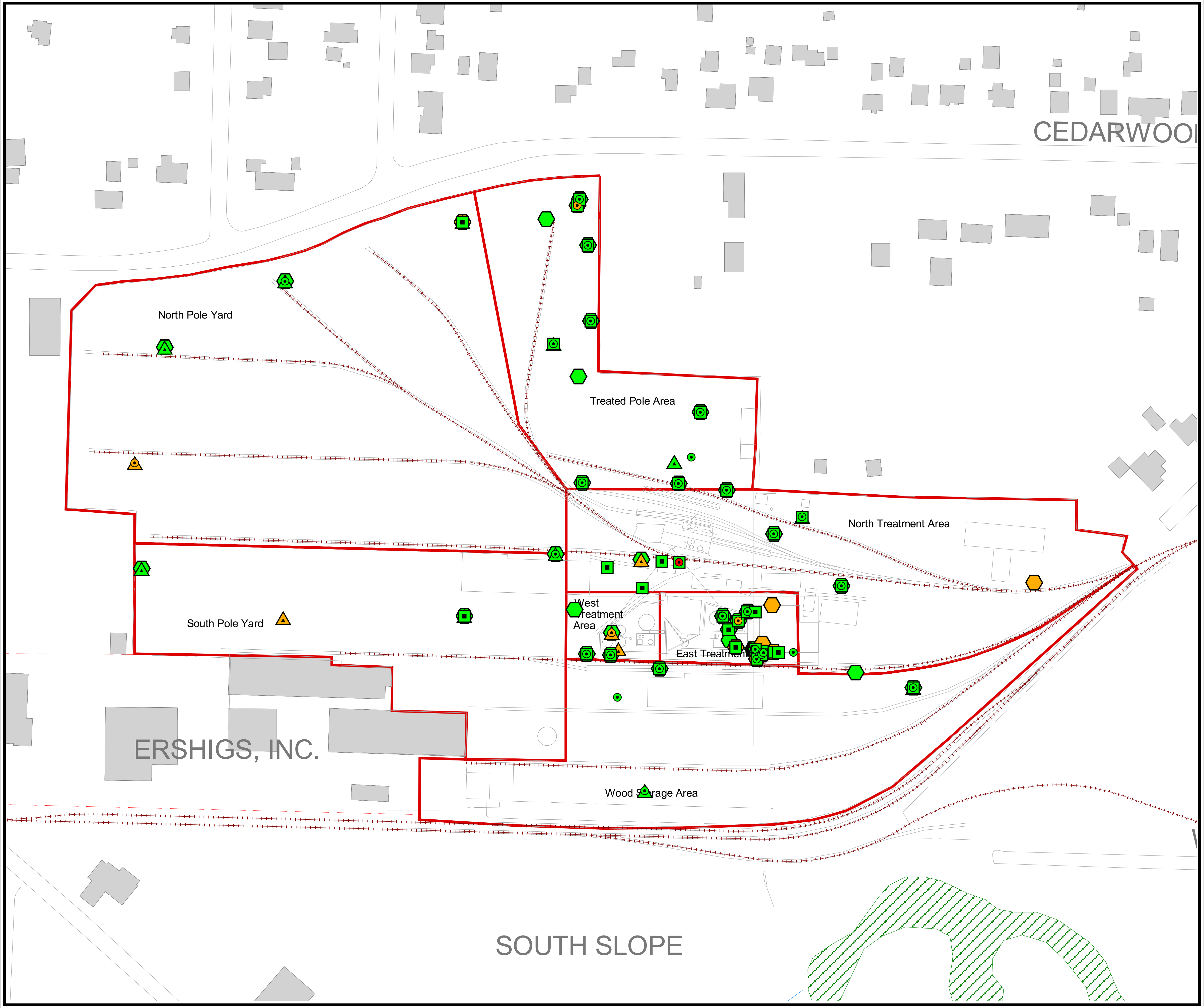

Figure 1-15

THE OESER COMPANY
SUPERFUND SITE

Bellingham, Washington

Subsurface Soil Contamination
Greater Than Proposed
Cleanup Levels
0 - 6 Feet

Legend

B(a)P Sample Location
- 0 - 8.9 mg/kg
- 8.9 - 89 mg/kg
- >= 89 mg/kg

Naphthalene Sample Location
- 0 - 262 mg/kg
- 262 - 2620 mg/kg
- >= 2620 mg/kg

Dioxin Sample Location
- 0 - 875 ng/kg
- 875 - 8750 ng/kg
- >= 8750 ng/kg

Pentachlorophenol Sample Location
- 0 - 120 mg/kg
- 120 - 1200 mg/kg
- >= 1200 mg/kg

Railroad
Oeser Facility Layout
Oeser Facility Areas
Wetlands
Buildings

N
W E
S

100 0 100 200 300 Feet

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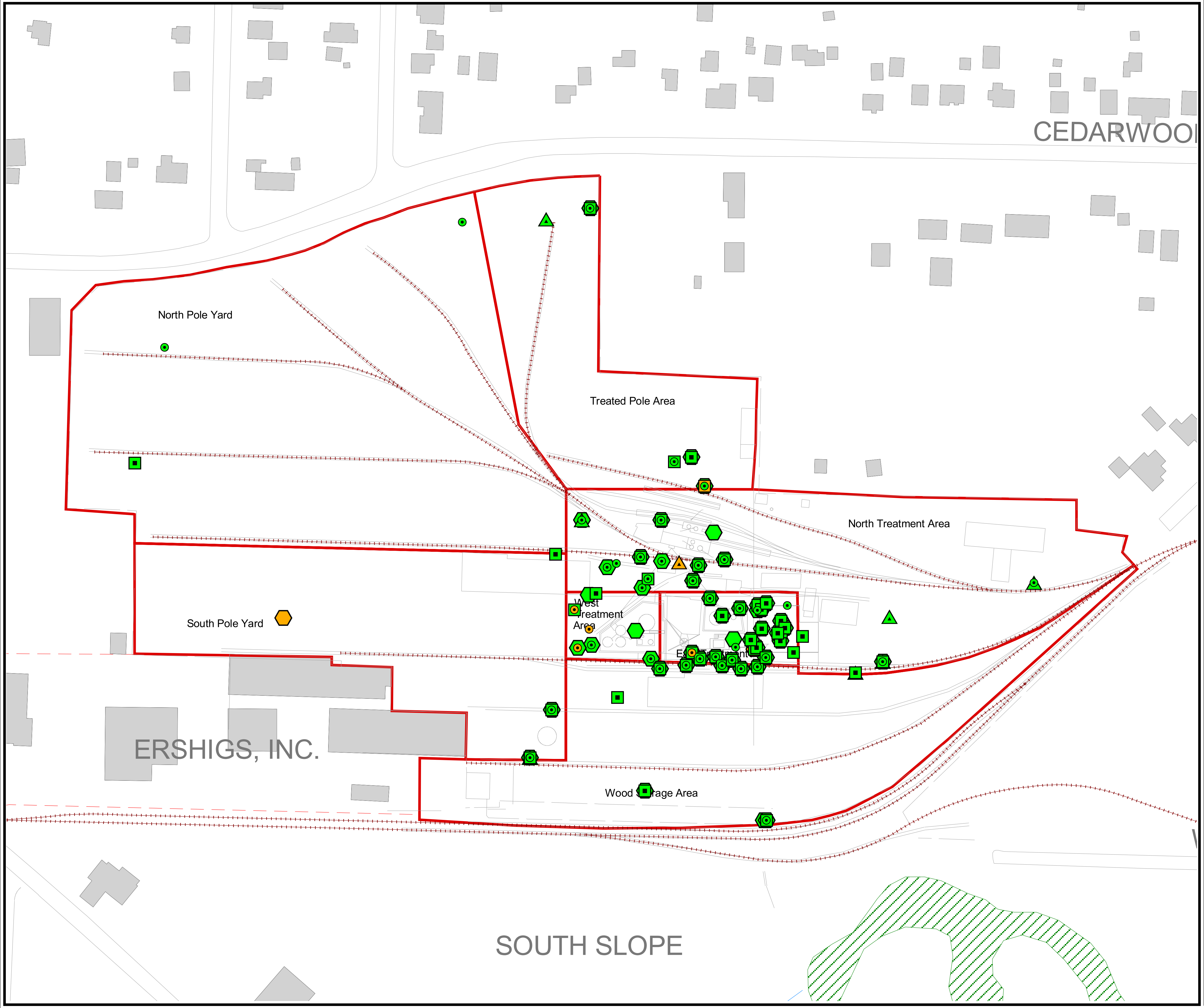
Figure 1-16

THE OESER COMPANY
SUPERFUND SITE

Bellingham, Washington

Subsurface Soil Contamination
Greater Than Proposed
Cleanup Levels
6 - 12 Feet



Legend

B(a)P Sample Location
- 0 - 8.9 mg/kg
- 8.9 - 89 mg/kg
- >= 89 mg/kg

Naphthalene Sample Location
- 0 - 262 mg/kg
- 262 - 2620 mg/kg
- >= 2620 mg/kg

Dioxin Sample Location
- 0 - 875 ng/kg
- 875 - 8750 ng/kg
- >= 8750 ng/kg

Pentachlorophenol Sample Location
- 0 - 120 mg/kg
- 120 - 1200 mg/kg
- >= 1200 mg/kg

Railroad
Oeser Facility Layout
Oeser Facility Areas
Wetlands
Buildings

N W E S

100 0 100 200 300 Feet

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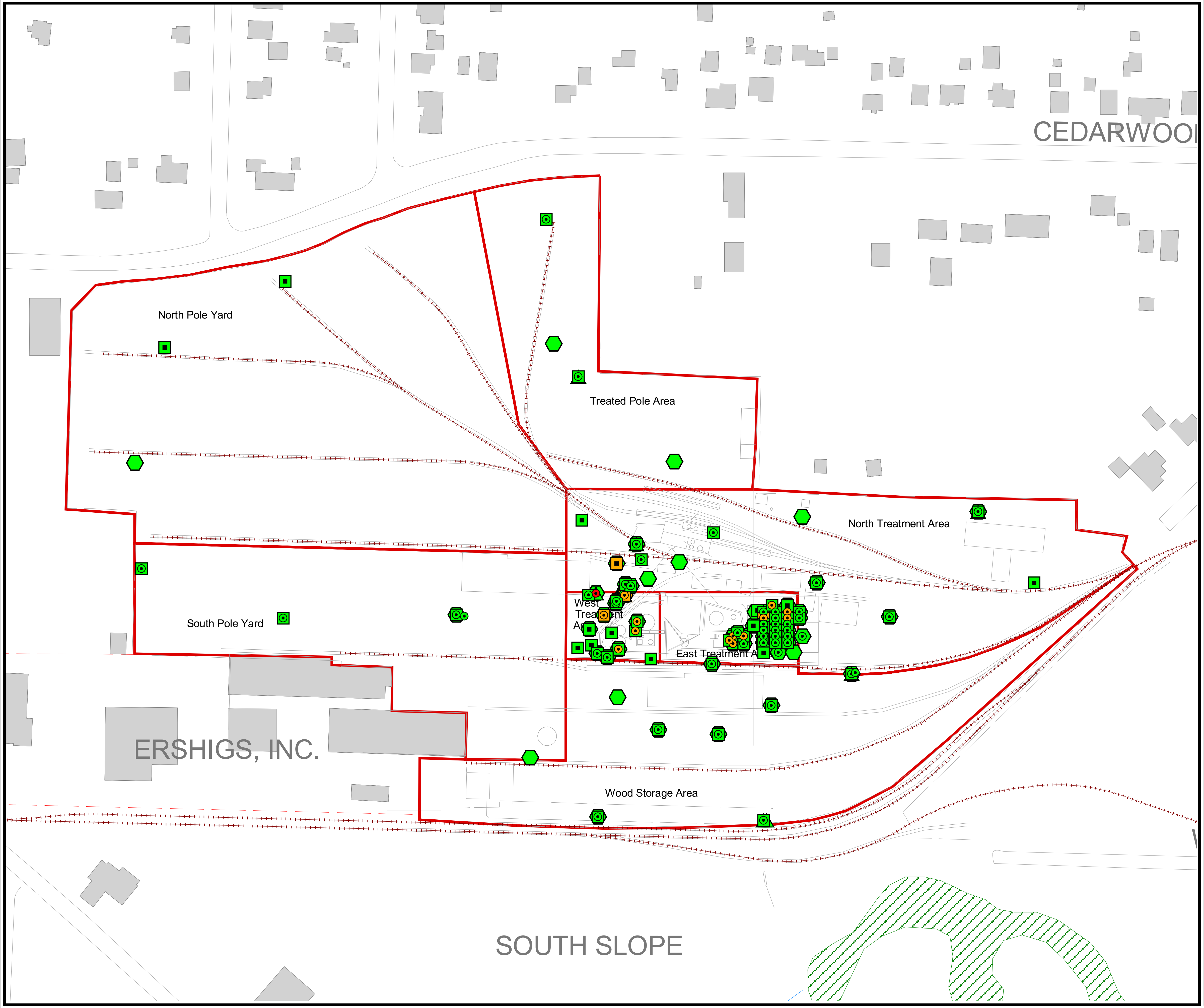
Figure 1-17

THE OESER COMPANY
SUPERFUND SITE

Bellingham, Washington

Subsurface Soil Contamination
Greater Than Proposed
Cleanup Levels
12 - 23 Feet



Legend

B(a)P Sample Location
- 0 - 8.9 mg/kg
- 8.9 - 89 mg/kg
- >= 89 mg/kg

Naphthalene Sample Location
- 0 - 262 mg/kg
- 262 - 2620 mg/kg
- >= 2620 mg/kg

Dioxin Sample Location
- 0 - 875 ng/kg
- 875 - 8750 ng/kg
- >= 8750 ng/kg

Pentachlorophenol Sample Location
- 0 - 120 mg/kg
- 120 - 1200 mg/kg
- >= 1200 mg/kg

Railroad
Oeser Facility Layout
Oeser Facility Areas
Wetlands
Buildings

N
W E
S

100 0 100 200 300 Feet

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Seattle, Washington

2. IDENTIFICATION AND SCREENING OF TECHNOLOGIES

2.1 INTRODUCTION

The following subsections describe the RAOs, present the general response actions, and identifies then screens the remedial technologies potentially applicable to Oeser. On the basis of the RI results, including the risk assessments, the media of concern to be evaluated in the FS were the on-facility soil and groundwater.

2.2 REMEDIAL ACTION OBJECTIVES

2.2.1 Summary of Facts

The following are the summary of facts about The Oeser Company Superfund site that were used to develop the RAOs for the site.

- The Oeser Company is an active industral facility (wood-treater).

C The majority of the facility property is zoned “heavy impact industrial” by Whatcom County. A small portion of the site located within the City of Bellingham is zoned “residential-single,” but the City issued The Oeser Company a “Certificate of Nonconformance” (an exemption).

- The expected future use of this facility is industrial.
- The facility is subject to the regulatory requirements of the RCRA.
- The facility is a registered emissions source with the Northwest Air Pollution Authority (NWAPA).
- The facility has an active NPDES permit.
- Groundwater is not used at the site, nor are there any current plans to use groundwater in the future at the site. The deeper aquifer is considered a viable source of groundwater for potable water, while the shallow groundwater is not.
- Both location- and media-specific RAOs were developed based on RI findings which include a site specific baseline HHRA and an ERA.
- EPA is required to consider ARARs when making remedial action decisions. There are a number of ARARs for this site including, but not limited to, the portions of RCRA, the State of Washington’s MTCA’s recently amended rules and Washington State’s Dangerous Waste (DW) Regulations.

2.2.2 Development of Remedial Action Objectives

Using the facts presented above, RAOs were developed for each area, medium, and COC at Oeser. The RAOs are summarized in Table 2-1. A discussion of proposed clean up levels for Oeser is provided as Appendix A.

2.2.2.1 Near-Facility Residential Area

Composite soil samples from a series of homes near the facility were obtained and analyzed for selected constituents that were associated with The Oeser Company's wood treating activities. Air samples also were collected from locations near the facility. Estimated risks based on dioxins and furans in soil and air were compared with soil and air samples obtained from urban areas in Bellingham (background samples) not expected to be affected by releases to air from The Oeser Company facility. Results indicated that estimated risks from dioxins and furans in soil and air are not significantly different between the residential area around the facility and the background area. Estimated risks associated with exposure to air are discussed in Subsection 2.2.2.7. Estimated cancer risks associated with exposure to near-facility surface soil (which include ingestion, dermal contact, and home-grown vegetable ingestion) ranged from 4E-06 to 2E-04. In cases where dioxins/furans and carcinogenic PAHs were not present at the DL, risk estimates were based on the use of one-half of the analytical DL. This is generally considered to result in an over-estimation of actual risk, especially when a high percentage of results are non-detect. There were no significant non-cancer hazards associated with exposure to near-facility residential surface soil.

Because risks associated with exposure to residential soil were not significantly different than those associated with background soils, RAOs were not developed for the near-facility residential area. The RAO for on-facility soil (described below) is expected to decrease residential exposure to facility-related dust and vapors by near-facility residents. To the extent that residential soils are impacted currently by such releases, those impacts should be reduced as a result of the RAO.

2.2.2.2 South Slope and Hiking Path

Estimated individual excess lifetime cancer risk associated with dermal, inhalation and ingestion exposure to surface soil within the south slope area and along the old railroad bed hiking path above Little Squalicum Creek to a recreational visitor was 1E-06. Conservatively, as with residential surface soil, risks calculated from dioxins/furans and carcinogenic PAHs were based in many cases on one-half of the analytical DLs when these chemicals were not detected. As described in the following section, ecological risks were driven by the levels of chemical contamination in surface soil (i.e., spoils piles) along the banks of Little Squalicum Creek, not by surface-soil contamination on the south slope or hiking path, which were low in comparison.

Based on this information, RAOs were not developed for the south slope and hiking path areas.

2.2.2.3 Spoils Piles on the Creek Bank

Samples from the spoils piles showed the presence of carcinogenic PAHs, dioxins/furans, and TPH above DLs. The risks and hazards associated with exposure of the recreational visitor to the spoils piles were within the acceptable range. Estimated individual excess lifetime cancer risk to the recreational visitor was 4E-05 and the HI was 0.5.

The ERA considered the south slope, hiking path, spoils piles, and creek bank as one area because wildlife are able to move freely between these areas. The assessment involved screening soil samples against benchmarks for plants and terrestrial invertebrates (e.g., earthworms). No risks to plants and soil fauna from PCP were identified; potential risks from exposure to PAHs appear to be limited to one sample location on the north bank of the creek. However, the location was heavily overgrown by various species of grasses, shrubs, and vines, and there was no visible evidence that the vegetation was stressed. Risks to the American robin and masked shrew were also evaluated due to their potential to feed on flora and fauna within the creek area. Total exposure estimates were calculated based on the sum of exposures via incidental ingestion of soil and ingestion of terrestrial invertebrates. Hazard quotients exceeded the benchmark level of 1 for exposure of both the robin and shrew to PCP, PAHs, and dioxins.

However, the estimated risks from PCP reflect the use of one-half the DL to represent the PCP concentration when it was not detected. Because the PCP DL was elevated in several samples due to matrix interference, the risks to wildlife from PCP likely are overestimated. For dioxins/furans and particularly for PAHs, the level of soil contamination at a single sample location contributed most to the estimated wildlife risks. For these groups of chemicals, because the contamination is restricted to a small area, it does not represent a threat to the population of small mammals and songbirds that use the creek area and south slope, although a few individuals could be affected if they were to forage only in the most contaminated locations (a situation that seems unlikely).

Overall there is not a compelling reason to pursue remedial work in the creek area to reduce risk to ecological receptors. Also, a remedial action (such as excavation) would destroy some of the local environment causing adverse effects on the eco-system. Consequently, no RAO for the spoils piles is recommended.

2.2.2.4 Little Squalicum Creek

Surface Water. Little Squalicum Creek is an intermittent stream fed primarily by untreated storm drainage from the surrounding area. Consequently, the surface water is not currently a source of drinking water by humans and is not expected to be used in the future for human drinking water. However, the surface water is visited by humans and is probably a source of drinking water to wildlife. The lack of flow appears to be the primary reason why this creek/storm drain does not support fish, nor is it likely to in the future. The Oeser Company maintains a current NPDES permit allowing the discharge of treated storm water from the facility into Little Squalicum Creek.

Risks and hazards to a recreational visitor to Little Squalicum Creek were assessed by evaluating dermal exposure to surface water. Potential excess individual lifetime cancer risk associated with dermal exposure to surface water by a recreational visitor was 5E-04. Dioxins and furans account for approximately 90% of the risk estimate, which in this case was largely based on detected results. The HI associated with dermal exposure to surface water was 0.005. However, the assessment of risks and hazards from dermal contact via water to very lipophilic molecules, such as TCDD, B(a)P and PCP, is highly uncertain. Their dermal permeability coefficients are outside the effective predictive domain, and therefore the estimations of doses received from dermal contact are considered to be less than reliable, but are in any case most likely to be highly overestimated.

The creek supports benthic invertebrates and probably also other forms of aquatic life, such as amphibians. In addition, salmon fingerlings have occasionally been observed in the small pool that forms where the creek meets the Bellingham Bay beach. Risks to such receptors from chemical contamination in surface water appear to be minimal, being restricted to two locations where minor exceedences of benchmarks were observed during a storm event. In evaluating risks to ecological receptors, one-half the DL was used for non-detects. However, even in the absence of chemical contamination, it seems unlikely that the creek would support a diverse community of aquatic biota given its shallowness and current flow condition. Drinking of creek water by wildlife accounts for an insignificant fraction of their total chemical exposure.

The dioxins present in the creek may be a result of the storm water discharge from The Oeser Company as well as the surrounding neighborhood. For example, based on the July 1999 sampling event, a distinct gradient of contamination could not be identified and yet, a decreasing gradient of contamination from upstream to downstream was found based on analytical data from the December 1999 sampling event.

Shallow groundwater does not appear to discharge directly to the creek, and deep groundwater is likely a source of only de minimus concentrations of Oeser-related contamination. Groundwater contaminant levels are reduced by about 3 to 4 orders of magnitude while migrating from shallow to deep groundwater. These levels are further reduced during the journey to the creek, and are further diluted upon entering the creek. Therefore, the contribution of contaminants from the shallow/deep groundwater occurs at a very slow rate and is negligible when compared with what the creek is receiving in direct run-off from the surrounding community. Based on the relationship of the transport of contaminants between the shallow to deep groundwater and then to the surface water, it is not necessary to develop a RAO for protection of surface water from shallow/deep groundwater because the contribution of contaminants to the creek are negligible.

Since NPDES discharges are regulated through a State permit, compliance with NPDES limits is enforced through the Washington State Department of Ecology's (Ecology's) Water Program. It should be noted that surface water data used in the HHRA and ERA was collected prior to the installation of the carbon treatment system at the Oeser outfall. This is expected to reduce the level of site-related contaminants which might otherwise be discharged to the creek. For all the reasons presented here, no RAOs have been established for storm water from The Oeser Company facility.

Sediment. Risks associated with dermal exposure to sediment in Little Squalicum Creek were within the acceptable range of risks; 8E-07 upstream from Marine Drive and 5E-07, downstream from Marine Drive. The background sediment sample risk was estimated to be 1E-08. PAHs were the primary COPCs for these locations. Risks associated with non-carcinogens were de minimus. Current levels of sediment contamination do not appear to pose a threat to benthic life in the creek, and risk to wildlife that consume aquatic insects from the creek also appears to be minimal. Therefore no RAOs have been developed for Little Squalicum Creek sediment.

2.2.2.5 On-Facility Soils

Potential excess individual lifetime cancer risks associated with exposure (ingestion, inhalation of soil-derived particulates and vapors, and dermal contact) to surface soil for current facility workers exceeded the acceptable range of risks as defined by the EPA; risks ranged from 5E-04 to 1E-03. Risks associated with future on-facility workers exposure to subsurface soil also exceeded the acceptable risk range. Incidental ingestion accounts for more than 90% of the risk estimate for the worker exposure scenario. The HI of 1 was not exceeded for surface soil but was exceeded for exposure to subsurface soil. A removal action in which 108,000 liters of PCP contaminated liquid, 92,000 liters of creosote, and 7,700,000 kilograms of contaminated soil were removed or excavated and treated off-site has been completed.

RAO 1: Reduce ingestion, inhalation, and dermal contact with soil contaminants above industrial CULs and reduce migration of soil contaminants that would result in deep groundwater contamination exceeding groundwater CULs.

2.2.2.6 On-Facility and Off-Facility Groundwater

Shallow Groundwater. Shallow groundwater is not used on-facility or off-facility. Shallow groundwater fails to meet either Washington State (MTCA [Chapter 173-340-720 WAC]) criteria or Federal (EPA 1986) guidelines for classification as a drinking water aquifer due to the low yield of water on pumping. Shallow groundwater does infiltrate into the deeper aquifer. Light nonaqueous phase liquid (LNAPL) was found in three shallow wells. Passive absorbent systems were installed in these wells for one year during the RI field event. LNAPL has not been found in these wells after that year.

RAO 2: Reduce ingestion and dermal contact with shallow groundwater, and reduce migration of contaminants from shallow groundwater that would result in deep groundwater contamination exceeding groundwater CULs.

Deep Groundwater. The deep groundwater yields sufficient water on pumping to be classified as a drinking water aquifer, although its use has been limited. The deep groundwater is not currently used on-facility. It has been used in the past and may be used at any time for ingestion and showering at the Tilbury Cement Company, located cross-gradient of groundwater flow from The Oeser Company facility. EPA sampled the two existing deep groundwater wells at Tilbury and found no detectable levels of Oeser-related contamination. The deep groundwater potentially discharges to Little Squalicum Creek and to Bellingham Bay.

During the remedial investigation, four quarterly samples were taken from several deep aquifer wells mainly located on-site. The deep aquifer was found to be slightly contaminated directly under the treatment facility. A total of approximately 60 samples were analyzed for COCs. Two wells located next to the treatment facility in the center of the site (deep wells 5D and 25D), had concentrations exceeding the residential MTCA Method B groundwater standard for PCP. Only one of these quarterly concentrations was above the industrial MTCA Method C groundwater standard for PCP. There was also one minor exceedance of the MTCA Method B groundwater standard for dioxin (deep well 1D), but it was below the MTCA Method C dioxin standard.

Future potential risks associated with on-site deep aquifer groundwater ingestion and dermal contact to on-facility residents ranged from 5E-04 to 1E-03, and potential HIs ranged from 0.01 to 0.1. For future on-facility workers, estimated risk with deep aquifer groundwater ingestion were 8E-06 and potential HIs ranged from 1E-04 to 2E-03. The estimated risks were primarily associated with dioxins/furans, PCP, and PAHs. However, only two PAHs were detected in one well, so most of the estimated risks for PAHs were based on the use of one-half of the DLs for these compounds. At least one dioxin congener was detected in every well, although none of the concentrations exceeded the respective screening value. Consequently, the calculation of the risks due to dioxins/furans is based largely on the use of one-half of the DLs for non-detected compounds.

RAO 3: Reduce potential for ingestion and dermal contact with deep groundwater containing contaminants above groundwater CULs and prevent off-site migration of groundwater with contaminants above CULs.

2.2.2.7 Air

The Oeser Company is an active wood treating facility that is a registered emission source with NWAPA. Estimated risks associated with exposure to air (inhalation of dust and vapors) to nearby residents ranged from 3E-06 to 3E-05. Only one sample location exceeded a risk of 1E-5 (AS-29). The main COPC that contributed to that risk was PCP. Noncancer HIs for air inhalation ranged from 0.06 to 5. Hazard indices exceeded 1 at two air sampling stations located along the facility's northeast fence line (AS-25 (HI=3) and AS-29 (HI=5)). The chemical contributing most to the HIs was 1,2,4-trimethylbenzene.

Because these risks and hazards at the near-facility residential area are likely associated with on-going permitted facility operations, this information has been provided to other programs within the EPA (i.e., RCRA), NWAPA, and Ecology, as well as to The Oeser Company and the residents.

Given the above information, RAOs have not been developed for air. However, to the extent that portions of the measured COPCs in air were due to dust and vapors from contaminated soil at The Oeser

Company facility, as opposed to on-going facility operations, the RAO for on-facility soils is expected to reduce such exposures.

2.3 GENERAL RESPONSE ACTIONS

General response actions are actions that satisfy the RAOs and ARARs. The general response actions are the conceptual components of remediation alternatives and, like RAOs, are medium-specific. Identifying the general response actions is the basis for the selection of the remedial alternatives. The media of concern at Oeser are soil and groundwater.

2.3.1 Soil

Actions to remediate hazardous substances in the soil can be categorized as no action, institutional controls, containment, excavation/disposal, and thermal/chemical/biological/chemical treatment.

- The no action alternative was included for all media of concern as a baseline for comparing other potential response actions.
- Institutional controls include access restrictions that reduce the number of people who may be exposed to hazardous substances via ingestion, direct contact, or inhalation of source material. Depending on the remedy selected, institutional controls may also include future use restrictions preventing nonindustrial uses (i.e., residential) and establishing O&M requirements through restrictive easements, enforcement orders, consent decrees, or other mechanisms.
- Containment inhibits the migration of hazardous substances and reduces exposure to hazardous substances by reducing contact with those substances.
- Excavation and disposal would remove the source of contamination and reduce the possibility of future exposure.
- Thermal/chemical/biological/chemical treatment includes in-situ and ex-situ treatment. Treatment prevents ingestion, direct contact, and inhalation of hazardous substances so that ingestion or dermal exposure to hazardous substances should not result in a significant health risk; and prevents migration of contaminants at concentrations above the CULs.

2.3.2 Groundwater

Actions to remediate hazardous substances in groundwater include no action, institutional controls, monitoring, containment, and treatment. The no action general response action for groundwater is defined in Subsection 2.3.1.

- Institutional controls and monitoring to assess the extent of contaminant migration, and groundwater use restrictions that limit pumping and on-facility use to reduce the number of people who may be exposed to hazardous substances via ingestion, direct contact, or inhalation of groundwater.
- Containment inhibits the migration of hazardous substances and reduces exposure to hazardous substances by reducing contact with those substances.
- Thermal/chemical/biological/chemical treatment includes in-situ and ex-situ treatment. Treatment removes contamination or reduces contaminant mobility, such that ingestion, direct contact, and inhalation of groundwater would not result in a significant health risk.

2.4 IDENTIFICATION AND SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS

RAOs have been identified for Oeser, which state the desired post-remedial results for locations, matrices, and chemicals. Individual RAOs are discussed in more detail in Subsection 2.2.

As stated previously, The Oeser Company is an active industrial wood treating facility. The facility is zoned for heavy industry and likely will continue to be zoned for heavy industry in the future. Areas of concern at Oeser include surface soil, subsurface soil, shallow groundwater, and deep groundwater at the facility. Based on the RI conducted at Oeser, soil at the facility is contaminated with dioxin, cPAHs in the form of B(a)P equivalents, PCP, naphthalene, and total petroleum hydrocarbons at levels exceeding acceptable risk levels. The majority of soil contamination is found in the wood treatment areas and extends to a depth of 20 feet bgs. The COCs in the groundwater include PCP, dioxin, and cPAHs in the form of B(a)P equivalents.

In general, sites are remediated using three strategies, separately or in combination:

- Destruction or alteration of contaminants,
- Extraction or separation of contaminants from the media, and
- Immobilization of contaminants.

Multiple technologies to implement each strategy have been developed. Usually, several technologies are appropriate to address specific media, contaminants, or site situations. The EPA also has developed presumptive remedies for some categories of sites that have similar characteristics, such as types of contaminants present, disposal practices performed, or environmental media affected (EPA 1995). For example, the EPA has developed presumptive remedies for soil, sludge, and sediment at wood treating facilities; and where appropriate, these remedies have been identified in this document.

General response actions were identified for each RAO in Subsection 2.3. For each response action, remedial technologies are identified, and where appropriate, process options also are identified and evaluated with respect to RAOs. The No Action alternative is evaluated for each RAO as required by the NCP and will be carried through to the detailed analysis of alternatives as a baseline for comparison to other alternatives.

The specific RAOs developed for the site and the response actions, technologies/process options for each are presented below. A general description of each technology is provided, followed by the rationale for retaining it or eliminating it from further consideration. Response actions, technologies, and process options have been identified and screened as applicable for remediation at Oeser and are evaluated with respect to each RAO in Table 2-2. Specific evaluation criteria include cost, effectiveness, and implementability. Response actions, technologies, and process options that do not satisfy RAOs and/or are not consistent with the above three evaluation criteria are eliminated from further analysis.

2.4.1 Technology Types and Process Options for RAO 1

RAO 1 addresses on-facility contaminated soil only. Proposed response actions include institutional controls and monitoring, containment, excavation/disposal, and treatment. Technologies and/or process options are discussed individually below.

2.4.1.1 Institutional Controls

Institutional controls may be used to reduce current or potential human exposure at a facility through direct contact with contaminated soils, sediments, and sludges. Institutional controls may include the use of physical barriers, such as fences and warning signs; and the use of legal restrictions, such as restrictive easements and covenants. Enforcement orders and consent decrees may also be used to restrict uses and require O&M and monitoring. When enforced, institutional controls limit direct contact with and ingestion of soils, sediments, and sludges. Monitoring generally is needed to determine the effectiveness of institutional controls. (EPA 1997b)

The use of physical barriers and warning signs as institutional controls generally are not consistent with the current land use as they could interfere with facility operations and would not reduce current or potential human exposure at the facility. The perimeter of the site already is fenced, limiting access to the public. The use of legal controls would not interfere with the current land use and would reduce the possibility of human exposure to contaminated soil; therefore, institutional controls will be retained for further analysis. Depending on the level of cleanup, a restrictive covenant may be needed to limit future nonindustrial uses (i.e., residential) of this facility. An enforcement order or consent decree would provide an additional layer of protection.

2.4.1.2 Containment

Containment technologies include capping and vertical/horizontal barriers. Slurry walls and sheet piles are examples of process options for vertical barriers. However, slurry walls and sheet piles are not applicable to the situation at Oeser because they will not prevent the downward migration of contaminants nor the infiltration of stormwater through surface soil. RAO 1 addresses vertical migration of contaminants and potential exposure to surface soil; slurry walls and sheet piles are used primarily to inhibit lateral migration of contaminants. Because slurry walls and sheet piles do not satisfy the conditions of RAO 1, they will not be retained for further analysis.

Capping systems reduce surface water infiltration, control gas and odor emissions, provide a stable surface over the waste, and prevent human exposure from direct contact with contaminated soil. Capping options evaluated for Oeser include gravel caps, single layer asphalt caps, soil/bentonite/clay caps, and multi-level cover systems.

The existing cap designs for Oeser also were evaluated. As part of the 1997-1998 removal action, a 6-inch thick gravel cap using 0.625-inch and 1.25-inch crushed rock was placed over a polypropylene, non-woven, needle-punched geotextile fabric in the North and South Pole yards. The gravel cap was designed and constructed in accordance with Ecology's *Storm Water Management Manual for the Puget Sound Basin and Source Control Best Management Practice* (Ecology 1992). In the NTA, a 4-inch asphalt cap was placed over 2 inches of base course. East of the asphalt cap, a gravel cap was constructed in the same manner as the gravel cap constructed in the North and South Pole yards. Four acres at Oeser were capped during the 1997-1998 removal action.

All capping options would reduce direct contact with contaminated soil; and all capping options, except the gravel cap, would inhibit the vertical migration of contaminated groundwater by reducing the infiltration of stormwater. Since this facility is subject to the requirements of RCRA and RCRA hazardous waste is present in the soils, the closure requirements under Subtitle C of RCRA are applicable. The cap must be constructed to meet the substantive closure requirements for an RCRA landfill, including impermeability, strength and thickness requirements, monitoring, and long-term maintenance. Any current and future use of the capped areas will need to be conducted in a manner that preserves the integrity of the cap. For example, the existing asphalt cap may need some modifications to meet the substantive closure requirements under RCRA Subtitle C.

2.4.1.3 Excavation and Disposal

Excavation and disposal includes on-site and off-site containment technologies.

Excavation and on-site disposal technologies encompass a set of process options for the removal of contaminated materials to on-site disposal facilities, including temporary on-site storage piles, long-term on-site landfills, on-site encapsulation, closure-in-place, and on-site vaults. On-site encapsulation, closure-in-place, and on-site vaults usually are temporary measures and may involve placing dirt or other cover over the contaminated materials in-place or excavating the contaminated materials and placing them in a secured vault or a lined and covered ditch. In the case of long-term on-site landfills, some pre-treatment of the contaminated media usually is required to meet RCRA and DW land disposal restrictions (LDRs). For all of these options, the mobility of the contaminated media is reduced by physically containing the media on site. (EPA 1997b)

On-site disposal would disrupt the current facility operations because each of the options would require a portion of the property to be set aside and/or labor to manage the contaminated soil. Excavation presents a potential short-term risk. Engineering controls and monitoring would be required so site personnel and the surrounding community would not be exposed to potentially hazardous levels of dust during excavation. Because on-site disposal is difficult to implement, it will be eliminated from further consideration.

Off-site Disposal technologies include options for the removal of contaminated material to permitted off-site treatment, storage, and disposal (TSD) facilities. Some pre-treatment of the contaminated material may be required to meet the RCRA LDRs. Moving the media from the unsecured site to a disposal facility that will contain it physically reduces the mobility of the contaminated media. (EPA 1997a)

Costs are relatively high for off-site treatment/disposal, and excavation presents a potential short-term risk. Engineering controls and monitoring would be required to ensure that site personnel and the surrounding community would not be exposed to potentially hazardous levels of dust during excavation. However, off-site treatment/disposal is effective and implementable. Off-site treatment/disposal will be retained for further analysis since it would reduce any ongoing risk from the soil and satisfy the requirements of RAO 1.

2.4.1.4 Treatment Technologies

Treatment technologies evaluated include thermal treatment, chemical treatment, biological treatment, and physical treatment.

Thermal Treatment. Thermal treatment technologies evaluated include pyrolysis, incineration, thermal desorption, vitrification, wet air oxidation, infrared incineration, and steam extraction. Because of the variability of these technologies, they will be discussed separately.

Pyrolysis is an ex-situ process that induces chemical decomposition by heat in the absence of oxygen. Organic materials are transformed into gaseous components and a solid residue (coke) containing fixed carbon and ash. Pyrolysis is not effective for dioxins or chlorinated organic carbons and the overall cost is high relative to other technologies (EPA 1997b). Because of the high cost of pyrolysis and its ineffectiveness at meeting the conditions of RAO 1, pyrolysis will be eliminated from further consideration.

Incineration is an EPA presumptive remedy for contaminated soil at wood treating facilities. Incineration generally treats organic contaminants by subjecting them to temperatures typically greater than 1,000 degrees Fahrenheit in the presence of oxygen and a flame. During incineration, volatilization and combustion convert the organic contaminants to carbon dioxide, water, hydrochloric acid (HCl), and sulfur dioxide (SO_2). The incinerator off-gas requires treatment by an air pollution control (APC) system to remove particulates and to neutralize and remove acid gases. Incineration may generate three residual waste streams: solids from the incinerator and APC system, water from the APC system, and air emissions from the APC system. (EPA 1995)

Incineration would satisfy the requirements of RAO 1; however, ex-situ incineration would be difficult to implement at an active facility. As with on-site excavation and disposal, ex-situ treatment would disrupt the current facility operations and the costs are relatively high. On-site incineration also would require a trial burn before full-scale implementation. Additionally, community acceptance would be difficult to obtain. Because on-site incineration is difficult and costly to implement, it will not be evaluated further. However, off-site incineration and other off-site treatment options will be further evaluated in this document under "Off-Site Options" as they would not interfere with on-site operations and would satisfy the requirement of RAO 1.

Thermal Desorption also is an EPA presumptive remedy for contaminated soil at wood treating facilities. Thermal desorption physically separates, but does not destroy, volatile and some semi-volatile contaminants. Significant material handling operations may be necessary to sort and size the soil for treatment. Thermal desorption uses heat and/or mechanical agitation to volatilize contaminants into a gas stream; subsequent treatment of the gas stream must be provided for the concentrated contaminants resulting from desorption. Depending on the process selected, thermal desorption heats contaminated media to varying temperatures, driving off water and volatile and semi-volatile contaminants. Off-gases may be condensed for disposal, incinerated, captured by carbon adsorption beds, or treated with biofilters. (EPA 1995)

Ex-situ thermal desorption would disrupt current facility operations. Thermal desorption also would require a treatibility study before full-scale implementation. Dioxins can be formed and released to the atmosphere in the off gas if chlorinated hydrocarbons are not completely combusted, thus the off gas presents a potential short-term risk. Because of the difficulty in implementing the technology and its questionable effectiveness, thermal desorption will be eliminated from further consideration.

Vitrification converts contaminated soil into a chemically inert, stable glass and crystalline product. In-situ vitrification is a complex, high-energy technology requiring a high degree of skill and training. An array of electrodes is inserted into the ground to the desired treatment depth. An electric current heats the soil to approximately 2,000 degrees Celsius, well above the initial melting temperature of soils. The pyrolized byproducts migrate to the surface of the vitrified zone, where they combust in the presence of oxygen. A vacuum hood placed over the treated area collects off gases, which are treated before they are released to the atmosphere. The off-gas treatment system typically consists of a glycol cooling system, a wet scrubbing system with condenser, and carbon filters. (EPA 1997b)

The high voltage used in in-situ vitrification and the creation of off-gas present potential health risks (EPA 1997b). In-situ vitrification also would disrupt facility operations and would require a treatibility study before full-scale implementation. Implementation of this technology is difficult, and its costs are high; therefore, vitrification will be eliminated from further consideration. (EPA 1997b)

Wet Air Oxidation is an ex-situ thermal treatment technology that breaks down organic materials by oxidation. Contaminated media are excavated and mixed in an oxidation unit with water and air. At elevated temperature and pressure, aqueous oxidation occurs that destroys many of the contaminants. In this process, liquids or sludges are mixed with compressed air. The waste-air mixture is pre-heated in a heat exchanger before entering the corrosion-resistant reactor where exothermic reactions increase the temperature to the desired value. The exit steam from the reactor is used as the heating medium in the heat exchanger before it enters a separator where the spent process vapors[2] are separated from the oxidized liquid phase. Effluent from the process is generally biodegradable. (EPA 1997a)

Wet air oxidation is an ex-situ process with high relative costs and the effluent requires additional treatment prior to discharge (EPA 1997b). This technology would disrupt current facility operations and would require a trial burn before full-scale implementation. Because it would be difficult and costly to

[2] Spent process vapors include non-condensable gases consisting primarily of air and carbon dioxide.

implement this technology at The Oeser Company facility, wet air oxidation will be eliminated from further consideration.

Infrared Incineration systems are designed to destroy hazardous wastes through tightly controlled process parameters with infrared energy as the primary heat source. Wastes are conveyed through the furnace for a very precise residence time on a woven metal alloy conveyor belt that passes the wastes under infrared heating elements. These heating elements are spaced over the length of a ceramic fiber-insulated furnace. (EPA 1997b)

At the discharge end of the furnace, ash residue is discharged to a hopper where it is conveyed to the collection system. Off gases from the primary furnace are exhausted to a secondary chamber equipped with a propane-fired burner or infrared heating elements to ensure complete combustion of any remaining organic contaminants. Before discharge to the stack, exhaust gases from the secondary chamber pass through APC equipment for removal of particulates and other emissions such as HCl and SO_2. (EPA 1997b)

Infrared incineration has relatively high costs and would require a trial burn to verify its effectiveness. Stack tests would be required to ensure sufficient destruction of chlorinated dioxins, and other air emissions would have to be managed (EPA 1997b). For the aforementioned reasons and the uncertainty regarding whether this technology would satisfy the requirements of RAO 1, infrared incineration will be eliminated from further analysis.

Steam Extraction physically separates VOCs and semivolatile organic compounds (SVOCs) from soil, sediment, and sludge. The process uses a combination of thermal and mechanical energies generated by steam, hot air, infrared elements, and electrical systems to volatilize and transport the contaminants to the desorbed phase. The extracted contaminants in the vapor phase can either be condensed and sent off-site for further treatment, or destroyed in the vapor phase using a suitable technology. After passing through a carbon adsorber that removes trace quantities of organic contaminants, the non-condensibles in the vapor phase can vent to the atmosphere. (EPA 1992)

Steam extraction is most effective for VOCs; its effectiveness for dioxins and SVOCs, including PAHs, is less certain. The variable soil composition at Oeser likely would yield inconsistent removal rates. Costs are dependent on the treatment rate, which is a function of the soil type, waste type, and on-line process efficiency (EPA 1992). Steam extraction also would be difficult to implement at an active facility. For these reasons and the uncertainty regarding whether this technology would satisfy the requirements of RAO 1, steam extraction will not be retained for further analysis.

Chemical Treatment. Chemical treatment technologies include dechlorination and solvent extraction. Because of the variability of these technologies, they will be discussed separately.

Dechlorination, also known as dehalogenation, uses a chemical reaction to remove chlorine atoms from chlorinated molecules. This converts the more toxic compounds into less toxic, more water-soluble products, leaving compounds that are separated more readily from the soil and treated. Dechlorination of halogenated aromatic compounds uses a nucleophilic substitution reaction to replace a chlorine atom with either an ether or a hydroxyl group. Dechlorination of chlorinated aliphatic compounds occurs through an elimination reaction and the formation of a double or triple carbon-carbon bond. (EPA 1997b)

Dechlorination generates three residual waste streams that include soil, wash water, and air emissions. The wash water may require treatment prior to discharge. Volatile air emissions, if captured by condensation or activated carbon, can be regenerated thermally. Dechlorination is not effective for dioxins and the cost is relatively high (EPA 1997b). Because the technology is not effective, difficult to implement, and costly, dechlorination will be eliminated from further consideration.

Solvent Extraction isolates contaminants from soil through a chemical process involving an organic solvent. Unlike soil washing, solvent extraction does not involve the use of water or water-based solutions. Solvent extraction reduces contaminant volume by concentrating contaminants in the extraction phase. There are three general categories of solvent extraction: conventional solvent extraction, critical fluid extraction, and supercritical fluid extraction. (EPA 1997b)

Solvent extraction also generates three residual waste streams, which include concentrated contaminants, treated soil, and separated solvent. Disposal of these waste streams could be problematic and could increase the cost of the project substantially. A bench-scale or pilot-scale test would be necessary to determine the effectiveness of the technology. Solvent extraction costs are high and its effectiveness is not well established relative to other technologies (EPA 1997b); therefore, solvent extraction will be eliminated from further consideration.

Biological Treatment. Bioremediation is an EPA presumptive remedy for contaminated soil at wood treating facilities and involves the chemical degradation of organic contaminants using microorganisms. Biological activity, or biodegradation, can occur either in the presence (aerobic) or absence (anaerobic) of oxygen. Aerobic biodegradation converts organic contaminants to various intermediate and final decomposition products, which may include various daughter compounds, carbon dioxide, water, humic materials, and microbial cell matter. Aerobic biodegradation also may cause binding of the contaminants to soil components, such as humic materials. Biodegradation of halogenated organic contaminants takes place primarily under anaerobic conditions. Anaerobic biodegradation converts the organic contaminants to various daughter compounds, carbon dioxide, methane, and microbial cell matter. (EPA 1995)

Bioremediation may be an ex-situ or in-situ process. Ex-situ bioremediation refers to the biological treatment of contaminants following excavation of the soil, and includes composting, land treatment in lined cells, treatment in soil piles, or the use of slurry reactors. In-situ bioremediation is the in-place treatment of contaminants and may involve the addition of nutrients, oxygen, water, and other enhancements to the subsurface. (EPA 1995)

Although ex-situ bioremediation typically is faster than in-situ bioremediation, both can require several years for completion. A bench or pilot test also would be necessary before beginning treatment (EPA 1995). In-situ bioremediation would not interfere with current land use; however, since much of the contamination is in the shallow subsurface soil and groundwater is discontinuous in this zone, the addition of water to the subsurface would be necessary in order to treat the soil successfully. This could mobilize some of the contaminants and spread contamination. Additionally, bioremediation generally is not considered effective for the treatment of dioxins (EPA 1997b). Because in-situ bioremediation would not meet the requirements of RAO 1, in-situ bioremediation will be eliminated from further consideration.

Although ex-situ bioremediation would not be effective for the treatment of dioxin, it is effective at treating the other COCs at Oeser. Because ex-situ bioremediation is cost effective and would successfully destroy many of the COCs at Oeser, it will be retained for further analysis. It is to be noted that ex-situ bioremediation would require a large area to manage the treatment and would disrupt current facility operations.

Physical Treatment. The physical treatment technologies evaluated include soil flushing, soil washing, attenuation, and aeration/soil venting. Because of the variability of these technologies, they will be discussed separately.

Soil Flushing is an in-situ process, where water, or water with an additive to enhance solubility, is applied to the soil or injected into the groundwater to raise the water table into the contaminated soil zone (EPA 1997b). Additives may include surfactants and/or co-solvents; acids or bases; oxidants; chelating agents; or solvents (Roote 1997). Contaminants then leach into the groundwater (EPA 1997b). Subsequently, the groundwater is extracted and the leached contaminants are captured and treated and/or removed or captured and treated before the groundwater is discharged (EPA 1997b).

Shallow groundwater at Oeser is characterized by discontinuous saturation that is perched on fine-grained material and discharges downward to an unconfined deeper aquifer (E & E 2002). Consequently, soil flushing could be difficult to control and also would disrupt facility operations. Because there is not a confining layer separating shallow and deep groundwater, the potential exists for contaminating the deep aquifer. Because soil flushing does not meet the requirements of RAO 1, it will be eliminated from further consideration.

Soil Washing is an ex-situ process where contaminants sorbed onto soil particles are separated from the soil with wash water. The wash water may be augmented with a basic leaching agent, a surfactant, a pH adjusting agent, or a chelating agent to help remove organics or heavy metals from the soil. (EPA 1997b)

Soil washing requires extensive equipment and vapor recovery treatment as well as solvent recovery and treatment of the washing fluid; therefore, implementation likely would interfere with facility operations. Soil washing is not efficient on fine-grained soils, which are present in the vadose zone at Oeser. Because this technology would be ineffective, difficult, and costly to implement at Oeser, soil washing will be eliminated from further consideration.

Attenuation is the process of mixing contaminated soil with clean soil to reduce concentrations below cleanup goals. Bentonite may be used as the clean soil mix. (EPA 1997b)

Attenuation is limited to the upper two feet of soil and does not reduce contaminant mobility, toxicity, or volume. Furthermore, the EPA does not consider attenuation to be a permanent remedy in accordance with the Superfund Amendments and Reauthorization Act (EPA 1997b). Because this technology would not meet the requirements of RAO 1, attenuation will be eliminated from further consideration.

Aeration/Soil Venting includes both in-situ and ex-situ processes. Aerated (in-situ) and excavated (ex-situ) soil is mixed, increasing air/soil contact and allowing for the release of VOCs trapped in soil. VOC emissions are captured as air is forced through the system and carried to an APC device for treatment. (EPA 1997b)

Aeration/soil venting is not effective for dioxins, and its effectiveness at removing SVOCs present at Oeser is questionable. Aeration/soil venting would generate air emissions that present a potential health risk (EPA 1997b). Because this technology is not effective for the conditions present at Oeser, aeration/soil venting will be eliminated from further consideration.

Immobilization is an EPA presumptive remedy for contaminated soil at wood treating facilities. Immobilization reduces the mobility of a contaminant, either by physically restricting its contact with a mobile phase (solidification) or by chemically altering/binding the contaminant (stabilization). The most common solidification binders are cementacious materials such as Portland cement, fly ash/lime, and fly ash/kiln dust. These binders form a solid, resistant, aluminosilicate matrix that can occlude waste particles, bind various contaminants, and reduce the permeability of the waste/binder mass. Immobilization is suited particularly to addressing inorganic contamination. (EPA 1995)

Immobilization is less effective than other technologies for treating organic contamination and would require a treatibility study prior to implementation (EPA 1995). Because inorganic contamination is not an issue at Oeser and this technology would not satisfy the conditions of RAO 1, immobilization will be eliminated from further consideration.

2.4.2 Technology Types and Process Options for RAO 2

RAO 2 addresses the potential risk stemming from the contact with and the migration of shallow groundwater. The response actions and technologies for RAO 2 include those considered previously for RAO 1 as well as groundwater treatment and institutional controls. Process options evaluated for groundwater treatment will be limited to ex-situ carbon adsorption and in-situ steam stripping because they are applicable to both halogenated SVOCs and fuel contaminants.

2.4.2.1 Ex-Situ Groundwater Treatment

Ex-situ treatment includes groundwater extraction through pumping and on-site treatment using one or more process options. Treated water then is discharged to a storm drain or sewer system or re-injected to the subsurface. Liquid phase carbon adsorption is the most common process option for treating halogenated SVOCs and fuel contaminants. Groundwater is pumped through a series of carbon vessels containing activated carbon to which dissolved contaminants are adsorbed. When the contaminant concentration in the effluent exceeds a certain level, the carbon can be regenerated in place; removed and regenerated at an off-site facility; or removed and disposed. (Van Deuren et al. 1997)

Since shallow groundwater at Oeser is characterized by discontinuous saturation, it may be difficult to sustain a groundwater extraction program. However, ex-situ treatment will be retained for further analysis as it may be the only option to reduce contamination in shallow groundwater by direct treatment, thus meeting the requirements of RAO 2. The technologies previously evaluated for RAO 1 also may decrease groundwater contaminant levels by minimizing the vertical migration of contaminants from the vadose zone. Those technologies retained for RAO 1 also will be retained for RAO 2.

2.4.2.2 In-Situ Groundwater Treatment

Steam stripping consists of forcing steam into an aquifer through injection wells to vaporize volatile and semi-volatile contaminants. Vaporized components rise to the vadose zone where they are removed by vacuum extraction and then treated. Hot water or steam flushing/stripping is a pilot scale technology. In-situ biological treatment may follow the displacement and is continued until the groundwater contaminant concentrations satisfy statutory requirements. (Van Deuren et al. 1997)

The most significant factor influencing cost is the number of wells required per unit area, which is related to the depth of contamination, permeability, and site geology; costs may be relatively high for implementation at Oeser since contamination is somewhat deep and the permeability and soil type are variable. This technology also would be difficult to implement at an active facility since a large number of injection and recovery wells likely would be required. Given that this technology would be costly and difficult to implement at The Oeser Company facility, steam stripping will not be analyzed further.

2.4.2.3 Institutional Controls

Institutional controls may be employed to prevent use of the shallow groundwater. This may include the use of legal restrictions, such as deed, lease, zoning restrictions, easements, and covenants. Enforcement orders and consent decrees may also be used.

2.4.2.4 Monitoring

Monitoring shallow groundwater includes checking for the presence of NAPL and COCs. A monitoring program for the shallow groundwater likely would consist of water level measurements, field measurements of water quality parameters, field measurements for NAPL, and the collection and analysis of samples from monitoring wells positioned in the shallow groundwater zone. Analytical data obtained during each monitoring event would be compared to previous data to determine if shallow groundwater contamination is migrating. This will enable rapid actions to be taken to address contaminant migration, should it be detected. Groundwater monitoring also will provide data to determine if RAOs are being met.

2.4.3 Technology Types and Process Options for RAO 3

Treatment technologies considered for RAO 3 include those technologies considered for RAO 2. Because there is only a minor amount of contamination in the deep aquifer, active treatment is not considered necessary. However, it should be noted that, unlike the shallow groundwater at The Oeser

Company facility, groundwater extraction from the deeper aquifer at Oeser would be sustainable. In addition to the technologies considered for RAO 2, institutional controls will be retained for further analysis.

Table 2-1

REMEDIAL ACTION OBJECTIVES SUMMARY TABLE
THE OESER COMPANY SUPERFUND SITE
BELLINGHAM, WASHINGTON

Media	Chemicals of Concern[a]	Exposure Routes	RAOs	Proposed Cleanup Levels	
Near-Facility Residential Surface Soil	None	None	None	None	
Near-Facility Residential Air	Dust and vapors	Human Inhalation	None[b]	None[b]	
Little Squalicum Creek Surface Soil from Spoils Piles	PCP, total PAHs, Dioxin TEQ	Wildlife Ingestion	None[c]	None[c]	
Little Squalicum Creek Surface Water	Dioxin TEQ	Human Dermal	None[d]	None[d]	
Little Squalicum Creek Sediment	None	None	None	None	
On-facility Surface and Subsurface Soil	Benzo[a]pyrene equivalent	Human ingestion and dermal contact	Reduce ingestion, inhalation, and dermal contact with soils having a HI above 1 and/or an excess lifetime cancer risk above the range of acceptable risks as defined by the EPA.	B(a)P eq.	8.9 mg/kg
	Dioxin TEQ	Human ingestion and dermal contact	Prevention of migration of contaminants that would result in groundwater contamination exceeding the range of acceptable risks off the facility.	Dioxin TEQ	875 ng/kg
	Naphthalene	Human ingestion, inhalation, and dermal contact		Naph-thalene	260 mg/kg
	Total Petroleum Hydrocarbons [d]	Human ingestion		TPH	1,100 mg/kg
	PCP [e]	None [e]		PCP	120 mg/kg
On-facility Shallow Groundwater	None [f]	None [f]	Reduce ingestion and dermal contact with shallow groundwater containing contaminants above the range of acceptable risks.	None [f]	
			Reduce migration of contaminants that would result in deep groundwater contamination exceeding the range of acceptable risks off the facility.		

Table 2-1

REMEDIAL ACTION OBJECTIVES SUMMARY TABLE
THE OESER COMPANY SUPERFUND SITE
BELLINGHAM, WASHINGTON

Media	Chemicals of Concern[a]	Exposure Routes	RAOs	Proposed Cleanup Levels	
On-facility Deep Groundwater	Benzo[a]pyrene equivalents [g]	Dermal	Reduce ingestion and dermal contact with deep groundwater containing contaminants above the range of acceptable risks.	B(a)P eq.	0.012 µg/L
	Dioxin TEQ [g]	Dermal	Protection against the development of future site groundwater supplies to prevent exposure to contaminated groundwater with contaminants above the range of acceptable risks.	Dioxin TEQ	5.83×10^{-7} µg/L
	PCP [e]	None [e]		PCP	0.729 µg/L
Air	1,2,4-Trimethylbenzene	Inhalation	None [h]	None [h]	

Note:

a Chemicals with an excess lifetime cancer risk over 1×10^{-4} and a HI greater than 1 are above the range of acceptable risks, as defined by the EPA.
b The RAO for On-Facility (Soil) described below addresses the potential risk from dust and vapor HI exceedences.
c Given the uncertainty of the risk to wildlife presented by the spoils piles, an RAO was not developed for this area.
d Because National Pollutant Discharge Elimination System (NPDES) discharges are regulated through the Clean Water Act, compliance with NPDES limits is not a Comprehensive Environmental Response, Compensation and Liability Act issue. Therefore, no RAOs have been established for stormwater from The Oeser Company facility.
e PCP does not exceed acceptable risk levels for any media at the site; however, cleanup levels were calculated because PCP is a common contaminant at wood treating facilities and was detected at the site in soil and groundwater.
f Shallow groundwater contamination was not evaluated in the Human Health Risk Assessment or in the Ecological Risk Assessment.
g The preliminary remedial action goal for this contaminant was developed using a future resident scenario since none of the future worker scenarios exceeded the acceptable risk level.
h The Oeser Company is an active wood treating facility currently registered with Northwest Air Pollution Authority. These risks are associated with facility operations should be addressed by other regulatory programs.

Key:

B(a)P eq. = Benzo(a)pyrene equivalent.
EPA = United States Environmental Protection Agency.
HI = Hazard index.
Fg/L = Micrograms per liter.
mg/kg = Milligrams per kilogram.
ng/kg = Nanograms per kilogram.
ng/L = Nanograms per liter.
PAHs = Polynuclear aromatic hydrocarbons.
PCP = Pentachlorophenol.
RAOs = Remedial Action Objectives.
TEQ = Toxicity equivalent.
TPH = Total petroleum hydrocarbon.

Table 2-2

SCREENING OF TECHNOLOGIES
THE OESER COMPANY SUPERFUND SITE
BELLINGHAM, WASHINGTON

Remedial Action Objective	Response Action	Technology	Process Options	Cost	Effectiveness	Implementability	Retained for Further Analysis
RAO 1: Reduce ingestion, inhalation, and dermal contact with soil contaminants above industrial CULs and reduce migration of soil contaminants that would result in deep groundwater contamination exceeding groundwater CULs.	No Action	NA	NA	No cost	Will not reduce risk.	NA	Yes - Required by NCP.
	Institutional Controls	Access Restrictions	Fencing	Low relative cost	Will not reduce risk.	Easy to implement.	No - Would not meet RAO 1
			Restrictive Easements and Covenants	Low relative cost.	Reduces possibility of human exposure to contaminated soil.	Requires cooperation from property owner.	Yes - Meets requirements of RAO 1.
	Containment	Capping	Gravel Cap	Low relative cost.	C Reduces human exposure to contaminated soil. C Will not reduce vertical migration of contaminants.	Long-term maintenance and monitoring required.	No - Does not meet requirements of RAO 1.
			Single-layer Asphalt Cap	Low relative cost.	Reduces human exposure and reduces vertical migration of contaminants. Does not meet substantive closure requirement for a landfill under RCRA Subtitle C.	Long-term maintenance and monitoring required. Does not meet substantive closure requirement for a landfill under RCRA Subtitle C.	No - Effectiveness is insufficient, given RCRA Subtitle C requirements.
			Soil/bentonite/ clay caps	Medium relative cost.	Reduces human exposure and reduces vertical migration of contaminants. Does not meet substantive closure requirement for a landfill under RCRA Subtitle C.	C Long-term maintenance and monitoring required. C Not consistent with current facility operations.	No - Interferes with current facility operations.
			Multi-level cover system.	High relative cost.	Reduces human exposure and reduces vertical migration of contaminants.	Long-term maintenance and monitoring required.	Yes - Meets requirements of RAO 1.
	Excavation/ Disposal	On-Site Containment	Encapsulation	C Unknown future treatment costs C High O&M costs	Not a permanent, long-term remedy.	C Difficult disposal and permitting issues. C Not consistent with current land use.	No - Does not meet requirements of RAO 1.
		Off-Site Options	Treatment, Storage, and Disposal	High relative cost	C Eliminates long-term risk. C Potential short-term risk associated with excavation.	Excavation disruptive to facility operations.	Yes - Meets requirements of RAO 1.

Table 2-2

SCREENING OF TECHNOLOGIES
THE OESER COMPANY SUPERFUND SITE
BELLINGHAM, WASHINGTON

Remedial Action Objective	Response Action	Technology	Process Options	Cost	Effectiveness	Implementability	Retained for Further Analysis
RAO 1 (cont'd)	Treatment	Thermal Treatment	Pyrolysis	High relative cost	Not effective for dioxins or chlorinated organic carbons.	Ex-situ treatment not consistent with current land use.	No - Would not meet RAO 1 requirements.
			Incineration	High relative cost	Effective in destroying all contaminants.	Ex-situ treatment not consistent with current land use.	No - High cost and difficult to implement.
			Thermal Desorption	Low relative cost	Potential short-term risk associated with dioxin formation in off-gas.	C Treatability study required before full-scale implementation. C Ex-situ treatment not consistent with current land use.	No - Questionable effectiveness and presents a short-term risk.
			Vitrification	High relative cost	Potential short-term risk associated with off-gas.	C High voltage required. C Ex-situ and in-situ treatment not consistent with current land use.	No - High cost and difficult to implement.
			Wet Air Oxidation	High relative cost	Not recommended for halogenated organic aromatics.	C Effluent requires additional treatment prior to discharge. C Ex-situ treatment not consistent with current land use.	No - High cost, not effective, and difficult to implement.
			Steam Extraction	Variable cost -- dependent upon site conditions.	Effectiveness at removing SVOCs is uncertain.	C Effluent requires additional treatment prior to discharge. C Ex-situ treatment not consistent with current land use.	No - Effectiveness uncertain and generates additional waste streams.
			Infrared Incineration	High relative cost	C Potential short-term risk associated with air emissions. C Less effective than rotary kiln incineration.	C Trial burn required before full scale implementation. C Ex-situ treatment not consistent with current land use.	No - High cost and questionable effectiveness.

Table 2-2

SCREENING OF TECHNOLOGIES
THE OESER COMPANY SUPERFUND SITE
BELLINGHAM, WASHINGTON

Remedial Action Objective	Response Action	Technology	Process Options	Cost	Effectiveness	Implementability	Retained for Further Analysis
RAO 1 (cont'd)	Treatment (cont'd)	Chemical Treatment	Dechlorination	High relative cost	Highly chlorinated dioxins may be converted to less chlorinated, more toxic dioxins.	C Soil, wash water, and air emissions are generated, which may require further treatment. C Ex-situ treatment not consistent with current land use.	No - High cost, not effective on site contaminants, and difficult to implement.
			Solvent Extraction	High relative cost	Effectiveness not well established relative to other technologies.	C Three residual streams created requiring further treatment/disposal. C Treatability study required. C Ex-situ treatment not consistent with current land use.	No - High cost, questionable effectiveness, and generates additional waste streams.
		Biological Treatment	In-situ Bioremediation	Low relative cost	Dioxins difficult to treat.	C Duration of treatment would be long. C Addition of water to subsurface could potentially contaminate deeper aquifer.	No - Would not meet requirements of RAO 1.
			Ex-situ Bioremediation	Low relative cost	Dioxins difficult to treat.	C Duration of treatment would be long. C Ex-situ treatment not consistent with current land use.	Yes - Cost effective, will reduce toxicity of some contaminants.

Table 2-2

SCREENING OF TECHNOLOGIES
THE OESER COMPANY SUPERFUND SITE
BELLINGHAM, WASHINGTON

Remedial Action Objective	Response Action	Technology	Process Options	Cost	Effectiveness	Implementability	Retained for Further Analysis
RAO 1 (cont'd)	Treatment (cont'd)	Physical Treatment	Soil Flushing	Moderate relative cost	C Low removal rates for SVOCs in low permeability soils. C Not effective for non-highly water soluble contaminants (e.g., PAHs).	C Treatability study required before full-scale implementation. C Due to discontinuous groundwater saturation at the Oeser site, soil flushing may be difficult to control. C Could potentially contaminate the deep aquifer. C In-situ treatment not consistent with current facility operations.	No - Does not meet the requirements of RAO 1.
			Soil Washing	Moderate relative cost	Not efficient on fine grained soils.	C Produces large volumes of sludge requiring disposal. C Requires extensive equipment and vapor recovery treatment as well as solvent recovery and treatment of the washing fluid.	No - Not effective and difficult to implement.
			Attenuation	Low relative cost	C Limited to upper two feet of soil. C Not considered a permanent remedy in accordance with SARA.	Additional treatment would be necessary below two feet.	No - Does not meet the requirements of RAO 1.
			Aeration/Soil Venting	Low relative cost	C Not effective for dioxins. C Potential health risk presented by air emissions.	In-situ and ex-situ treatment are not consistent with current land use.	No - Not effective.

Table 2-2

SCREENING OF TECHNOLOGIES
THE OESER COMPANY SUPERFUND SITE
BELLINGHAM, WASHINGTON

Remedial Action Objective	Response Action	Technology	Process Options	Cost	Effectiveness	Implementability	Retained for Further Analysis
RAO 1 (cont'd)	Treatment (cont'd)	Physical Treatment (cont'd)	Immobilization	Low relative cost	Less effective for organic contaminants than other technologies; more effective for inorganic contaminants.	C Treatability study required before full scale implementation. C Other technologies would be required to treat organic contaminants. C Not consistent with current facility operations.	No - Does not meet the requirements of RAO 1.
RAO 2: Reduce ingestion and dermal contact with shallow groundwater, and reduce migration of contaminants from shallow groundwater that would result in deep groundwater contamination exceeding groundwater CULs.	No Action	NA	NA	No cost	Will not reduce risk.	NA	Yes - Required by NCP.
	Treatment	Ex-Situ Treatment	Groundwater extraction followed by liquid-phase carbon absorption.	C High relative cost C Long-term O&M costs.	Effective for fuels and SVOCs.	C Discontinuous saturation may inhibit sustained groundwater extraction program. C Treatability study required. C Spent carbon requires regeneration or disposal.	Yes - Meets requirements of RAO 2.
	Treatment (cont'd)	In-Situ Treatment	Steam Stripping	Variable cost - dependent on site conditions.	C Effective for VOCs and SVOCs. C Variable soil conditions could impact effectiveness.	C Due to discontinuous groundwater saturation at the Oeser site, soil flushing may be difficult to control. C Could potentially contaminate deeper aquifer. C Not consistent with current facility operations.	No - High cost and difficult to implement.

Table 2-2

SCREENING OF TECHNOLOGIES
THE OESER COMPANY SUPERFUND SITE
BELLINGHAM, WASHINGTON

Remedial Action Objective	Response Action	Technology	Process Options	Cost	Effectiveness	Implementability	Retained for Further Analysis
RAO 2 (cont'd)	Institutional Controls	Deed, lease, zoning restrictions, easements and covenants	NA	No cost	Will reduce exposure.	Easy to implement.	Yes - Meets requirements of RAO 2.
	Monitoring	Groundwater Monitoring	NA	Long-term O&M Costs	Effective for determining if RAOs are being met.	Easy to implement.	Yes - Easy to implement.
RAO 3: Reduce potential for ingestion and dermal contact with deep groundwater containing contaminants above groundwater CULs and prevent off-site migration of groundwater with contaminant above CULs.	See RAO 2 above						
	Institutional Controls	Restriction on Groundwater Use	Restrictive Easements and Covenants	No cost	Will reduce exposure.	Often requires cooperation from property owner and other parties.	Yes - Meets requirements of RAO 3.

Key:

NA	= Not applicable.
NCP	= National Oil and hazardous Substances Pollution Contingency Plan
O&M	= Operation and maintenance.
PAHs	= Polynuclear aromatic hydrocarbons.
RAO	= Remedial Action Objective.
RCRA	= Resource Conservation and Recovery Act.
SARA	= Superfund Amendments and Reauthorization Act.
SVOCs	= Semivolatile organic compounds.
VOCs	= Volatile organic compounds.

3. DEVELOPMENT OF ALTERNATIVES

3.1 ALTERNATIVE DEVELOPMENT RATIONALE

The technology types and process options retained for further consideration based on cost, effectiveness, and implementability are as follows:

C Deed and zoning restrictions, restrictive easements, covenants, enforcement orders, and consent decrees;

C Multi cover cap;

C Offsite TSD (soil);

C Ex-situ bioremediation (soil);

C Ex-situ groundwater treatment using carbon adsorption;

C Groundwater monitoring.

While assembling these treatment technologies and process options into alternatives, a range of treatment, disposal, and containment options were considered. Preference was given to bioremediation as a treatment option because it is an EPA presumptive remedy for wood treating facilities. Groundwater treatment was included in two alternatives as an aggressive way to contain contamination in the saturated zone and therefore achieve the RAOs; however, the objective of groundwater treatment is not to remove all contaminants from the saturated zone. The technology types and process options were combined into alternatives which are briefly described in this section and evaluated in detail in Section 4. Each alternative, with the exception of no action, incorporates O&M requirements, groundwater monitoring and restrictions on future land use and groundwater use on The Oeser Company property.

The alternatives were screened for their effectiveness, implementability, and cost. These criteria are defined in the NCP as:

- Effectiveness- The degree to which the alternative reduces the toxicity, mobility, or volume of contaminants, complies with ARARs, minimizes short-term impacts and residual risks, provides long-term protection and the speed at which the alternative accomplishes these benefits;

- Implementability- The technical feasibility and availability of the technologies employed and the administrative feasibility of implementing the alternative; and
- Cost- The costs of construction, operation, and maintenance.

Alternatives were assembled to account for current site activities. Additionally, a scenario which would be less restrictive in regard to site access and use of the property was considered. Specifically, Alternatives 2 (capping) and 4 (capping and ex-situ groundwater treatment) were selected assuming that current site activities will continue. Alternatives 3 (soil excavation) and 5 (ex-situ soil and groundwater treatment) were selected assuming significant changes in current site operations that would allow unrestricted access to the property by the remedial contractor.

3.2 SUMMARY OF ALTERNATIVES

3.2.1 Alternative 1: No Action

This alternative is being retained for analysis as required under the NCP and will be a baseline for comparison to the action alternatives. The no action alternative would not reduce the risk posed by site contamination and would not meet any of the RAOs.

3.2.2 Alternative 2: Capping

Capping is an easily implemented technology, consistent with current site operations, that would meet the RAO for both on-facility surface and subsurface soil as well as the RAO for on-facility shallow groundwater. The capping process option consists of installing a cap to inhibit the vertical infiltration of precipitation into the contaminated soil and to reduce the potential for site personnel and the community to come into direct contact with contaminated soil and shallow groundwater. Although this alternative would meet the RAOs for soil and shallow groundwater effectively, soil and shallow groundwater contamination would not be removed through this alternative. Institutional controls and long-term O&M measures would be implemented to ensure the protectiveness of the cap. To meet the RAO for deep groundwater, institutional controls to restrict its use on The Oeser Company property and long-term monitoring would be implemented through this alternative.

3.2.3 Alternative 3: Soil Excavation

To meet the RAO for on-facility soil, this alternative includes excavation and off-site disposal of soil containing contaminants above CULs. Existing soil contamination would be removed from the site, which also would reduce the source of groundwater contamination and meet the RAO for shallow groundwater. However, to get access to contaminated soil for excavation, demolition of existing structures would have to be conducted, requiring current operations at the facility to be discontinued. To meet the RAO for deep groundwater, institutional controls would be implemented to restrict its use on The Oeser Company property and long-term monitoring would be implemented to meet RAOs. Although this alternative would be effective in reducing risk and meeting RAOs, the cost is significantly higher than for other alternatives.

3.2.4 Alternative 4: Capping and Ex-Situ Groundwater Treatment

To meet the RAOs for on-facility soil and shallow groundwater, this alternative involves the capping of contaminated soil (see Alternative 2) and the ex-situ treatment of shallow groundwater. The latter would include groundwater extraction through existing wells; treatment using carbon adsorption; and disposal under a NPDES-permitted discharge. To meet the RAO for deep groundwater, institutional controls would be implemented to restrict its use on The Oeser Company property along with long-term monitoring.

Existing contamination can be capped with temporary disruption to current facility operations. The groundwater extraction system may require long-term O&M; however, the groundwater treatment system would not require significant space nor labor to operate and would not interfere with facility operations. This alternative would be effective at reducing risk and meeting the RAOs. Alternative 4 would have a higher overall cost than Alternative 2, but lower cost than Alternatives 3 and 5.

3.2.5 Alternative 5: Ex-Situ Soil and Groundwater Treatment

Alternative 5 would meet the RAOs for on-facility soil and shallow groundwater through the excavation and on-site bioremediation of contaminated soil and through ex-situ groundwater treatment. Excavation and off-site disposal of dioxin-contaminated soil will be required in selected areas because bioremediation is not effective for the treatment of dioxin. Shallow groundwater would be extracted and treated in the same manner as in Alternative 4. To meet the RAO for deep groundwater, institutional controls would be implemented to restrict its use on The Oeser Company property along with long-term monitoring.

Bioremediation is an EPA presumptive remedy for wood treating facilities and could cost-effectively reduce most contaminant levels over time. The duration of treatment cannot be predicted without a treatibility test, although multiple years of treatment have been required for other sites. Ex-situ bioremediation is not compatible with the current site operations because demolition of existing structures would be required to obtain access to contaminated soil. In addition, long-term labor and space requirements are associated with this alternative. Labor would be required for mixing soil, adding nutrients, sampling, and other activities associated with maintaining a bioremediation system.

4. DETAILED ANALYSIS OF ALTERNATIVES

This section provides a detailed analysis of the alternatives proposed for addressing the contamination at The Oeser Company Superfund site. The alternatives are introduced, followed by a description of the evaluation criteria defined in the 1988 EPA *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* and the NCP (Subsection 4.1). The detailed description of each alternative and its evaluation against these criteria are then presented (Subsection 4.2).

The remedial technologies screened in Section 3 were assembled into five site-specific remedial alternatives (Table 4-1). The detailed analysis of the alternatives will provide the relevant information needed to select a remedy. The alternatives will be assessed using the seven evaluation criteria listed below:

- Overall protection of human health and the environment;
- Compliance with ARARs;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume;
- Short-term effectiveness;
- Implementability; and
- Cost.

Two additional criteria, state (or support agency) acceptance and community acceptance, will be addressed by the EPA once the RI/FS is complete and comments have been received on the proposed plan. The seven criteria listed above will be used as the basis for conducting the detailed analysis and formulating the recommendation of a site remedy.

4.1 EVALUATION CRITERIA

The evaluation criteria from the 1988 EPA *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* are presented below with descriptions summarized from the guidance document:

- **Overall protection of human health and the environment.** This evaluation criterion focuses on the ability of the alternative to achieve adequate protection by addressing how the site risks posed by the contaminant pathways are eliminated, reduced, or controlled.
    - This includes health- or risk-based numerical values identified in the risk assessments for this site. These have been established previously for the media during the RAO development and are shown in Table 4-2. Table 4-2 summarizes the chemical-specific ARARs for COCs that were identified in *Final Human Health Risk Assessment for The Oeser Company Superfund Site* (E & E 2002) as being the greatest contributors to elevated site risks. These COCs include dioxins/furans, cPAHs, PCP, naphthalene, and TPH. Although PCP is not a primary contributor to elevated site risks, it is found in multiple locations at concentrations exceeding site-specific CULs and will be considered in this FS as a COC. Risks attributable to exposure to cPAHs and dioxin/furans were calculated based on equivalency to B(a)P and 2,3,7,8-TCDD, respectively. This equivalency method is described in Appendix B.
- **Compliance with ARARs.** This criterion is used to determine the ability of an alternative to meet all of the federal and state ARARs that may apply to the site. Federally mandated cleanups do not require permitting, but the substantive components of federal, state, and local ARARs must be fulfilled. ARARs are classified as chemical-, location-, and action-specific:
    - <u>Chemical-specific ARARs</u> are usually health- or risk-based numerical values established in federal or state regulations.
    - <u>Location-specific ARARs</u> generally are restrictions imposed when remedial activities are performed in an environmentally sensitive area or special location, such as wetlands, flood plains, and historic areas. A search of various federal and state regulatory programs did not identify any location-specific ARARs for this site.
    - <u>Action-specific ARARs</u> are restrictions placed on specific treatment or disposal technologies and include such activities as effluent discharge limits, hazardous waste TSD requirements, and hazardous waste manifest requirements. Action-specific ARARs that may apply to the site are listed in Table 4-4 and Tables 4-6 through 4-8.

The ARARs concept does not apply to off-site response actions such as off-site disposal. Off-site actions must comply with all applicable laws, both substantive and administrative, and with EPA's "Procedures for Planning and Implementing Off-Site Response Actions" (58 FR 49200, September 22, 1993), which requires that any facility receiving CERCLA-generated waste meet specified criteria. In addition, alternatives that involve off-site transportation of hazardous waste must comply with RCRA and Washington DW manifesting and transportation requirements (40 CFR Part 262 Subpart B and 40 CFR Part 203; WAC 173-303).

In addition, all action alternatives will require compliance with worker safety regulations as administered under the Washington Department of Labor and Industries. Worker safety and health requirements for hazardous waste sites include plans for chemical safety hazard communication, training, medical monitoring, right-to-know, and additional measures for working with asbestos-containing materials. These requirements are outlined in Safety and Health Regulations for Construction (29 CFR 1926), Occupational Safety and Health Standards (29 CFR 1910), Toxics Substances Control Act: Asbestos (40 CFR 763), CERCLA: Worker Protection (40 CFR 311), RCRA: Standards for Owners and Operators of Hazardous Waste TSD Facilities (40 CFR 264), as well as general state regulations for worker safety and health (WAC 296-62 to 296-67).

- **Long-term effectiveness and permanence.** The evaluation under this criterion addresses the risk that remains after the objectives have been met. Elements of this criterion include the magnitude of the residual risk and assessment of the adequacy and reliability of any controls, if used, to ensure protective levels for human and environmental receptors.
- **Reduction of toxicity, mobility, or volume through treatment.** Under this criterion, the statutory (SARA, Section 121) preference to reduce toxicity, mobility, or volume is evaluated for the alternative. Specifically, this evaluation will focus on:
  - The treatment processes and the media they will treat;
  - The amount of hazardous materials that will be destroyed or treated;
  - The degree of expected reduction in toxicity, mobility, or volume;
  - The degree to which the treatment will be irreversible;
  - The type and quantity of treatment residuals that will remain following treatment; and
  - The degree to which the alternative would satisfy the statutory preference for treatment as a principal element.
- **Short-term effectiveness.** This evaluation criterion addresses the effects of the alternative during construction and implementation until the time that the RAOs have been met. Elements of this evaluation include protection of the community and workers, environmental impacts, and the time from start until the RAOs are achieved.
- **Implementability.** This criterion addresses the technical and administrative feasibility of implementing the alternative and the availability of the materials and services required for implementation.
- **Cost.** Detailed cost analysis of the remedial alternatives presented in this section include the following steps:
  - Estimation of capital costs;
  - Estimation of O&M costs;
  - Estimation of periodic costs; and
  - Analysis of present worth.

The cost estimates for each action alternative were developed from published estimating sources (RS Means 2002), vendor quotes, and engineering judgement. Cost estimates include a 15% scope contingency and a 15% bid contingency for capital costs. For Alternative 5, a 20% scope contingency for capital costs was used due to the number of uncertainties associated with the alternative. The present worth of annual O&M costs was calculated using a discount rate of 5%. The cost estimates are expected to provide an accuracy of +50% to -30% and are based on available data. Future costs have been converted to a base year cost using a present worth analysis that assumes that money will be invested in the base year (typically the current year) and disbursed as needed. The length of the O&M period typically is specific to the activity but, for consistency, the O&M period for each action alternative presented in this analysis has been assumed to be 30 years. A summary of the costs for each alternative is presented in Table 4-9 and detailed cost estimate tables and descriptions are provided in Appendix C.

- **State or support agency acceptance.** This criterion reflects the state's and/or supporting agency's apparent preferences among or concerns about the proposed alternatives.
- **Community acceptance.** This criterion reflects the community's apparent preferences among or concerns regarding the proposed alternatives.

The first two evaluation criteria described above are threshold determinations that must be met by an alternative for it to be considered eligible for selection in the record of decision. The next five criteria are primary criteria upon which the detailed analysis is based and will enable the EPA to compare the advantages and disadvantages of each of the alternatives. The last two criteria are not evaluated formally until after the FS is complete and distributed for agency and public review. Because these last two criteria are not evaluated until after the FS is complete, they will not be included as part of this analysis.

4.2 DETAILED ANALYSIS OF ALTERNATIVES

In this subsection, each alternative will be described and evaluated on the basis of the first seven evaluation criteria presented in Section 4.1.

4.2.1 Alternative 1: No Action

Between 1997 and 1998, a removal action was conducted at The Oeser Company facility. The primary objective of the removal action was to mitigate the potential threat to human health and the environment posed by the contamination present at the facility. To address the most immediate threats, the following actions were taken:

- The Oeser Company installed a chain-link fence with two locking gates around the facility to restrict public access;
- Creosote was removed from tanks and shipped off site;
- Gravel caps were constructed over the most contaminated areas in the North and South Pole yards and in the NTA;
- Approximately 8,500 tons of highly contaminated soil were excavated and disposed of off site; and
- An asphalt cap was installed over the excavated area in a portion of the NTA.

Because actions have been taken already to reduce risk at the site, under this alternative, no further remedial or monitoring actions would occur at the site under this alternative.

4.2.2 Analysis of Alternative 1

Overall protection of human health and the environment. As a result of the removal action, a significant amount of contamination at the site was addressed and the potential for exposure was reduced; however, the removal action did not address all of the contamination at the site, and therefore, the site still poses risks to human health and the environment. This alternative provides no further contaminant remediation. The contamination remaining at the site would be left in place without reducing risk or inhibiting its migration potential, therefore Alternative 1 is not considered protective of human health and the environment.

Compliance with ARARs. Alternative 1 does not comply with federal and state ARARs.

Long-term effectiveness and permanence. Since RAOs would not be met under Alternative 1, long-term effectiveness and permanence is not applicable.

Reduction of toxicity, mobility, or volume through treatment. Minimal reduction of soil and groundwater contaminant toxicity, mobility, or volume would be achieved through this alternative via natural attenuation.

Short-term effectiveness. Since RAOs would not be met under Alternative 1, discussion of short-term effectiveness is not applicable.

Implementability. Alternative 1 is easy to implement as it entails no action.

Cost. There is no cost associated with Alternative 1.

4.2.3 Alternative 2: Capping

The primary component of Alternative 2 involves capping areas with soil contamination exceeding the site-specific CULs. The contaminated areas, rather than the entire site, would be capped because the lateral movement of shallow groundwater is minimal and not expected to be influenced by infiltration through uncapped areas of the facility (E & E 2002). Therefore, infiltration through uncontaminated uncapped areas is not expected to cause lateral or vertical contaminant migration. The purpose of installing a cap is to prevent direct contact with any subsurface COC and to prevent infiltration of precipitation through contaminated soil that can generate leachate and potentially cause further migration of contaminants to the deep groundwater. The proposed areas to be capped or addressed by RCRA include portions of the TPA, the NTA, the SPY, and the WSA. Table 4-2 provides the estimated size of the areas proposed for capping broken down by subareas. Figure 4-1 shows the areas proposed for capping and those areas paved currently.

The purpose of installing a cap at the site is to prevent direct contact with surface soil contamination and to inhibit vertical contaminant migration by minimizing stormwater infiltration. The objective of the design is to construct a cap that meets the substantive closure requirements under RCRA Subtitle C; in addition, the cap should be capable of withstanding the impact of heavy equipment traffic associated with on-going operations at the site. In 1995, The Oeser Company installed a cap in the TPA constructed with asphalt concrete paving. During the 1997-1998 Removal Action, caps constructed with environmental asphalt concrete paving were installed in the NTA. Some modifications to the existing asphalt at the site may be required in order to enhance the impermeability and therefore meet the substantive closure requirements for a landfill under RCRA Subtitle C. Additionally, a multi-level, impervious cap that also meets the substantive closure requirements for a landfill under RCRA Subtitle C will be designed for the areas not covered currently. One cap being considered is a multilayer cap designed such that the cap can handle heavy equipment traffic. For this cap, an O&M plan would need to be developed. O&M of the cap would involve inspecting the cap's structural integrity, conducting preventative maintenance on the cap, and repairing damage to the cap.

An important aspect to consider when designing the cap for the site is how to manage stormwater drainage. The existing stormwater treatment system installed at the site can treat up to 60 gallons per minute; however, the system normally treats a maximum of 30 gallons per minute. It is possible that the drainage system designed for the new cap could potentially be tied into the existing drainage system. If a subsurface drainage system is installed to convey stormwater to the stormwater treatment system, then the system needs to be designed such that the catch basins and piping do not leak. As part of the O&M

of the cap, the drainage system requires inspection, preventative maintenance, cleaning, and repairs as necessary.

Based on a brief review of the site topography and the existing storm drainage system, drainage improvements may be necessary for some portions of the proposed areas to be capped. The drainage improvement may involve installation of stormwater catch basins and underground piping for diverting and connecting the flow towards the existing on-site stormwater management system. The areas to be capped that may require drainage improvement include those in the NTA, TPA, and SPY. It is assumed that the proposed areas to be capped within the WSA can be graded to the surrounding ground for draining toward the nearest on-site drainage collection basin or to ditches without the drainage improvement.

Under Alternative 2, long-term O&M will be required. Operational use restrictions on the cap will also be necessary to preserve the integrity of the cap and to ensure long-term protection of human health and the environment. Institutional controls will be required as discussed below.

Institutional Controls. A restrictive easement or covenant and an enforcement order or consent decree will be required to limit future nonindustrial (i.e., residential) use. In addition, institutional controls will be employed to restrict the use of shallow and deep groundwater at the facility. Institutional controls for the deep groundwater involves implementing restrictions that would prevent the installation of wells for use as potable water on The Oeser Company property. It is expected that this restriction will be part of a restrictive covenant and enforcement order or consent decree.

Shallow Groundwater Monitoring. Monitoring to be implemented for the shallow groundwater includes periodic sampling of the shallow groundwater for NAPL and COC contamination. The monitoring program for the shallow groundwater likely would consist of water level measurements, field measurements of water quality parameters, and collection and analysis of samples from shallow monitoring wells at the site. Shallow monitoring wells likely to be included in the monitoring program would be the three wells that contained NAPL prior to the 1997-1998 removal action[3] and wells colocated with deep wells to be monitored as part of the deep groundwater monitoring program. Analytical data would be compared to previous data to determine the effectiveness of the action taken. If NAPL is found in wells during the monitoring program, actions will be taken to remove it. Under this alternative, a passive removal system, rather than an active removal system, would be employed. A passive removal system would be as effective as an active system but does not involve any additional space or power

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[3] These wells include MW07-S, MW13-S, and MW26-S.

requirements and is less labor-intensive. The passive removal system proposed for use at the site includes installing an oil-absorbent boom in the well. Because the absorbent boom is hydrophobic, it only picks up NAPL. Once removed from the well, the NAPL-saturated absorbent boom would be transported off-site to a TSD facility to be incinerated.

Deep Groundwater Monitoring. Monitoring to be implemented for the deep groundwater will include periodic sampling of the deep groundwater zone. The objective of this monitoring is to record significant changes in plume concentrations and shape so as to determine whether the plume is migrating off site. Such an objective is accomplished by collecting and analyzing samples from wells that define the maximum geographic extent of possible remediation efforts and the single well with the highest concentrations of contaminants. The following existing wells at Oeser are the wells that likely will be the most beneficial for monitoring: MW05-D, MW33-D, MW02-D, MW35-D, MW06-D, and MWLSC03 (Figure 1-9). Installing additional wells is not recommended at this time.

Additional Requirements. Although not subject to EPA's final remedy, the following requirements would further restrict deep aquifer usage for human consumption.

Water quality testing is required for new land development in Whatcom County, including subdivision and commercial building. When there are suspected contaminants in the groundwater, the county can require that the drinking water be tested specifically for those contaminants. If levels exceed drinking water standards, the water cannot be used in the development for human consumption until groundwater treatment has reduced contaminant levels below drinking water standards. The contamination present at the property and treatment method will be noted on the property deed. Potential future property owners would become aware of the contamination when performing the title search on the property.

Whatcom County currently is in the process of requiring a water quality disclosure statement on all property sales. The disclosure statement would provide information regarding well testing and analytical results, known contamination, and other issues concerning the water quality at the property in question. This allows the prospective property buyer the opportunity to be informed about the property's water quality prior to purchasing the property, and provides information as to whether or not the installation of a drinking water well on the property would meet drinking water standards. The water quality disclosure statement for property sale is expected to be implemented by August 2002. Based on the results of the monitoring program, EPA can provide to Whatcom County the properties that potentially require drinking well installation restrictions.

4.2.4 Analysis of Alternative 2

Overall protection of human health and the environment. By capping the contaminated areas, Alternative 2 is expected to control the contaminant source and reduce the risk of direct contact with contaminated soil. Shallow groundwater represents a relatively small fraction of the total mass of contaminants; residual contaminated groundwater would be reduced through natural attenuation, including dispersion. The deep aquifer is minimally contaminated and would also be addressed by natural attenuation and groundwater restrictions. Although existing contamination would be left in place, the RAOs would be met and risk to human health and the environment would be reduced to acceptable levels as defined by the EPA; groundwater monitoring would provide a mechanism to confirm that this is occurring.

Compliance with ARARs. Potential action-specific ARARs for capping are presented in Table 4-4. This alternative would comply with requirements set forth in RCRA and the State of Washington DW regulations. This alternative also would comply with United States Department of Transportation (DOT) requirements for packaging and shipping hazardous wastes to off-facility locations.

The installation of additional catch basins and diversion of surface water flow to the existing stormwater management system will increase the volume of discharge from the Oeser outfalls. Therefore, the existing NPDES permit may require updating. This permit is managed by Ecology and the City of Bellingham.

MTCA requires compliance monitoring for all cleanup actions, with the development of a compliance monitoring plan. Compliance monitoring will serve two purposes: performance monitoring to confirm that the cap prevents further infiltration of precipitation and concomitant leaching of contaminants present in subsurface soil and shallow groundwater to the deep aquifer; and confirmation monitoring to confirm that CULs are attained for the long-term. In addition, use restrictions for groundwater also would be implemented through a restrictive covenant to prevent future use of groundwater underlying Oeser for drinking water. Any new wells installed would comply with Ecology's standards for well construction and maintenance.

Long-term effectiveness and permanence. Alternative 2 is expected to be effective for the long term. As long as the integrity of the cap is maintained, existing contamination is not expected to migrate and direct contact with contaminated soil will be minimized. By removing the primary transport mechanism for groundwater contamination, deep groundwater quality should be protected. It is recommended that regular inspections and periodic application of surface treatments be conducted to prevent damage and to fill cracks. Additionally, resurfacing may be required at a frequency of every five years based on best professional judgement. Operational use restrictions on the cap will also be necessary to preserve the integrity of the cap and to ensure long-term protection of human health and the environment.

Groundwater and land use restrictions also would provide long-term protection from the potential exposure to contaminated groundwater. Long-term groundwater monitoring would provide assurance that the RAOs will continue to be met through this alternative.

Reduction of toxicity, mobility, or volume through treatment. The cap is expected to control the contaminant source by significantly reducing precipitation infiltration, which facilitates the migration of groundwater contamination. Although contaminants would remain in place, by reducing infiltration of precipitation, the mobility of existing contamination also would be reduced. The mobility of NAPL, if present, also would be reduced by preventing the infiltration of precipitation. It is critical to maintain the structural integrity of the cap to facilitate the continued effectiveness of this alternative. The removal and off-site incineration of NAPL, if necessary, would reduce contaminant volume and toxicity. This alternative does not include direct remedial measures for existing groundwater contamination. However, contaminant concentrations in the groundwater are relatively low and would be expected to decrease through natural attenuation processes.

Short-term effectiveness. During construction, health and safety protocols would be established to reduce exposure to workers and the community. Possible exposures include migration of dust or direct exposure to contaminated soil. As the cap components are placed, the exposure will decrease. During installation of the cap, dust generation, noise, and an increase in truck traffic are expected to impact the surrounding community and the environment. Dust generation can be controlled through the use of water spray. Limited work hours and exhaust mufflers could be employed to minimize noise impacts. It is estimated that capping activities would be conducted for approximately one month once design activities have been completed.

Implementability. Capping is an easily implemented technology and the resources required to construct the cap are readily available. Because construction of the cap would disrupt facility activities temporarily, the construction schedule would have to be coordinated with The Oeser Company management to minimize this disruption. Groundwater monitoring also can be easily implemented, given that it has been conducted at the site in the past and the equipment is readily available.

The implementability of property use restrictions depends on the cooperation of the property owners. No materials are required and the process can be completed within a short time frame, provided that all parties agree that a restriction should be placed on the property.

Cost. The total estimated capital cost associated with this alternative is $2,876,800. Costs included and assumptions made in this estimate are detailed in Appendix C. Also included in Appendix C is the present worth analysis of this alternative. Average annual O&M costs for this alternative are estimated to be $93,000 per year for 30 years and include the cost of environmental monitoring activities and patching and resurfacing the top layer of the cap. A cost of $25,000 is included every fifth year for the 5-year CERCLA review which entails a review of site data and conditions to confirm that the alternative remains protective of human health and the environment. The present worth of the annual costs is $1,300,000, and the total estimated present worth cost for Alternative 2 is approximately $4,200,000.

4.2.5 Alternative 3: Soil Excavation

This alternative includes the excavation and off-site disposal of contaminated soil followed by the backfilling of excavated areas with clean fill. Institutional controls to restrict the use of deep groundwater, as described in Alternative 2, also would be implemented through this alternative. The proposed excavation areas include portions of the NPY, SPY, TPA, NTA, and the WSA, with a majority of the excavation taking place in the ETA and WTA. The areas proposed for excavation are shown by subareas in Figure 4-2 and the estimated volume of soil to be excavated, by subarea, is presented in Table 4-5. In order to excavate contaminated soil and treat it on site, demolition of existing structures would be required, followed by decontamination and transport to an off-site disposal facility. For these reasons, this alternative cannot be implemented without discontinuance of The Oeser Company's current operation. Before excavation could begin, existing structures would have to be demolished, decontaminated, and transported to an off-site disposal facility. This would include pumping free liquid from tanks, dismantling buildings, breaking concrete and other materials into manageable sections, containing all hazardous materials, and transporting them off site. Detailed specifications would be prepared as part of the remedial design.

The two classes of contaminants which most significantly influence risk are cPAHs and dioxin/furans. These classes are the most common at The Oeser Company facility; therefore, contaminant volumes are delineated according to these classes within each subarea. There are a few locations where PCP, TPH, and naphthalene levels exceed the CULs; however, these areas are co-located in areas of cPAH and/or dioxin/furan contamination. The total volume of contaminated soil at the facility is estimated to be 40,600 cubic yards. Of that amount, approximately 5,340 cubic yards are contaminated with dioxin/furans and approximately 38,260 cubic yards are contaminated with cPAHs only.

Under this alternative, contaminated soil would be excavated and de-watered as necessary and loaded onto rail cars. After receipt of confirmation data, contaminated soil would be transported via rail to a RCRA Subtitle C landfill. Verification sampling would be conducted to confirm removal of all contaminated soil from the areas of concern. After excavation is complete, excavated areas would be backfilled with clean fill.

During demolition, excavation, backfill, and restoration activities, dust levels would be monitored continuously by the construction manager for fine particulate levels both upwind and downwind of potential dust-generating activities. If dust emissions above a pre-determined level occur, dust control measures would be required. These measures may include spraying water, plastic tarps, plywood walkways, or other procedures, depending on the area of concern.

Groundwater monitoring and groundwater use restrictions would be implemented as described under Alternative 2.

4.2.6 Analysis of Alternative 3

Overall protection of human health and the environment. Alternative 3 would be protective of human health and the environment. The source of contamination would be removed, reducing the potential for direct contact and the possibility of further groundwater contamination. The relatively low levels of groundwater contamination that currently exist would decrease through natural attenuation; groundwater monitoring would provide a mechanism to confirm that this is occurring. Placing restrictions on groundwater use would provide an additional layer of protection to the public by reducing the risk associated with the ingestion exposure route.

Compliance with ARARs. Potential action-specific ARARs for excavation are presented in Table 4-6. This alternative would comply with the requirements set forth in the RCRA and the State of Washington DW regulations. This alternative would also comply with DOT requirements for packaging and shipping hazardous wastes to off-facility locations.

Soil excavation and building demolition activities would require the classification of wastes. RCRA and Ecology’s DW regulations provide guidelines for classification, transport, and disposal of hazardous and solid wastes.

Compliance monitoring and institutional controls for the deep groundwater also would be required under MTCA. Monitoring would confirm that excavation of facility soils has removed the potential for further contaminant leaching to the deep groundwater aquifer while use restrictions would ensure that the deep groundwater is not used for consumption by humans. Additional wells that might be installed for compliance monitoring activities would comply with Ecology's requirements for well construction and maintenance.

Long-term effectiveness and permanence. Excavation and off-site disposal provides a permanent resolution to the issues of direct contact and contaminant migration. The absence of a contaminant source also would provide protection of groundwater quality. Groundwater use restrictions also would provide long-term protection from the potential exposure to contaminated groundwater. Long-term groundwater monitoring would be conducted to confirm that the RAOs will continue to be met through this alternative.

Reduction of toxicity, mobility, or volume through treatment. Excavation achieves complete removal of the contaminated source from the site. The potential for contaminant mobility to groundwater would be reduced because of source removal. This alternative does not include direct treatment of contaminated groundwater; however, groundwater contaminant levels should decrease through natural attenuation.

Short-term effectiveness. Demolition and excavation of contaminated soil would require careful attention to health and safety protocols and work plans to protect workers and the environment. Upon completion, the action would be very effective at removing the contaminant source. During excavation, dust generation, noise, and an increase in truck traffic would be expected to impact the surrounding community and the environment. Dust generation can be controlled through the use of water spray. Limited work hours and exhaust mufflers could be employed to minimize noise impacts. It is estimated that excavation activities will require approximately three months to conduct once design activities have been completed.

Implementability. This alternative would require discontinuance of The Oeser Company's current operations. Most of the contamination is located below the primary treatment area; therefore tanks, buildings, and other structures would have to be demolished and removed before excavation could occur. The use of heavy equipment and trained operators would be required to implement this alternative. Implementability of institutional controls for deep groundwater for The Oeser Company property depends on the cooperation of the property owner, as discussed in Alternative 2.

Cost. The total estimated capital cost associated with this alternative is approximately $13,500,000. Costs included and assumptions made in this estimate are detailed in Appendix C along with the present worth analysis. Annual O&M costs for this alternative are estimated to be $14,500 per year for 30 years and include the cost of environmental monitoring activities. A cost of $25,000 is included every fifth year for the 5-year CERCLA review. The present worth of the annual costs is $236,000, and the total estimated present worth cost for Alternative 3 is $13,700,000.

4.2.7 Alternative 4: Capping and Ex-Situ Groundwater Treatment

This alternative includes the capping of contaminated soil, as previously described under Alternative 2, and the ex-situ treatment of shallow groundwater. In order to prevent the downward migration of NAPL and shallow groundwater contamination to the deep aquifer, the shallow discontinuous zone would have to be de-watered. By de-watering this zone, the primary transport mechanism for subsurface contaminant migration is removed.

Conventional pumping of existing wells would entail installing pumps with level control and groundwater collection systems. All existing wells could be pumped to de-water the entire contaminated area. Pumps with the ability to cycle on and off in accordance with water availability may prove the most efficient and convenient equipment for this method. Institutional controls as described in Alternative 2 for the shallow and deep groundwater would be employed under this alternative as well.

Extracted groundwater would be treated using carbon adsorption. Carbon adsorption is a simple and well-established treatment technology for removing organic contaminants from groundwater. Adsorption is a surface phenomenon where contaminants are adsorbed selectively onto GAC. GAC provides a large number of sites, known as pores, where various organic contaminants can become affixed when contaminated water is passed over them. A typical GAC treatment process would start with a pre-filtration stage to remove suspended solids, followed by a minimum of two stages of carbon treatment before discharging treated water. Separate stages of carbon treatment often are used to obtain greater overall removal efficiency. The first stage can be used until breakthrough occurs. At this point, the first GAC unit is taken off line and shipped off site for disposal or regeneration. The other on-line units then move up in sequence. A fresh canister then is installed at the end of the treatment system to provide for final polishing.

Treated water likely would be discharged to the stormwater system either under The Oeser Company’s existing NPDES permit or through a new NPDES permit. Periodic monitoring would be required to determine compliance in either case.

4.2.8 Analysis of Alternative 4

Overall protection of human health and the environment. Capping would control the contaminant source and reduce possible exposure through direct contact. Currently, there are no known risks to human health or the environment from shallow groundwater as it is not a potable water source. The shallow groundwater at the site fails to meet either Washington state (WAC Chapter 173-340-720) or federal criteria (EPA 1986) as a drinking water aquifer due to the low yield of water on pumping. Future human health risks could result if contaminants migrate to drinking water supply wells. Although relatively little contamination is present in the shallow groundwater, this alternative would prevent the migration of existing groundwater contamination and eventually would remove most of the contaminants and NAPL (if present) from the subsurface. Groundwater monitoring would provide a mechanism to confirm that this is occurring. Placing restrictions on groundwater use would provide an additional layer of protection to the public by reducing the risk associated with the ingestion exposure route.

Compliance with ARARs. Potential action-specific ARARs for ex-situ treatment of shallow groundwater are presented in Table 4-7 while action-specific ARARs for capping are presented in Table 4-4. This alternative would comply with the requirements set forth in RCRA and the State of Washington DW regulations. This alternative also would comply with DOT requirements for packaging and shipping hazardous wastes to off-facility locations.

Spent carbon from the groundwater treatment system would need to be disposed of or regenerated. A hazardous waste determination would be needed prior to disposal of the spent carbon, as required under RCRA and Ecology's DW regulations. The treated water would be discharged into the stormwater discharge system, which would require modification of the existing NPDES permit for the site.

Ecology's MTCA would require compliance monitoring to confirm that the cap was preventing further infiltration of chemicals to the deep aquifer and would require institutional controls for the deep groundwater to prevent consumption of and direct contact with deep groundwater underlying the site. Ecology's requirements for well construction and maintenance would need to be met under this alternative should additional wells be installed for monitoring purposes.

Long-term effectiveness and permanence. With proper maintenance of the cap and O&M of the groundwater treatment system, this alternative would provide long-term protection from potential exposure to contaminated soil and protect groundwater quality. However, the long-term effectiveness of the groundwater treatment system is uncertain because of the low yield of the shallow aquifer. Operation of the treatment system could be interrupted frequently as the shallow discontinuous zones are de-watered. The increased long-term effectiveness of this alternative provided by operation of the groundwater treatment system is minimal. Groundwater use restrictions also would provide long-term protection from the potential exposure to contaminated groundwater. Long-term groundwater monitoring would provide assurance that the RAOs will continue to be met through this alternative.

Reduction of toxicity, mobility, or volume through treatment. The cap is expected to control the contaminant source by reducing precipitation infiltration through contaminated areas. Although contaminants would remain in place, the mobility of existing contamination would be reduced by prohibiting infiltration. It is crucial to maintain the cap's structural integrity to ensure continued effectiveness of the alternative.

By extracting the groundwater, this alternative may reduce the levels of groundwater contamination. This would result in a reduction in volume and mobility. The carbon used to adsorb these contaminants would be sent to a regeneration facility upon saturation. The contaminants then would be desorbed thermally and incinerated, thereby resulting in a permanent reduction in toxicity.

Short-term effectiveness. During construction, health and safety protocols would be established to reduce exposure to workers and the community. Possible exposures include migration of dust or direct exposure to contaminated soil. As the cap components are placed, the potential for exposure decreases. Once in place, the cap will be immediately effective at minimizing the mobility of contamination. During installation of the cap, dust generation, noise, and an increase in truck traffic are expected to impact the surrounding community and the environment. Dust generation can be controlled through the use of water spray. Limited work hours and exhaust mufflers could be employed to minimize noise impacts. It is estimated that capping and groundwater treatment activities will require approximately one month to conduct, once design activities have been completed.

In this alternative, groundwater contaminants would be removed from the subsurface through extraction followed by carbon adsorption. Possible exposure to site workers and the community from construction and operation of the groundwater treatment system is considered minimal. Standard personal protection practices would protect workers from potential exposures.

Implementability. This alternative incorporates proven, well-established technologies. Construction of the cap would disrupt facility activities temporarily; therefore, the construction schedule would have to be coordinated with The Oeser Company management to minimize this disruption. Construction of the groundwater treatment system would be less disruptive to site activities. However, it should be noted that operation of the groundwater treatment system would be sporadic because of the low yield of the shallow groundwater. Implementability of institutional controls for deep groundwater for

The Oeser Company property depends on the cooperation of the property owner, as discussed in Alternative 2.

Cost. The total estimated capital cost associated with the alternative is $3,225,000. Costs included and assumptions made in this estimate are detailed in Appendix C. Appendix C also includes the present worth analysis of the costs associated with this alternative. Annual O&M costs for this alternative are estimated to be $93,000 per year for 30 years and include the cost of maintaining the cap, environmental monitoring activities, and NAPL removal. A cost of $25,000 is included every fifth year for the 5-year CERCLA review. The present worth of the annual costs is $1,300,000, and the total estimated present worth cost for Alternative 4 is $4,500,000.

4.2.9 Alternative 5: Ex-Situ Soil and Groundwater Treatment

This alternative includes excavation and on-site bioremediation of soil contaminated only with cPAHs and ex-situ groundwater treatment using carbon adsorption. Excavation and off-site disposal also may be required in selected areas to remove dioxin-contaminated soil, which bioremediation is not effective in treating. The total volume of contaminated soil at the facility is estimated to be 40,700 cubic yards. Of that amount, approximately 5,400 cubic yards is contaminated with dioxin/furans and approximately 35,300 cubic yards are contaminated with cPAHs only. Also included in this alternative is shallow groundwater extraction and treatment as described in Alternative 4. Groundwater monitoring would be conducted and institutional controls would be employed to restrict the use of deep groundwater as described in Alternative 2.

In order to excavate contaminated soil and treat it on site, demolition of existing structures would be required, followed by decontamination and transport off site to appropriate disposal facilities. This alternative would require discontinuance of The Oeser Company's current operation.

Bioremediation assists microorganisms' growth and increases microbial populations by creating optimum environmental conditions for them to detoxify and metabolize the maximum amount of contaminants. Different microorganisms degrade different types of compounds and survive under different conditions. Because microorganisms are ubiquitous, indigenous populations usually can be stimulated to biodegrade the COCs. The specific bioremediation process to be employed at the site depends upon several factors including: the type of microorganisms present, the site conditions, and the quantity and toxicity of contaminants. A bench-scale treatability test and a field pilot study would be required to determine the optimal conditions for bioremediation and the type of process that would be most effective at treating the contamination present at the site.

Bioremediation can take place under both aerobic and anaerobic conditions; however, under this alternative, bioremediation would take place under aerobic conditions. Under aerobic conditions, microorganisms use available atmospheric oxygen in order to metabolize contaminants. With sufficient oxygen, microorganisms will mineralize many organic contaminants to carbon dioxide and water. Bioremediation is limited by extremes in pH (below 4.5 or greater than 9), low ambient temperatures, short time/growth seasons, low or high rainfall rates, and the absence of indigenous microbes.

Ex-situ bioremediation incorporates many aspects that would be excluded in an off-site remedy. These include site evaluation and selection, which is influenced by impacts to groundwater, influences of floodplains, and surface water run-on. Contaminated soil would be treated in a lined on-site waste cell where the levels of moisture, heat, nutrients, and oxygen are controlled to enhance biodegradation. After treatment, residual contamination likely will remain. Since some contamination will remain, the treated soil should not be utilized for backfill but either disposed of in an on-site lined waste cell or disposed of off site at an appropriate disposal facility.

4.2.10 Analysis of Alternative 5

Overall protection of human health and the environment. On-site bioremediation can be used to effectively remediate creosote-contaminated soils. Bioremediation can achieve 90 to 99% destruction of two-, three-, and four-ring compounds, but only 60% destruction of five- and six-ring compounds. Contaminants present at The Oeser Company facility include compounds up to six rings.

Although bioremediation can be used to reduce the contaminant concentrations in the waste cell soils, treated soils ultimately will be disposed of on site. Numerous natural and augmented environmental factors influence the rate of biodegradation; however, the degree of treatment ultimately depends on the treatment period. Dioxin-contaminated soil would be excavated and transported off site to a RCRA Subtitle C landfill for permanent disposal. Because dioxin-contaminated soil would no longer be present at the site, it is considered protective.

Currently, there are no known risks to human health or the environment from shallow groundwater because it is not a potable water source and is unlikely to be one in the future. The shallow groundwater at the site fails to meet either Washington state (WAC Chapter 173-340-720) or Federal criteria (EPA 1986) as a drinking water aquifer due to the low yield of water on pumping. Future human health risks could result if contaminants migrate to drinking water supply wells. Although relatively little contamination is present in the shallow groundwater, this alternative would prevent the migration of existing groundwater contamination and eventually would remove most of the contaminants from the subsurface. Groundwater monitoring would provide a mechanism to confirm that this is occurring. Placing restrictions on groundwater use would provide an additional layer of protection to the public by reducing the risk associated with the ingestion exposure route.

Compliance with ARARs. Potential action-specific ARARs for bioremediation are presented in Table 4-8 while action-specific ARARs for excavation and off-site disposal are presented in Table 4-6 and ARARs for ex-situ groundwater treatment are provided in Table 4-7. This alternative would comply with the requirements set forth in RCRA and the State of Washington DW regulations. This alternative would also comply with DOT requirements for packaging and shipping hazardous wastes to off-facility locations.

Waste treatment cells that enhance bioremediation of contaminated soils would be subject to Ecology's DW regulations for land treatment. These regulations govern the physical and chemical parameters of the treatment cell.

Compliance monitoring would be required under Ecology's MTCA for this alternative to confirm that treatment of the soil has reduced further migration of site contaminants to the deep aquifer. Institutional controls for deep groundwater also would be required under Ecology's MTCA to prevent consumption of the deep groundwater by humans. Well construction and maintenance requirements would be met under this alternative.

Long-term effectiveness and permanence. Bioremediation can reduce the cPAH concentration in contaminated soils. Treated soils will be disposed on-site. Because residual soils would contain limited quantities of contamination, construction of an engineered landfill would be required to dispose of the treated soils. Because treated soils remain on-site, bioremediation is less effective at reducing risk than off-site remedies. However, this alternative could reduce cPAH contamination to acceptable risk levels for human health and the environment. Dioxin-contaminated soils would be permanently removed from the site; hence, the risk associated with dioxin-contaminated soil would be reduced.

Reduction of toxicity, mobility, or volume through treatment. On-site bioremediation of cPAH-contaminated soil and the off-site disposal of dioxin-contaminated soil would decrease the volume and toxicity of contaminated soil at the site. As clay liners would be constructed underneath the land treatment units, staging area, and the final disposal area, seepage of contaminated soils would be reduced and the mobility of contaminated soil controlled. Stormwater control would be implemented so that runoff does not adversely effect the surrounding areas. It is expected that this can be done through grading and surface controls.

By extracting the groundwater, this alternative may reduce the levels of groundwater contamination subsequently resulting in a reduction in volume and mobility. The carbon used to adsorb these contaminants would be sent to a regeneration facility upon saturation. The contaminants then would be desorbed thermally and incinerated, thereby resulting in a permanent reduction in toxicity.

Short-term effectiveness. While the land treatment units are constructed and operated, the contaminated soils remain on-site. The total operational period for on-site bioremediation could exceed five years. Although on-site bioremediation could be effective for long-term remediation, in the short-term, contaminated soil remains until the treatment process is complete and all of the soil has been treated. Because contaminated soil remains on site, the potential for direct exposure to the contaminated soil remains until treatment is complete. During excavation, construction, and maintenance activities, dust generation, noise, and an increase in truck traffic are expected to impact the surrounding community and the environment. Dust generation can be controlled through the use of water spray. Limited work hours and exhaust mufflers could be utilized to minimize noise impacts.

Implementability. This alternative would require discontinuance of The Oeser Company facility's current operations. Most of the contamination is located below the primary treatment area; therefore tanks, buildings, and other structures would have to be demolished and removed before excavation could occur. Segregating dioxin-contaminated soil from cPAH-contaminated soil would require extensive confirmation sampling that could result in significant time delays while waiting for analytical results.

Field data indicate that a one-foot layer of soil can be treated through land farming techniques. The total volume of cPAH-contaminated soil is approximately 35,260 cubic yards, or 23.5 acre-feet. Therefore, 23.5 acres would be required to remediate the contaminated soil that is not transported off-site. Because of the large space requirements, multiple operational cycles would be required to treat the contaminated soil in a smaller land treatment unit.

The excavation of on-site waste cells would require heavy equipment, confirmation sampling, dust abatement, and runoff abatement. Land treatment units and staging areas would require construction. Excavated soils from the waste cell would be placed in the land treatment units. The land treatment units would require tillage, irrigation, fertilization, and confirmation sampling. After each operational cycle, treated soils would require removal from the land treatment units and storage in the staging area. Additional contaminated soil would be excavated and placed in the land treatment units. After all of the contaminated soils have been treated, construction of a permanent disposal area would be necessary for disposing of treated soils stored in the staging area if soil is not disposed of off site. The site then would be re-graded to provide a level site with proper drainage.

Installation and operation of the groundwater treatment system under this alternative is easily implemented; however, it should be noted that operation of the groundwater treatment system would be sporadic because of the extremely low yield of the shallow groundwater.

Implementability of institutional controls on deep groundwater for The Oeser Company property depends on the cooperation of the property owner, as discussed in Alternative 2.

Cost. The total estimated capital cost associated with this alternative is $6,600,000. Costs included and assumptions made in this estimate are detailed in Appendix C. Appendix C also includes the present worth analysis of the costs associated with this alternative. Annual O&M costs for this alternative are estimated to be $27,000 per year for 30 years and include the cost of operating the bioremediation system and monitoring groundwater. A cost of $25,000 is included every fifth year for the 5-year CERCLA review. The present worth of the annual costs is $564,000, and the total estimated present worth cost for Alternative 5 is $7,160,000.

4.3 COMPARATIVE ANALYSIS OF ALTERNATIVES

In this section, the remedial alternatives are compared with one another using the threshold, primary balancing, and modifying criteria identified in the NCP. The threshold criteria include protection of human health and the environment, and compliance with ARARs. Because the threshold criteria must be met by all alternatives, these serve as the basic criteria for retaining an alternative. The primary balancing criteria include short-and long-term effectiveness; reduction of toxicity, mobility, or volume; implementability; and cost. Evaluation of the primary balancing criteria generally identifies the significant differences and important tradeoffs between alternatives. The modifying criteria, state and community acceptance, are not addressed in this document, but will be addressed by the EPA once the public comment period on the proposed plan is complete. The purpose of the evaluation presented below is to identify the relative advantages and disadvantages of each alternative to facilitate decision making. The comparative analysis results are summarized in Table 4-10.

4.3.1 Overall Protection of Human Health and the Environment

Alternative 1 would not satisfy the NCP threshold criteria for overall protection of human health and the environment. With respect to contaminated soil at the site, Alternative 3 is most protective of human health and the environment because all soil containing contaminants in excess of the CULs would be removed, significantly reducing the possibility of direct contact with contaminated soil and removing the source of potential future groundwater contamination. Alternatives 2, 4, and 5 also are protective with respect to the risks posed by contaminated soil. After treatment is complete, residual, non-hazardous levels of soil contamination would remain on-site under Alternative 5. Alternatives 2 and 4 would leave existing soil contamination in place but would achieve RAOs by reducing the potential for direct contact with contaminants and limiting contaminant mobility.

Alternatives 4 and 5 are slightly more protective with respect to shallow groundwater contamination, but since the total mass of contamination in shallow groundwater is low relative to the mass in soil; the extraction and treatment of shallow groundwater does not significantly increase the overall protection to human health and the environment. Each of the four action alternatives include the same institutional controls for the deep groundwater and are therefore equally protective in that respect.

The alternatives that are most protective of human health and the environment overall in order from most protective to least protective are as follows: Alternative 3, Alternative 5, Alternative 4, Alternative 2, and then Alternative 1.

4.3.2 Compliance with ARARs

Alternative 1 would not comply with ARARs. The four action alternatives would comply with ARARs and many of those requirements are common to the action alternatives. These four alternatives would also comply with the requirements set forth in RCRA and the State of Washington DW regulations. Alternatives 2 and 4 also must comply with federal and state NPDES requirements associated with design and control of surface water flow, which are not included in the other alternatives. ARARs unique to Alternatives 3 and 5 include MTCA building demolition requirements. Alternative 5 also includes MTCA and RCRA requirements for land treatment.

Each of the four action alternatives require property and groundwater use restrictions. In the case of The Oeser Company's property, restrictive covenants would be required.

In summary, with the exception of Alternative 1, all of the action alternatives are equally compliant with ARARs.

4.3.3 Short-Term Effectiveness

There are more short-term impacts associated with Alternatives 3 and 5 than Alternatives 2 and 4; although, all four action alternatives do involve heavy equipment operation and increases in traffic, dust generation, and noise. Alternatives 3 and 5 would require the development of extensive health and safety protocols to address the hazards associated with deep excavations and demolition. Because contaminated soil would remain on site under Alternative 5, the potential for direct exposure to the contaminated soil remains until treatment is complete.

The estimated operational periods for each action alternative increase progressively. It is estimated that under Alternatives 2 and 4 it would take one month to install the cap. Under Alternative 3 it is estimated that it would take three months to excavate, and under Alternative 5 it is estimated that excavation would take four months and bioremediation would last approximately five years.

All of the action alternatives involve the use of heavy equipment; however, Alternatives 3 and 5 would require more attention to health and safety protocols than Alternatives 2 and 4. In summary, short term effectiveness associated with implementation of alternatives are highest for: Alternative 2, Alternative 4, Alternative 3, Alternative 5, and then Alternative 1.

4.3.4 Long-Term Effectiveness and Permanence

Long-term effectiveness concerns two primary factors: the magnitude of the residual risk remaining from untreated contaminants and the risks remaining at the conclusion of remedial activities. Although natural attenuation of contaminated soil and groundwater would occur under Alternative 1, the risk levels associated with the site would not be reduced. Alternatives 3 and 5 are more permanent and effective over the long-term than Alternatives 2 and 4 because instead of simply reducing contaminant mobility (Alternatives 2 and 4), the contamination would be removed. The adequacy and reliability of caps are dependant on frequent inspection and proper maintenance. Thus, regular inspections and maintenance of the cap would be required under Alternatives 2 and 4, but would not be required for excavation under Alternative 3 or for ex-situ treatment under Alternative 5. Shallow groundwater contamination would be addressed more effectively and permanently through Alternatives 4 and 5 (extraction and treatment) than through Alternatives 2 and 3.

To summarize, the long-term effectiveness and permanence of the alternatives in order of most effective and permanent to the least are as follows: Alternative 3, Alternative 5, Alternative 4, Alternative 2, and then Alternative 1.

4.3.5 Reduction of Toxicity, Mobility, or Volume Through Treatment

Except by the mechanism of natural attenuation, the toxicity, mobility, and volume of soil contamination would not be reduced through Alternative 1, and the potential for future migration of contaminants to groundwater would remain unchanged. The volume and mobility of soil contamination would be reduced most significantly by Alternative 3, which would remove all soil contamination above CULs from the site. Although Alternative 3 reduces the volume and mobility of soil contamination it does not do so through treatment per the NCP preference. The mobility of soil contamination, but not the volume or toxicity, would be reduced through Alternatives 2 and 4. Statutory preference is for treatment that notably reduces the toxicity, mobility, or volume of contaminants.

The mobility of groundwater contamination would be reduced through Alternatives 2 and 3. Alternatives 4 and 5 would reduce the toxicity, mobility, and volume of groundwater contamination.

The only alternative the reduces toxicity, mobility, and volume of both soil and groundwater contamination is Alternative 5. Alternative 4 reduces the mobility of soil contamination and reduces the volume, toxicity, and mobility of groundwater contamination. After that, Alternative 3 reduces the volume and mobility of soil contamination but does not reduce groundwater contamination except by natural attenuation. Alternative 2 only decreases the mobility of soil contamination. Alternative 1 does not reduce the toxicity, mobility, or volume of soil or groundwater contamination except by natural attenuation.

4.3.6 Implementability

Alternative 1 requires no implementation. Alternatives 2 and 4 are the easiest to implement. Although re-grading and drainage control may be required for Alternatives 2 and 4, all the necessary equipment, materials, and contractors are readily available in the vicinity of the site. Coordination with The Oeser Company would be required to minimize disruption to the facility.

Alternatives 3 and 5 would require discontinuance of The Oeser Company's operations. If The Oeser Company facility becomes inactive, it would be easier to implement Alternatives 3 and 5 but these alternatives would involve the use of heavy equipment over a longer period of time than the other alternatives. Additionally, the implementability of ex-situ bioremediation (Alternative 5) would need to be demonstrated during treatability testing. Although this technology has been effective at other sites with similar contaminants, the technology's site-specific effectiveness must be demonstrated by bench-scale and/or pilot-scale studies.

With respect to implementability, the alternatives in order that are the easiest to implement to the ones that are the most difficult to implement are as follows: Alternative 2, Alternative 4, Alternative 3, and then Alternative 5.

4.3.7 Cost

There are no costs associated with implementing Alternative 1. The capital cost and total present worth for Alternatives 2 and 4 are similar and are the lowest of the action alternatives. The capital cost and total present worth of Alternative 5 are significantly higher than Alternatives 2 and 4 but are substantially less than the total capital cost and total present worth of Alternative 3.

Although the capital costs associated with Alternatives 2 and 4 are the lowest of the action alternatives, the annual O&M costs and the annual O&M present worth are the highest of the four action alternatives. The increased O&M cost for Alternatives 2 and 4 is due to the increased monitoring and maintenance activities associated with implementing the two alternatives. The annual O&M costs for Alternative 5 are higher than the O&M costs for Alternatives 2 and 4 during treatment but decrease significantly after treatment of the excavated soil is complete. Because the annual O&M costs for Alternative 5 decrease substantially after completing treatment, the annual O&M present worth of Alternative 5 is less than the annual O&M present worth of Alternatives 2 and 4. The annual O&M cost and annual O&M present worth of Alternative 3 are the lowest of the action alternatives, as only limited environmental monitoring is associated with the long-term operations of this alternative.

With respect to the overall present worth of the alternatives, the alternatives with the highest present worth to the lowest are as follows: Alternative 3, Alternative 5, Alternative 4, Alternative 2, and then Alternative 1.

4.3.8 Cost Sensitivity Analysis

A cost sensitivity analysis was performed to assess the effect that variations in assumptions would have on the estimated cost of each alternative. The factors with the highest degree of uncertainty, and therefore the greatest potential impact on overall costs, include variations in the estimated area to be capped, the estimated volume of soil to be excavated, and the effectiveness and treatment time of bioremediation.

For the alternatives involving capping, costs were developed assuming a 30% increase in the area to be capped. It is likely that some on-site areas paved prior to the 1997-1998 removal action would need to be re-paved if they did not meet the permeability requirements for the proposed cap. The 30% increase in cap size reflects the potential need for cap replacement. Costs also have been developed for each excavation alternative based on a 30% increase in contaminated soil volume. Although the extent of contamination at Oeser has been well characterized, the possibility remains that more soil would require removal based on confirmation sampling results. A comparison of the impacts to the estimated cost of each alternative is summarized in Table 4-11.

Soil at Oeser was defined as contaminated if it contained contamination at levels greater than the site-specific CULs. The area proposed for capping and the volume of soil requiring excavation used to develop the cost estimates for the four action alternatives were determined using the site-specific CULs. If the site-specific CULs are modified, this will change the size of the area proposed for capping and the volume requiring excavation, and thus, the cost of the each alternative would change. A less stringent remediation goal for the soil would result in a lower cost for each action alternative. Likewise, a more stringent remediation goal would increase the cost of each alternative.

The effectiveness of bioremediation would need to be demonstrated through bench-scale and/or pilot treatability studies. Although this technology has been effective at other sites with similar contamination, its effectiveness on contamination at Oeser has yet to be demonstrated. A treatability test also would reveal the length of time it would take to reduce contaminant levels to the final cleanup goals. In the FS, it is assumed that two batches of soil would be treated per year; however, it is likely that the batch treatment time could be as long as one to two years. A longer batch treatment time increases the number of years it takes to treat all of the excavated soil. Thus, an increase in the present worth of the annual costs is expected if the batch treatment time increases. It also should be noted that the bench-scale and pilot-scale treatability tests for Alternative 5 were estimated to cost approximately $200,000. This would be a sunk cost should bioremediation prove not to be effective for treating the soil at Oeser.

Table 4-1

RETAINED REMEDIAL ALTERNATIVES
THE OESER COMPANY SUPERFUND SITE
BELLINGHAM, WASHINGTON

Alternative 1	No Action
Alternative 2	Capping
Alternative 3	Soil Excavation
Alternative 4	Capping and Ex-Situ Groundwater Treatment
Alternative 5	Ex-Situ Soil and Groundwater Treatment

Table 4-2

CHEMICAL-SPECIFIC APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
THE OESER COMPANY SUPERFUND SITE
BELLINGHAM, WASHINGTON

		Soil (mg/kg)				Groundwater (µg/L)		
Chemical	CAS	Site Specific Risk-Based Industrial [a]	MTCA Method C Industrial [b]	MTCA Terrestrial Ecological Unrestricted Land Use [b]	MTCA Method B Groundwater Protection [c]	MTCA Method B Potable [b]	MTCA Method C Potable [b]	Federal MCLG/ MCL [d]
Benzo(a)pyrene	50-32-8	8.9 [e]	18 [e]	30	2.32	0.012 [e]	0.12 [e]	0.2
Naphthalene	91-20-3	260	70,000	NA	23.5	160	350	NA
Pentachlorophenol	87-86-5	120 [e]	1,090 [e]	11	0.077	0.729 [e]	7.29 [e]	1
2,3,7,8-TCDD	1746-01-6	0.00083 [e]	0.000875 [e]	0.000005	0.000314	0.000000583 [e]	0.00000583 [e]	0.00003
TPH (Total)	NA	1,100	NA	NA	NA	NA	NA	NA
TPH (Diesel)	NA	NA	2,000[f]	460	2,000[f]	500[f]	500[f]	NA
TPH (Gasoline)	NA	NA	30[f]	200	30[f]	800[f]	800[f]	NA

Note:

a Calculations are specific to The Oeser Company Superfund site, based on an excess lifetime cancer risk of 1E-04 or hazard quotient of 1.
b Derived from MTCA (CLARC 3.1), updated November 2001.
c Derived from WAC 173-340, Equation 747-1.
d MCLGs are substituted for MCLs when MCLGs are above zero (Drinking Water Standards and Health Advisories, EPA 2000).
e Carcinogen cleanup levels correspond to an excess lifetime cancer risk level of: 1E-04 for site-specific cleanup levels, 1E-05 for MTCA Method C, and 1E-06 for MTCA Method B.
f MCTA Method A value.

Key:

CAS = Chemical abstracts service.
EPA = United States Environmental Protection Agency.
MCL = Maximum Contaminant Level.
MCLG = Maximum Contaminant Level Goal.
µg/L = Micrograms per liter.
mg/kg = Milligrams per kilogram.
MTCA = Model Toxics Control Act.
NA = Not available.
TCDD = Tetrachlorodibenzo-p-dioxin.
TPH = Total petroleum hydrocarbon.
WAC = Washington Administrative Code.

Table 4-3 AREAS PROPOSED FOR CAPPING THE OESER COMPANY SUPERFUND SITE BELLINGHAM, WASHINGTON		
Subarea	**Subarea Size**	**Proposed Cap Size**
North Pole Yard	8.53 acres	0.42 acres
South Pole Yard	3.93 acres	0.74 acres
Treated Pole Area	2.99 acres	0.77 acres
North Treatment Area	4.53 acres	1.63 acres
West Treatment Area	0.41 acres	0.06 acres
East Treatment Area	0.63 acres	0.05 acres
Wood Storage Area	4.59 acres	1.05 acres
Total	**25.61 acres**	**4.72 acres**

Table 4-4

POTENTIAL ACTION-SPECIFIC ARARS FOR CAPPING
THE OESER COMPANY SUPERFUND SITE
BELLINGHAM, WASHINGTON

Citation	Description
Federal Action-Specific ARARs	
40 CFR 122	EPA CWA NPDES permit regulations
40 CFR 260-273	EPA RCRA standards for owners and operators of hazardous waste TSD facilities
40 CFR 264	EPA RCRA standards for owners and operators of hazardous waste TSD facilities, including surface water control and cap design requirements
49 CFR 171 - 180	DOT Hazardous materials table, communication, emergency response, instructions for shippers, instructions for packaging
State Action-Specific ARARs	
WAC 173-220-130	Ecology NPDES Program Regulations: Permit requirements
WAC 173-303-141 to -270	Ecology Dangerous Waste Regulations: TSD and transportation of dangerous waste
WAC 173-303-646	Ecology Dangerous Waste Regulations: Corrective action
WAC 173-303-665	Ecology Dangerous Waste Regulations: Landfills
WAC 173-340-350	Ecology MTCA: Remedial investigations and feasibility studies
WAC 173-340-410	Ecology MTCA: Compliance monitoring
WAC 173-340-440	Ecology MTCA: Institutional controls
WAC 173-160	Ecology Minimum Standards For Construction and Maintenance of Wells

Key:

ARARs = Applicable or relevant and appropriate requirements.
CFR = Code of Federal Regulations.
CWA = Clean Water Act.
DOT = United States Department of Transportation.
Ecology = Washington State Department of Ecology.
EPA = United States Environmental Protection Agency.
MTCA = Model Toxics Control Act.
NPDES = National Pollutant Discharge Elimination System.
RCRA = Resource Conservation and Recovery Act.
TSD = Treatment, storage, and disposal.
WAC = Washington Administrative Code.

Table 4-5

ESTIMATED EXCAVATION VOLUMES
THE OESER COMPANY SUPERFUND SITE
BELLINGHAM, WASHINGTON

Subarea	**Excavation Volume**
North Pole Yard	820 cubic yards
South Pole Yard	870 cubic yards
Treated Pole Area	1,310 cubic yards
North Treatment Area	5,490 cubic yards
West Treatment Area	16,760 cubic yards
East Treatment Area	15,200 cubic yards
Wood Storage Area	150 cubic yards
Total	**40,600 cubic yards**

Table 4-6

POTENTIAL ACTION-SPECIFIC ARARs FOR EXCAVATION
THE OESER COMPANY SUPERFUND SITE
BELLINGHAM, WASHINGTON

Citation	Description
Federal Action-Specific ARARs	
40 CFR 260-273	EPA RCRA: Regulations for identification, generation, TSD, and transportation of hazardous wastes
40 CFR 268	EPA RCRA: Land disposal requirements
40 CFR 262	EPA RCRA: Hazardous waste determination
40 CFR 264	EPA RCRA standards for owners and operators of hazardous waste TSD facilities, including surface water control
49 CFR 171-180	DOT Hazardous materials table, communication, emergency response, instructions for shippers, instructions for packaging
State Action-Specific ARARs	
WAC 173-303-071	Ecology Dangerous Waste Regulations: Excluded categories of waste for building demolition
WAC 173-303-080 to -100	Ecology Dangerous Waste Regulations: Dangerous waste lists, characteristics, criteria
WAC 173-303-141 to -270	Ecology Dangerous Waste Regulations: TSD and transportation of dangerous wastes
WAC 173-303-140	Ecology Dangerous Waste Regulations: Disposal Restrictions
WAC 173-303-646	Ecology Dangerous Waste Regulations: Corrective action
WAC 173-340-350	Ecology MTCA: Remedial investigations and feasibility studies
WAC 173-340-440	Ecology MTCA: Institutional controls
WAC 173-340-410	Ecology MTCA: Compliance monitoring
WAC 173-160	Ecology Minimum Standards For Construction and Maintenance of Wells

Key:

ARARs = Applicable or relevant and appropriate requirements.
CFR = Code of Federal Regulations.
DOT = United States Department of Transportation.
Ecology = Washington State Department of Ecology.
EPA = United States Environmental Protection Agency.
MTCA = Model Toxics Control Act.
RCRA = Resource Conservation and Recovery Act.
TSD = Treatment, storage, and disposal.
WAC = Washington Administrative Code.

Table 4-7

POTENTIAL ACTION-SPECIFIC ARARs FOR EX-SITU TREATMENT OF GROUNDWATER
THE OESER COMPANY SUPERFUND SITE
BELLINGHAM, WASHINGTON

Citation	Description
Federal Action-Specific ARARs	
40 CFR 122	EPA CWA NPDES permit regulations
40 CFR 260-273	EPA RCRA: Regulations for identification, generation, TSD, and transportation of hazardous wastes
40 CFR 268	EPA RCRA: Land disposal requirements
40 CFR 262	EPA RCRA: Hazardous waste determination
40 CFR 264	EPA RCRA standards for owners and operators of hazardous waste TSD facilities, including surface water control
49 CFR 171-180	DOT Hazardous materials table, communication, emergency response, instructions for shippers, instructions for packaging
State Action-Specific ARARs	
WAC 173-220-130	Ecology NPDES Program Regulations: Permit requirements
WAC 173-303-071	Ecology Dangerous Waste Regulations: Excluded categories of waste
WAC 173-303-080 to -100	Ecology Dangerous Waste Regulations: Dangerous waste lists, characteristics, criteria
WAC 173-303-141 to -270	Ecology Dangerous Waste Regulations: TSD and transportation of dangerous wastes
WAC 173-303-646	Ecology Dangerous Waste Regulations: Corrective action
WAC 173-340-350	Ecology MTCA: Remedial investigations and feasibility studies
WAC 173-340-440	Ecology MTCA: Institutional controls
WAC 173-340-410	Ecology MTCA: Compliance monitoring
WAC 173-160	Ecology Minimum Standards For Construction and Maintenance of Wells

Key:

ARARs = Applicable or relevant and appropriate requirements.
CFR = Code of Federal Regulations.
CWA = Clean Water Act.
DOT = United States Department of Transportation.
Ecology = Washington State Department of Ecology.
EPA = United States Environmental Protection Agency.
MTCA = Model Toxics Control Act.
NPDES = National Pollutant Discharge Elimination System.
RCRA = Resource Conservation and Recovery Act.
TSD = Treatment, storage, and disposal.
WAC = Washington Administrative Code.

Table 4-8

**POTENTIAL ACTION-SPECIFIC ARARS FOR BIOREMEDIATION
THE OESER COMPANY SUPERFUND SITE
BELLINGHAM, WASHINGTON**

Citation	Description
Federal Action-Specific ARARs:	
40 CFR 260-273	EPA RCRA: Regulations for identification, generation, TSD, and transportation of hazardous wastes
40 CFR 268	EPA RCRA: Land disposal requirements
40 CFR 262	EPA RCRA: Hazardous waste determination
40 CFR 264	EPA RCRA standards for owners and operators of hazardous waste TSD facilities, including surface water control
49 CFR 171-180	DOT Hazardous materials table, communication, emergency response, instructions for shippers, instructions for packaging
State Action-Specific ARARs:	
WAC 173-303-071	Ecology Dangerous Waste Regulations: Excluded categories of waste
WAC 173-303-080 to -100	Ecology Dangerous Waste Regulations: Dangerous waste lists, characteristics, criteria
WAC 173-303-141 to -270	Ecology Dangerous Waste Regulations: TSD and transportation of dangerous wastes
WAC 173-303-646	Ecology Dangerous Waste Regulations: Corrective action
WAC 173-303-655	Ecology Dangerous Waste Regulations: Land treatment
WAC 173-340-350	Ecology MTCA: Remedial investigations and feasibility studies
WAC 173-340-440	Ecology MTCA: Institutional controls
WAC 173-340-410	Ecology MTCA: Compliance monitoring
WAC 173-160	Ecology Minimum Standards For Construction and Maintenance of Wells

Key:

ARARs = Applicable or relevant and appropriate requirements.
CFR = Code of Federal Regulations.
DOT = United States Department of Transportation.
Ecology = Washington State Department of Ecology.
EPA = United States Environmental Protection Agency.
MTCA = Model Toxics Control Act.
RCRA = Resource Conservation and Recovery Act.
TSD = Treatment, storage, and disposal.
WAC = Washington Administrative Code.

Table 4-9

SUMMARY OF ALTERNATIVE COSTS
THE OESER COMPANY SUPERFUND SITE
BELLINGHAM, WASHINGTON

	Capital Cost	Average Annual Cost	Present Worth of Annual Costs	Total Present Worth
Alternative 1	$0	$0	$0	$0
Alternative 2	$ 2,876,800	$93,000	$1,300,000	$4,177,000
Alternative 3	$13,481,000	$14,600	$236,000	$13,717,000
Alternative 4	$3,224,500	$93,000	$1,300,000	$4,524,000
Alternative 5	$6,591,000	$27,120	$564,000	$7,155,000

Table 4-10

COMPARATIVE ANALYSIS SUMMARY
THE OESER COMPANY SUPERFUND SITE
BELLINGHAM, WASHINGTON

Criterion	Alternative 1: No Action	Alternative 2: Capping	Alternative 3: Excavation	Alternative 4: Capping and Ex-Situ Groundwater Treatment	Alternative 5: Ex-Situ Soil and Groundwater Treatment
Overall Protection of Human Health and the Environment	Not protective	Protective	Protective	Protective	Protective
Compliance with ARARs	No	Yes	Yes	Yes	Yes
Long-Term Effectiveness and Permanence	Not Effective	Effective	Effective	Effective	Effective
Reduction of Toxicity, Mobility, or Volume	None	Reduction in mobility of soil and groundwater contamination.	Reduction in volume and mobility of soil contamination.	Reduction in mobility of soil contamination; toxicity, mobility, and volume of groundwater contamination.	Reduction in toxicity and volume of soil contamination; toxicity, mobility, and volume of groundwater contamination.
Short-Term Effectiveness	Not applicable	Effective	Moderately effective	Effective	Moderately effective
Implementability	Easily implemented	Easily implemented	Not implementable with current land use	Moderately implementable	Not implementable with current land use
Present Worth Cost	No additional costs	$4.2 million	$13.7 million	$4.5 million	$7.2 million

Key:

ARARs = Applicable or relevant and appropriate requirements.

Table 4-11

SUMMARY OF SENSITIVITY ANALYSIS EVALUATION
THE OESER COMPANY SUPERFUND SITE
BELLINGHAM, WASHINGTON

Sensitivity Analysis Factor	Alternative 2: Capping		Alternative 3: Excavation		Alternative 4: Capping and Ex-Situ Groundwater Treatment		Alternative 5: Ex-Situ Soil and Groundwater Treatment	
No Change	Total Present Worth:	$4,177,000	Total Present Worth:	$13,717,000	Total Present Worth:	$4,524,000	Total Present Worth:	$7,155,000
	Present Worth Annual Costs:	$1,300,000	Present Worth Annual Costs:	$236,000	Present Worth Annual Costs:	$1,300,000	Present Worth Annual Costs:	$564,000
30% Increase in Cap Size/30% Increase in Soil Volume	Total Present Worth:	$4,854,000	Total Present Worth:	$17,590,000	Total Present Worth:	$5,202,000	Total Present Worth:	$8,480,000
	Present Worth Annual Costs:	$1,414,000	Present Worth Annual Costs:	No Change	Present Worth Annual Costs:	$1,414,000	Present Worth Annual Costs:	$661,000
Cost Increase	Total Present Worth:	$677,000	Total Present Worth:	$3,873,000	Total Present Worth:	$678,000	Total Present Worth:	$1,325,000
	Present Worth Annual Costs:	$114,000	Present Worth Annual Costs:	No Change	Present Worth Annual Costs:	$114,000	Present Worth Annual Costs:	$97,000
Percent Increase in Cost	Total Present Worth:	16%	Total Present Worth:	28%	Total Present Worth:	15%	Total Present Worth:	18%
	Present Worth Annual Costs:	9%	Present Worth Annual Costs:	No Change	Present Worth Annual Costs:	9%	Present Worth Annual Costs:	17%

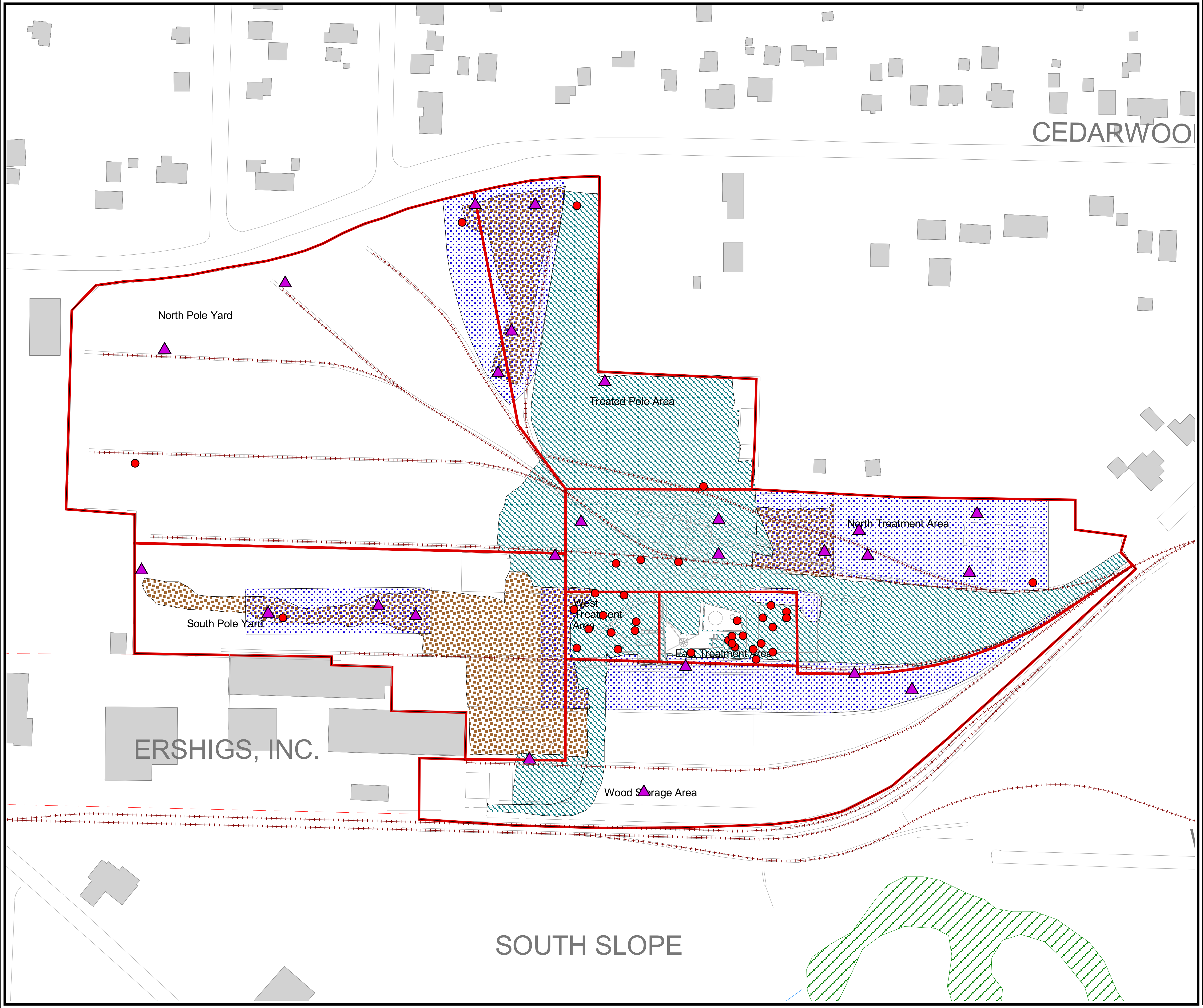

Figure 4-1

THE OESER COMPANY
SUPERFUND SITE

Bellingham, Washington

Areas Proposed for Capping

Legend

- Surface Soil Sample Exceeding CULs
- Subsurface Soil Sample Exceeding CULs
- Railroad
- Oeser Facility Areas
- Oeser Facility Layout
- Wetlands
- Buildings
- Proposed New Cap
- Asphalt
- Gravel Cap

N W E S

100 0 100 200 300 Feet

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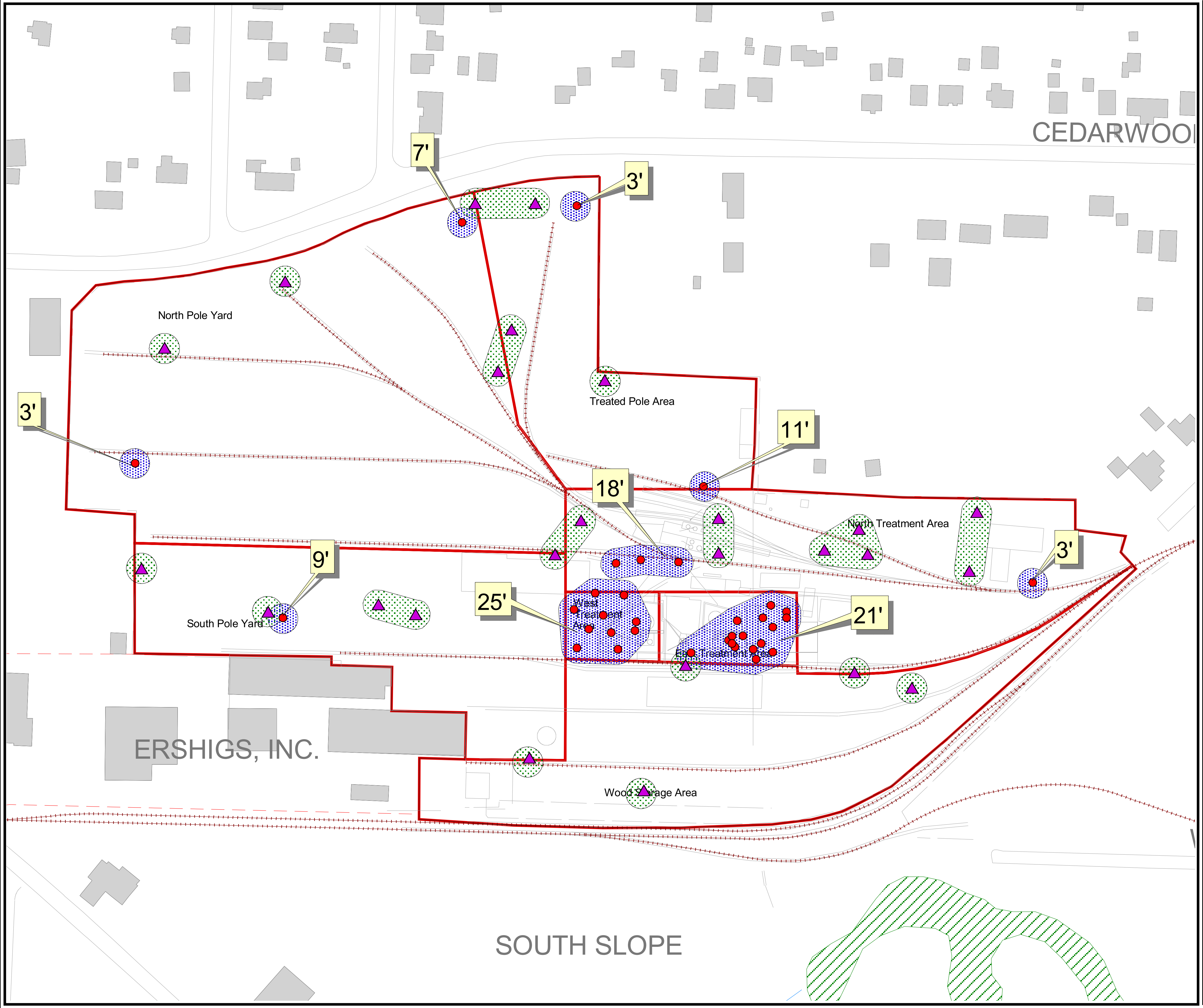

Figure 4-2

THE OESER COMPANY
SUPERFUND SITE

Bellingham, Washington

Areas Proposed for Excavation

Legend

- Subsurface Soil Sample Exceeding CULs
- Surface Soil Sample Exceeding CULs
- Surface Soil Excavation Area
- Subsurface Soil Excavation Area
- Railroad
- Oeser Facility Layout
- Oeser Facility Areas
- Wetlands
- Buildings
- 18' Excavation Depth in Feet

N W E S

100 0 100 200 300 Feet

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International Specialists in the Environment
Seattle, Washington

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APPENDIX A
PROPOSED CLEANUP LEVELS FOR THE OESER COMPANY SUPERFUND SITE

A. PROPOSED CLEANUP LEVELS FOR THE OESER COMPANY SUPERFUND SITE

A.1 Introduction

A baseline human health risk assessment (HHRA; E & E 2002) was conducted to evaluate potential adverse health effects attributable to site-related contaminants at The Oeser Company Superfund site (Oeser) in the absence of remedial action. This baseline risk assessment provided conservative estimates of risks to potentially exposed populations assuming that no remediation or institutional controls were applied to the site. The United State Environmental Protection Agency's (EPA's) range for acceptable risks for exposure to carcinogens is 1E-04 to 1E-06 and the benchmark for exposure to noncarcinogens is a hazard index (HI) of 1. The potential for adverse health effects for off-facility residents were below EPA levels of concern. Risks for on-facility workers exceeded EPA's acceptable range. Excess lifetime cancer risks for frequent recreational users of Little Squalicum Creek was estimated to have an upper bound of 5E-04, which exceeds EPA's acceptable risk range. However, assessment of risks and hazards from dermal exposures to very lipophilic compounds in water, such as dioxins/furans, is highly uncertain and is likely to significantly overestimate risks. The uncertainty in the permeability coefficients and resulting exposure estimates is discussed in more detail in the HHRA.

Contaminants contributing to risks above EPA's acceptable limits (i.e., contaminants of concern [COCs]) were dioxin/furan congeners, carcinogenic polycyclic aromatic hydrocarbons (cPAHs), naphthalene, total petroleum hydrocarbons (TPH), and pentachlorophenol (PCP). Site remediation activities will focus on reducing exposure to the above COCs. The COCs were used to delineate the vertical and areal extent of contamination and development of remedial alternatives.

All chemical-specific applicable or relevant and appropriate requirements (ARARs) were evaluated for Oeser. Chemical-specific ARARs are necessary to determine the extent to which the site will be remediated. ARARs for each media type were evaluated separately. In addition, site-specific cleanup levels (CULs) were developed, based on the risk characterization of the HHRA. The following sections describe chemical-specific ARARs and the development of site-specific CULs, and the rationale for the CULs selected as the basis for remedial actions at Oeser.

A.2 Chemical-Specific Applicable, Relevant, and Appropriate Requirements

The Model Toxics Control Act (MTCA) Cleanup Regulation (Chapter 173-340 WAC) provides cleanup standards for soil, groundwater, surface water, and air in the state of Washington. CULs are established for a site under MTCA Method A, Method B, or Method C. The on-facility portion of Oeser is industrial and qualifies for Method C soil CUL development (Table 1). Method C soil CULs are protective of an industrial worker scenario and are based on an acceptable risk level of 1E-05 for carcinogens and an acceptable HI of 1 for noncarcinogens. MTCA's industrial worker scenario for calculation of soil CULs assumes exposure to COCs through incidental ingestion of soil and uses a soil ingestion rate of 50 milligrams per day.

For groundwater, the MTCA Method B (unrestricted use) calculation for the deep groundwater aquifer is appropriate, since users of groundwater may not be limited to on-site industrial workers. It assumes exposure through inhalation and ingestion and is based on an acceptable risk level of 1E-6 for individual carcinogens and 1E-5 for carcinogenic risks from multiple carcinogens and an acceptable HI of 1 for noncarcinogens. Both the EPA and MTCA specify that federal Maximum Contaminant Levels (MCLs) are also applicable cleanup goals for groundwater; however, under MTCA, calculated values must be used where MCLs are considered insufficiently protective, i.e., they are higher than calculated concentrations. The CUL calculation for groundwater assumes exposure through inhalation and ingestion. An ingestion rate of 2 liters per day is used and an inhalation correction factor of 2 is used for volatile organic compounds and a factor of 1 is used for all other compounds.

MTCA provides alternative instructions for calculating risks and CULs for TPH in soil using fractionated data. Under the fractionated analysis method, concentrations of individual equivalent carbon (EC) ranges are obtained for both aliphatic and aromatic TPH constituents, as well as individual cPAHs and benzene. For risk assessment, the toxicity of EC ranges are evaluated separately according to the concentration of hydrocarbon compounds within each EC range. The risks for each range then are summed to obtain a total HI and excess lifetime cancer risk for exposure to a particular TPH sample location and depth. However, development of soil CULs specific to each sample location and sample depth is not practical for site remediation activities, and using this information to develop a site-wide CUL for TPH is challenging because the TPH profile is not consistent throughout the site. At this time, there is no guidance for determination of site-wide CULs based on fractionated TPH concentration data. Therefore, MTCA Method A soil CULs for diesel range petroleum hydrocarbons and gasoline range petroleum hydrocarbons are presented in Table 1 as ARARs for Oeser.

In the HHRA, risks associated with exposure to cPAHs and dioxins/furans were presented in terms of exposure to benzo(a)pyrene [B(a)P] equivalents and 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) toxicity equivalents (TEQ), respectively. Concentrations of individual cPAHs and dioxin/furan congeners were multiplied by chemical-specific relative potency factors or equivalency factors to obtain equivalent concentrations of B(a)P and 2,3,7,8-TCDD. This method is described in detail in the HHRA

(E & E 2002). MTCA CULs for B(a)P and 2,3,7,8-TCDD are presented in Table 1 to represent ARARs for cPAHs and dioxins/furans.

Table 1 Chemical-Specific ARARs For Soil and Groundwater

Contaminant of Concern	MTCA Method C Cleanup Levels For Soil (mg/kg)	MTCA Method B Cleanup Levels For Groundwater (Fg/L)	Federal Maximum Contaminant Levels (Fg/L)
Benzo(a)pyrene[a]	18	0.012	0.2
2,3,7,8-TCDD[a]	0.000875	0.000000583	0.00003
Pentachlorophenol	1,090	0.729	1
Naphthalene	70,000	160	NA
TPH - Diesel Range	2,000[b]	NC	NA
TPH - Gasoline Range	30[b]	NC	NA

Note:

a = Risks attributable to exposure to cPAHs and dioxin/furans were calculated based on equivalency to benzo(a)pyrene and 2,3,7,8-TCDD, respectively. Therefore, benzo(a)pyrene and 2,3,7,8-TCDD CULs will be surrogates for site cleanup.

b = MTCA Method A.

NA = Not available.

NC = Not a contaminant of concern in groundwater.

A.3 Site-Specific Cleanup Levels

The site-specific CULs are based on on-facility exposure scenarios developed in the HHRA (E & E 2002). CULs for soil are protective of exposure to COCs via incidental ingestion of soil, inhalation of particles and vapors, and dermal contact with soil. CULs for groundwater are protective of exposure to COCs via ingestion, inhalation of vapors, and dermal contact with groundwater. Site-specific CULs were adjusted downward to account for exposure to multiple COCs through multiple exposure pathways such that total site risks would not exceed an excess lifetime cancer risk of 1E-04 or a HI of 1. An excess lifetime cancer risk of 1E-04 is consistent with EPA's acceptable range of 1E-04 to 1E-06. The following generic equation was used to calculate site-specific CULs; chemical-specific calculations are provided in Attachment 1:

$$CUL = \frac{C \times Risk_{\text{target}}}{\sum Risk}$$

where:

CUL = Cleanup level (soil, groundwater)

C	= Concentration of COC (mg/kg for soil; Fg/L for groundwater)
$Risk_{target}$	= Target risk level (1E-04) or HI (1)
Risk	= Total site risks (sum of risks for all COCs, all exposure pathways)

Chemical-specific CULs were calculated for each COC by selecting the on-facility area where risk was greatest for each COC. The total risk for that location (sum of risks resulting from exposure to all contaminants via inhalation, ingestion, and dermal contact) then was used in the above equation along with the corresponding COC concentration. The resulting CUL is the site-wide CUL (i.e., is considered protective of exposures occurring throughout the site). This method also was applied to the calculation of a CUL for cPAHs and dioxins/furans although the risk concentrations were converted to B(a)P equivalents and 2,3,7,8-TCDD TEQ. For TPH, the sample containing the greatest concentrations for each EC range was used to develop a site-wide TPH CUL. However, only noncarcinogenic constituents were considered because carcinogenic TPH constituents (cPAHs, benzene) were evaluated separately. Table 2 provides the site-specific CULs calculated for Oeser using the methods described above.

Table 2 Site-Specific Cleanup Levels For Soil and Groundwater

	Site-Specific Cleanup Levels For Soil and Groundwater	
Contaminant of Concern	**Soil (mg/kg)**	**Groundwater (Fg/L)**
Benzo(a)pyrene[a]	8.9	0.032
2,3,7,8-TCDD[a]	0.00083	0.0000012
Pentachlorophenol	120	55
Naphthalene	260	44
TPH	1,100	NC

Note:

a = Risks attributable to exposure to cPAHs and dioxin/furans were calculated based on equivalency to benzo(a)pyrene and 2,3,7,8-TCDD, respectively. Therefore, benzo(a)pyrene and 2,3,7,8-TCDD CULs will be surrogates for site cleanup.

NC = Not a contaminant of concern in groundwater.

A.4 Selection of Cleanup Levels for Remedial Action

Selection of one CUL for each COC in soil and groundwater is necessary in order to delineate the extent of contamination and evaluate remedial alternatives. The proposed CULs for Oeser are presented in Table 3.

The site-specific soil CULs based on the HHRA results are more conservative, i.e., lower, than the MTCA Method C CULs for soil. This is due to the fact that the MTCA Method C soil CULs consider exposure to COCs through incidental ingestion only, while EPA's site-specific CULs consider exposure through all potential pathways, including inhalation of particulates and vapors and dermal contact with soil. Therefore, site-specific CULs are considered to be adequately protective and will be used to guide remedial actions for soil at Oeser for all COCs except dioxins/furans (Tables 2 and 3). EPA Headquarters has established written policy guidance providing a range of acceptable soil CULs for dioxins/furans at industrial Comprehensive Environmental Response, Compensation, and Liability Act sites across the country. Because the concentrations within this range are higher than MTCA Method C soil CULs for dioxins/furans, the MTCA Method C CUL, which is based on an acceptable cancer risk of 1E-05, was selected to guide remediation of dioxin/furan-contaminated soil at the on-facility portion of Oeser. This value is within EPA's acceptable risk range and is 0.000045 mg/kg greater than the site-specific CUL.

Alternatively, MTCA Method B CULs will be used to guide remedial actions for groundwater (Tables 1 and 3). The Method B CULs are based on groundwater consumption as the beneficial use. Method B CULs are more protective than the Federal MCLs for all COCs. Although the Method B CULs are less conservative than the site-specific CULs, it is assumed that Method B CULs will be adequately protective since the deeper groundwater underlying the site is unlikely to be used as future drinking water source. The shallow groundwater is not an continuous aquifer, but is intermittent, and not considered a potential future source of drinking water. Therefore, CULs for the shallow groundwater do not necessarily need to be at drinking water concentrations; however, they must be protective of the deeper aquifer, to which shallow groundwater eventually discharges. MTCA Method B levels are the default CULs for the shallow groundwater unless other appropriate and protective levels are developed.

Table 3 Proposed Cleanup Levels For Soil and Groundwater

Contaminant of Concern	Site-Specific Cleanup Levels For Soil (mg/kg)	MTCA Method B Cleanup Levels For Groundwater[c] (Fg/L)
Benzo(a)pyrene[a]	8.9	0.012
2,3,7,8-TCDD[a]	0.000875[b]	0.000000583
Pentachlorophenol	120	0.729
Naphthalene	260	160
TPH	1,100	NC

Note:

a = Risks attributable to exposure to cPAHs and dioxin/furans were calculated based on equivalency to benzo(a)pyrene and 2,3,7,8-TCDD, respectively. Therefore, benzo(a)pyrene and 2,3,7,8-TCDD CULs will be surrogates for site cleanup.

b = The cleanup level for 2,3,7,8-TCDD is based on MTCA Method C.

c = If any areas onsite are designated as waste management areas by the EPA Superfund Program, these cleanup levels will not apply.

NC = Not a contaminant of concern in groundwater.

A.5 References

Ecology and Environment, Inc. (E & E), April 2002, *The Oeser Company Superfund Site Remedial Investigation Report*, Bellingham, Washington, by the Superfund Technical Assessment and Response Team (START)-2 under Contract No. 68-S0-01-01, Technical Direction Document (TDD) No. 01-03-0016, prepared for the United States Environmental Protection Agency, (EPA) Region 10, Seattle, Washington.

Attachment 1

Site-Specific Cleanup Level Calculations

This attachment contains the site-specific CUL calculations for each COC. The location where the greatest risk was present, COC concentration for that location, and total risk for that location is provided for each COC in soil and groundwater.

Soil Cleanup Level Calculations

Pentachlorophenol:

The highest PCP concentration was 490 mg/kg located in the North Pole Yard (NPY) at a depth of 0 to 6 feet below ground surface (ft bgs), resulting in a total risk of 4.0E-04. Using the general equation provided in the attached memorandum, the CUL was calculated as follows (concentrations in mg/kg):

$$CUL = \frac{490 \times (1E-04)}{(4E-04)} = 12$$

2,3,7,8-TCDD toxicity equivalents:

The highest 2,3,7,8-TCDD TEQ concentration was 0.0191 mg/kg located in NPY surface soil, resulting in a total risk of 2.3E-03. The CUL was calculated as follows (concentrations in mg/kg):

$$CUL = \frac{0.0191 \times (1E-04)}{(2.3E-03)} = 0.000083$$

Benzo(a)pyrene equivalents:

The highest B(a)P equivalent concentration was 168.22 mg/kg located in the North Treatment Area (NTA) at a depth of 0 to 6 ft bgs, resulting in a total risk of 1.9E-03. The CUL was calculated as follows (concentrations in mg/kg):

$$CUL = \frac{168.22 \times (1E-04)}{(1.9E-03)} = 0.89$$

***TPH**:*

The highest TPH concentration was 5,520 mg/kg located in the NTA at a depth of 0 to 6 ft bgs, resulting in a total HI of 5.03. The CUL was calculated as follows (concentrations in mg/kg):

$$CUL = \frac{5{,}520 \times 1}{5.03} = 1{,}100$$

***Naphthalene**:*

The highest naphthalene concentration was 2,900 mg/kg located in the East and West Treatment Areas (ETA/WTA) at a depth of 0 to 6 ft bgs, resulting in a HI of 11.05. The CUL was calculated as follows (concentrations in mg/kg):

$$CUL = \frac{2{,}900 \times 1}{11.05} = 260$$

Groundwater Cleanup Level Calculations

***2,3,7,8-TCDD toxicity equivalents**:*

The highest 2,3,7,8-TCDD TEQ concentration in deep groundwater was 0.0000109 Fg/L in MW 34-D, resulting in a risk of 9.1E-04. The CUL was calculated as follows (concentrations in Fg/L):

$$CUL = \frac{(1.09E-05)\times(1E-04)}{(9.1E-04)} = 0.00000012$$

***Benzo(a)pyrene equivalents**:*

The highest B(a)P equivalent concentration in deep groundwater was 0.136 Fg/L in TC-6, resulting in a risk of 4.2E-04. The CUL was calculated as follows (concentrations in Fg/L):

$$CUL = \frac{0.136 \times (1E-04)}{(4.2E-04)} = 0.0032$$

***Pentachlorophenol**:*

The highest PCP concentration in deep groundwater was 5.4 Fg/L, resulting in a risk of 9.8E-06. The CUL was calculated as follows (concentrations in Fg/L):

$$CUL = \frac{5.4 \times (1E - 04)}{(9.8E - 06)} = 55$$

Naphthalene*:*

The highest naphthalene concentration in deep groundwater was 0.087 Fg/L, resulting in a hazard of 2E-03. The CUL was calculated as follows (concentrations in Fg/L):

$$CUL = \frac{0.087 \times 1}{(2E - 03)} = 44$$

APPENDIX B
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO-BE-CONSIDERED CRITERIA

B. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO-BE-CONSIDERED CRITERIA

This appendix identifies applicable or relevant and appropriate (ARARs) and other standards, criteria, and guidance "to be considered" (TBC) for remedial activities at The Oeser Company Superfund site (Oeser). ARAR/TBC determinations were made in accordance with Section 121(d) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), 40 CFR 300, and the United States Environmental Protection Agency's (EPA's) two-part guidance document entitled *CERCLA Compliance with Other Laws Manual* (EPA 1989).

An ARAR may be either "applicable" or "relevant and appropriate." Applicable requirements are those substantive environmental protection standards, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, remedial action, location, or other circumstance at a CERCLA site. Relevant and appropriate requirements are those substantive environmental requirements promulgated under federal or state law that, while not legally applicable to the circumstances at a CERCLA site, address situations sufficiently similar to those encountered at the site that their use is well suited to the particular site. Administrative requirements such as obtaining permits and agency approvals, record keeping, and reporting are not ARARs and, therefore, do not need to be complied with during on-site remedial actions. The determination of whether a requirement is applicable versus relevant and appropriate involves consideration of a number of site-specific factors.

TBC criteria are federal or state advisories, guidance, or proposed rules that are not binding legally. TBC criteria do not have the status of a potential ARAR, but are useful in determining the necessary level of cleanup for protection of human health and the environment in situations where ARARs are not available.

Identification of ARARs and TBC criteria is an iterative process conducted throughout the remedial investigation/feasibility study (RI/FS) process. Preliminary identification of ARARs/TBC criteria began during the development of The Oeser Company scoping report and work plan (E & E 1999a, 1999b), continued through the RI/FS, and will remain ongoing through the development of the Record of Decision (ROD). ARARs and TBC criteria identified in this FS will be subject to change until the ROD is signed.

There are three different types of potential ARARs and TBCs:

- Chemical-specific requirements that may define acceptable exposure levels and may be used to establish preliminary cleanup goals;
- Location-specific requirements that may set restrictions on activities within specific locations, such as flood plains or federally designated wetlands; or
- Action-specific requirements that may set controls or restrictions for particular treatment and disposal activities associated with the management of hazardous wastes.

This section includes an overview of potential chemical-specific ARARs and TBC criteria for contaminated media at Oeser followed by a general discussion of location- and action-specific requirements. A more detailed presentation of action-specific ARARs is provided in Section 4, Detailed Analysis, of the FS.

B.1 MAJOR LEGISLATION PERTAINING TO CLEANUP ACTIONS

The following sections describe legislation that provide regulations and CULs for contaminated sites and are applicable to Oeser.

B.1.1 CERCLA; National Contingency Plan (40 CFR 300)

CERCLA and its major implementing regulation, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), require that remedies at CERCLA sites be protective of human health and the environment and meet ARARs. The NCP establishes risk based criteria for establishing cleanup requirements that are protective of human health. For carcinogens, acceptable exposure levels are generally levels that represent an excess upperbound lifetime cancer risk to an individual of between 1×10^{-4} and 1×10^{-6}. For systemic toxicants, acceptable exposure levels represent concentrations to which the human population, including sensitive subgroups, may be exposed without adverse effects during a lifetime or part of a lifetime, incorporating an adequate margin of safety.

These criteria for exposure levels will be used in evaluating the risks associated with Oeser during the RI/FS process; but are not duly promulgated standards, and therefore not necessary. There are a number of guidance documents developed by the EPA to implement the CERCLA program such as the "Role of Baseline Risk Assessment" memorandum, and guidance on the selection of presumptive remedies for wood treatment sites and groundwater, which also are not ARARs or TBCs, but may be useful in the selection of a remedy. The EPA's CERCLA off-site disposal policy requires that any remedial wastes containing hazardous substances from this site be treated or disposed of at a permitted facility in compliance with all permit requirements.

B.1.2 Model Toxics Control Act (WAC 173-340)

The Washington Model Toxics Control Act (MTCA) was established to create a fund and a process for the cleanup of hazardous wastes sites in the state of Washington. Pursuant to MTCA authority, the Washington State Department of Ecology (Ecology) has promulgated media cleanup standards for soil, groundwater, surface water, and air (WAC 173-340-700 through 760) which are ARARs for The Oeser Company facility. Major revisions to the MTCA became effective on August 15, 2001.

WAC 173-340-700(5) specifies three alternative methods that may be used for establishing cleanup levels (CULs) for groundwater, surface water, soils, and air at a site: Methods A, B, and C. The method to be used for a particular site depends on the complexity of the site and the expected future use. CULs for individual hazardous substances must be at least as stringent as concentrations established under applicable state and federal laws. For those hazardous substances for which sufficiently protective, health-based criteria or standards have not been established under applicable state and federal laws, CULs for protecting human health are determined using the values or formulas presented in the regulation for each affected media. All cleanup actions in the state of Washington are required to meet identified cleanup standards for a particular hazardous substance at a site and the specific area or pathway (e.g., soil, groundwater).

Method A (ARARs and tables; WAC 173-340-704) cleanup standards apply to routine cleanups or to sites with relatively few hazardous substances and are specified in tables 720-1, 740-1, and 745-1 of WAC 173-340-900.

Method B (Universal Method; WAC 173-340-705) CULs are applicable to all media at all sites (unless one or more of the conditions for using Methods A or C are demonstrated, and the person conducting the cleanup elects to use that method). These CULs must be as stringent as CULs for individual hazardous substances established under applicable state and federal laws. Risk equations provided in the regulations are used to calculate the constituent concentrations that would result in no adverse human health effects due to acute or chronic toxicity or carcinogenicity. These equations use a number of variables including average body weight, unit conversion factors, averaging time, duration and frequency of exposure, and target hazard quotient for noncarcinogens and target cancer risk level for carcinogens.

Method C (Conditional Method; WAC 173-340-706) provides for less stringent CULs to be set in situations where cleanup levels under Method A or B are technically impossible to achieve or may cause more environmental harm than good, or for sites that meet specified uses and conditions, such as industrial properties.

Other MTCA requirements which are potential ARARs at Oeser include selection of cleanup actions (WAC 173-340-360), compliance monitoring (WAC 173-340-410), and institutional controls (WAC 173-340-440).

B.1.3 Federal Safe Drinking Water Act and Washington State Drinking Water Standards (40 CFR 141-147; WAC 246-290-310)

The federal Safe Drinking Water Act (SDWA) protects public health by establishing primary and secondary drinking water standards for public and community water supplies; the Washington State Department of Health implements drinking water standards in Washington. State regulations have adopted federal drinking water standards for organics by reference. For inorganics, they have adopted the federal Maximum Contaminant Levels (MCLs), but have included some additional chemicals (e.g., nickel and methylene chloride) for which there are no federal standards. The primary drinking water standards address toxicity and are called MCLs and Maximum Contaminant Level Goals (MCLGs). MCLs are designed to be attainable technically, while MCLGs are set at levels that would result in no known adverse health effects regardless of technical feasibility.

CERCLA and MTCA mandate that both the MCLs and the MCLGs be considered as potential chemical-specific ARARs at sites where groundwater and surface water are potential sources of drinking water; however, it is the EPA's policy to consider MCLGs as potential ARARs for the cleanup of groundwater or surface waters that are current or potential sources of drinking water only where the MCLG is established at a level above zero. Under MTCA, carcinogenic contaminants with an MCL which exceeds a 1×10^{-5} cancer risk level, and non-carcinogens, with a hazard quotient of greater than 1, are not considered protective of human health CULs for these contaminants. However, the deep aquifer underlying Oeser likely will not be used as a drinking water source in the future because the City of Bellingham, including residences in the vicinity of Oeser, obtain drinking water from Lake Whatcom. Shallow groundwater underlying the site is discontinuous and cannot produce a sufficient or consistent quantity of water to be used as drinking water.

The SDWA also establishes requirements for underground injection wells and requires permits for injection of contaminated materials in certain circumstances (40 CFR Part 144). The State of Washington's underground injection control (UIC) program under the SDWA is found at RCW 90.48.020, .080, .160, and .162 and WAC 173-218-010 to 110, WAC 344-12-001 to 262, and WAC 173-160. These requirements may be action-specific ARARs if, for example, contaminated groundwater contaminates stormwater, or hazardous waste is disposed of through a french drain or other injection well.

B.1.4 Clean Water Act, Washington State Water Pollution Control Act, Washington State Water Resources Act, and Water Quality Standards for Surface Waters (40 CFR 129, 131; WAC 173-201A)

The objectives of the Clean Water Act (CWA) and Washington State's Water Pollution Control Act and Water Resources Act are to restore and maintain the chemical, physical, and biological integrity of the nation's waters. To achieve these objectives, generic and water body-specific ambient surface water quality criteria have been set at the federal level (National Toxics Rule, 40 CFR 131). Water quality criteria have been established by the EPA for water bodies in Washington with various use classifications. The State of Washington also has established surface water quality standards for a number of contaminants. These surface water quality standards are potentially relevant and appropriate for the purpose of establishing CULs at Oeser.

The CWA also establishes a National Pollutant Discharge Elimination System (NPDES) permitting program (40 CFR Parts 122-125) which establishes discharge limits and monitoring requirements for direct discharges to surface waters and establishes pretreatment requirements for discharges to sewers going to publicly owned treatment works (POTWs). The NPDES program has been delegated to the State of Washington, and the pretreatment requirements for discharge to POTWs are implemented by the City of Bellingham. NPDES discharge and monitoring requirements, including stormwater management requirements, may be action-specific requirements at Oeser if a discharge is made to surface water during cleanup.

B.1.5 Federal Resource Conservation and Recovery Act and Washington State Dangerous Waste Regulations (40 CFR 260-273; WAC 173-303)

The Resource Conservation and Recovery Act (RCRA) provides guidelines for the control of hazardous waste from the "cradle to grave." This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. Ecology is authorized to implement RCRA authority through the Washington State Dangerous Waste (DW) regulations. RCRA and the DW regulations put forth a framework for the management of both hazardous and non-hazardous wastes.

Since The Oeser Company is subject to the requirements of RCRA and RCRA hazardous waste is present in the soils, the closure requirements under Subtitle C of RCRA are applicable action-specific ARARs. Action-specific ARARs include requirements for generators of hazardous waste, classification, treatment, storage, disposal, and transportation of hazardous wastes, and requirements for various disposal options and land disposal restrictions. For example, any cap must be constructed to meet the substantive closure requirements for a RCRA landfill, including impermeability requirements and long-term maintenance. Other remedial actions may also be required to meet the substantive closure requirements for a RCRA landfill or applicable RCRA provisions.

B.2 PRELIMINARY CHEMICAL-SPECIFIC ARARs

Chemical-specific ARARs and TBCs for Oeser are addressed in this section by affected or potentially affected media: soil, groundwater, surface water, air, and sediment. The potential chemical-specific ARARs for Oeser are presented in the form of a table of numeric values.

B.2.1 Preliminary ARARs for Soil

The majority (greater than three-quarters) of The Oeser Company facility is located within Whatcom County's Heavy Impact Industrial zone except for a portion zoned "single residential." The facility has a "Certificate of Nonconforming Use" from the City of Bellingham allowing it to continue operations although a small portion of the site is zoned "single residential." Residential properties abut a portion of Oeser. Therefore, Oeser meets the definition of an industrial property provided that access to the property by residents is restricted, future land use is restricted to industrial, and that the selected remedy prevents migration of contaminants off site.

MTCA Method C industrial CULs, MTCA Method B CULs that are protective of groundwater, and MTCA terrestrial ecological levels for industrial land are presented as preliminary ARARs in Table X-1 for COCs determined to be the greatest contributors to elevated risk. The MTCA Method C soil CULs are protective of direct contact (e.g., ingestion, dermal contact) with soil for an adult worker.

Also presented with the ARARs for soil are site-specific risk-based CULs. These levels are alternate CULs based on the facility worker exposure scenario from *The Oeser Company Superfund Site Human Health Risk Assessment* (HHRA; E & E 2002). Levels for carcinogenic COCs are based on a risk of 1 in 100,000 and levels for noncarcinogenic COCs are based on a HQ of 1. CULs for cPAHs and dioxins/furans are based on a benzo(a)pyrene [B(a)P] equivalent and a 2,3,7,8-TCDD toxicity equivalent (TEQ), respectively. Use of B(a)P equivalents and the dioxin TEQ is explained in detail in the HHRA. Briefly, B(a)P equivalents were calculated by multiplying each cPAH by its relative potency factor (RPF; EPA 1993; CalEPA 2002) and then by summing the results to obtain a single B(a)P equivalent concentration. Similarly, the 2,3,7,8-TCDD TEQ was calculated by multiplying each dioxin/furan congener by its respective toxicity equivalency factor (TEF; Vanden Berg et al. 1998) and then by summing the results to obtain a single 2,3,7,8-TCDD TEQ. Site-specific CULs for TPH are based on the highest on-facility TPH concentration.

B.2.2 Preliminary ARARs for Groundwater

Groundwater is not currently a source of drinking water for the City of Bellingham; the City's drinking water supply is Lake Whatcom. Under federal groundwater classification guidelines, the deep groundwater under the site would likely be classified as either Class II (water currently being used or water that might be used as a drinking water source in the future) or Class III (groundwater that cannot be used for drinking water due to insufficient quality or quantity). Because shallow groundwater cannot be pumped in sufficient quantities to meet the needs of an average household, this groundwater would be classified as Class III.

Although groundwater is not currently a drinking water source and is not expected to be a drinking water source in the future, deep groundwater underlying The Oeser Company falls under the MTCA definition of potable groundwater. However, the MTCA states that site-specific factors, such as distance to existing water supply wells, may be taken into account when determining CULs (WAC 173-340-720). Method B and C groundwater CULs for potable water are presented in Table A-1 as preliminary ARARs for deep groundwater. Federal MCLs are also presented for groundwater.

B.3 ACTION- AND LOCATION-SPECIFIC ARARS

Potential action- and location-specific ARARs are discussed generally in this section. The applicability of these requirements to Oeser are evaluated in more detail in Section 4, Detailed Analysis, of the FS.

B.3.1 Waste Management

The federal RCRA Subtitle "C" regulations contain requirements for the "cradle to grave" management of materials that meet the RCRA definition of hazardous waste and are potential ARARs at Oeser (RCRA Subtitle C, 40 CFR 260-266; Washington State Hazardous Waste Management Act, Washington State Dangerous Waste Regulations, WAC 173-303). The major RCRA requirements would be action-specific ARARs and include standards that govern hazardous waste generators; transporters; treatment, storage, and disposal facilities; and the land disposal of hazardous waste. Washington's DW regulations parallel the federal RCRA regulations, although they are more stringent in certain respects (e.g., the state's definition of "dangerous waste" is broader than that found in RCRA regulations, and the state includes the DW criteria categories of toxicity or persistence). The EPA has authorized Washington state to implement its DW regulations in lieu of RCRA.

RCRA and DW regulations under Subtitle C are action-specific ARARs at Oeser since RCRA hazardous waste is present in the soil. Any remedial decision involving the use of a cap to contain contaminated soil must include cap designs that meet the substantive closure requirements for a RCRA landfill, including impermeability requirements and long-term maintenance. Other remedial actions may also be required to meet the substantive closure requirements for a RCRA landfill or applicable RCRA provisions.

State solid waste landfill requirements incorporate the RCRA Subtitle "D" regulatory requirements for solid waste handling facilities statewide and may be considered action-specific ARARs if an on-site landfill were constructed for the disposal of solid waste or for closure of any onsite disposal areas (RCRA Subtitle D, Solid Waste Regulations, 40 CFR 258; Washington State Solid Waste Management Act — Washington State Minimum Functional Standards for Solid Waste Handling Regulations, WAC 173-304; Municipal Landfill Standards, WAC 173-351). Washington State has delegated the regulation of municipal waste landfills to county health departments.

B.3.2 Well Construction

The Washington State Water Well Construction Act (RCW 18.104) requires that provisions be made for the regulation of water well construction and for the regulation and licensing of water well contractors. The regulations governing the minimum standards for construction of wells (WAC 173-160) include requirements for both water supply wells and resource protection wells (e.g., monitoring wells). The regulation consists of design and construction requirements regarding surface protective measures, casing, well screen, filter pack, development, and abandonment. The regulations governing regulation and licensing of well contractors and operators (WAC 173-162) consist of the requirements (examinations, fees, and licenses) by the State of Washington for well contractors and operators. These regulations will may be action-specific ARARs if any wells are constructed or abandoned at Oeser.

B.3.3 Waste Water Discharges/Stormwater Runoff

Substantive NPDES permit regulations and City of Bellingham POTW sewer use requirements may be action-specific ARARs if waste waters are discharged as a result of remedial activities. In addition, any substantive requirements of a temporary water quality modification may need to be obtained from Ecology for discharges that would cause surface water quality standards to be exceeded on a temporary basis (e.g., runoff from remedial operations that would increase turbidity levels).

Potential action-specific ARARs under the NPDES stormwater program include covering practices such as filter fabric fences, mulching, and hydroseeding, as well as structural measures, such as berms to control drainage and detention basins to trap runoff and sediments.

B.3.4 Transport of Hazardous Materials

The USDOT has promulgated regulations that govern the transportation of hazardous materials, including communications and emergency response requirements, shipping, and packaging requirements (40 CFR 171-180). If hazardous materials are transported off site, these USDOT requirements will be action-specific ARARs.

B.4 REFERENCES

California State Environmental Protection Agency (CalEPA), May 2002, Office of Environmental Health Hazard Assessment, *California Cancer Potency Factors*, http://oehha.ca.gov/risk/pdf/Cancer%20petency%20list%20May2002.pdf, updated May 2002.

Ecology and Environment, Inc. (E & E), April 2002, *The Oeser Company Superfund Site Remedial Investigation Report, Bellingham, Washington*, by the Superfund Technical Assessment and Response Team (START-2) under Contract No. 68-S0-01-01, Technical Direction Document (TDD) No. 01-03-0016, prepared for the United States Environmental Protection Agency, (EPA) Region 10, Seattle, Washington.

United States Environmental Protection Agency (EPA), 1993, *Provisional Guidance For Quantitative Risk Assessment of Polycylic Aromatic Hydrocarbons*, Office of Research and Development, EPA/600/R-93/089, Washington, D.C.

Vanden Berg, M. et al., 1998, *Toxic Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs, for Humans and Wildlife*, Environmental Health Perspectives, 106(2):775-792.

APPENDIX C
ASSUMPTIONS USED IN REMEDIAL ACTION ALTERNATIVE COST ESTIMATES

C. ASSUMPTIONS USED IN ACTION ALTERNATIVE COST ESTIMATES

The costs provided in the FS are estimates and are provided primarily for the purpose of comparing remedial alternatives during the remedy selection process, not for establishing project budgets. Because a detailed design has not been developed for The Oeser Company Superfund site (Oeser), assumptions were made in order to obtain a cost for each alternative to present as part of the detailed analysis and comparative analysis. The assumptions made for each alternative are discussed in this appendix.

C.1 Cost Assumptions for Capping

C.1.1 Capital Costs

The two action alternatives that include capping as part of the remedial action are Alternatives 2 and 4. Costs associated with the capping element of these two alternatives are assumed to be the same.

Potential paving contractors are available within close proximity to the site, therefore the mobilization and demobilization costs are considered minimal. Costs for mobilizing construction equipment and establishing a site office were included in the cost estimate.

Capital costs associated with capping include the cost of materials associated with improving the existing cap, installing a new cap, and drainage improvements. Capital costs also include direct and indirect costs such as project management, engineering and design, construction oversight, and legal fees. The total amount of existing asphalt at the site that may require improvement to meet requirements of a RCRA Subtitle C cover is approximately 5.98 acres; this number was used to determine the costs for cap improvements. The proposed improvement to the existing caps include adding an impermeable fluid-applied membrane layer, an additional layer of asphalt, and three coats of sealant. The elements of the cap improvement are as follows (from top surface down): three coats of surface sealant, 3-inch layer of Class B environmental asphalt concrete pavement (EACP), Petromat geotextile, cold-spray-applied fluid membrane, then another layer of geotextile on top of the existing asphalt. The bottom layer of geotexitle would be applied to the existing asphalt using a tack coat. The composition of these layers may change during the design phase once a detailed engineering analysis is performed.

Based on extent of contamination information from the Remedial Investigation, it is estimated that a total of approximately 4.72 acres at the site will require additional capping and capital costs for the additional capping were developed based on this number. Once possible suggested design of the multilayer cap system would consist of (from the top surface down): a 3-inch layer of Class B environmental asphalt concrete pavement (EACP), Petromat geotextile, cold-spray-applied fluid membrane, another layer of geotextile applied to a 3-inch layer of Class B EACP wearing course, paving fabric, a low permeability 3-inch EACP layer, a 2-inch asphalt stabilized top course layer, a 10-inch crushed rock base course followed by a layer of geotextile that overlays the native ground or backfill materials. Three coats of sealants will be applied on the final asphalt surface to help maintain the structural integrity of the surface. The thickness and composition of these layers may change during the design phase once a detailed engineering analysis is performed.

For the drainage improvements, it was assumed that water-tight catch basins would be installed in three of the four proposed areas to be capped and the stormwater runoff then would be conveyed to the stormwater treatment system through water-tight High Density Polyethylene piping then discharged in accordance with The Oeser Company's National Pollutant Discharge Elimination System (NPDES) permit.

Excavation and/or re-grading to accommodate the design thickness of the paving system increases the cost of construction significantly, especially if the excavated soil requires off-site disposal at a Resource Conservation and Recovery Act (RCRA) Subtitle C landfill. However, it is unlikely that excavation to accommodate design thickness of the paving system would be necessary at The Oeser Company facility because the conditions present are conducive to paving without much preparation.

C.1.2 Operation and Maintenance (O&M) Costs

Operation and maintenance costs include the cost to patch and maintain the structural integrity of the cap. Maintenance costs provided in the cost estimate include the cost to patch and repair the asphalt concrete paving layer and the paving fabric over the life of the project. It is assumed in the estimate that 3% of the cap would require patching annually for the first 10 years, then 6% of the patch course would require patching annually for the next 10 years, then 10% patching per year is assumed for the last 10 years of the project. Additional maintenance costs include applying top seal coating to the capped areas once every two years for the duration of the project.

C.2 Cost Assumptions for Excavation

C.2.1 Capital Costs

The two action alternatives that have excavation included as part of the remedial action are Alternatives 3 and 5. For Alternatives 3 and 5, it is assumed that approximately 40,600 cubic yards of contaminated soil will be excavated and these areas will be backfilled with clean soil. Once the areas were backfilled, they would then be covered with a 6-inch layer of topsoil and seeded for erosion control. Costs associated with the excavation element of these two alternatives are assumed to be the same with the exception of the confirmation sampling costs. In Alternative 5, dioxin-contaminated soil would need to be separated from soil contaminated only with carcinogenic polynuclear aromatic hydrocarbons (cPAHs).

Prior to excavation, the structures overlaying the contaminated areas would need to be demolished. Before demolishing the PCP tanks, the product would require removal and proper disposal. On average, The Oeser Company facility has 50,000 gallons of product on site, so this number was used to determine the cost of product disposal. The specific gravity of the carrier oil is 0.87 and is assumed to increase to 0.9 when PCP is added to the oil, the actual specific gravity would need to be determined through sampling prior to arranging for disposal. With this information, it is assumed that 188 tons of product would be transported by tank truck to an incinerator. After removing product from the tanks, the PCP tanks and the wastewater storage tank would be cleaned. These four tanks along with the two tanks that previously contained creosote[1] would then be dismantled. The two storage tanks associated with the retort in the north treatment area were not included in the cost estimate as they are in salvageable condition and could be recycled. Disposal costs of the scrap resulting from demolition of the tanks also was not included in the cost estimate as the scrap metal could be recycled.

In the cost estimate, it is assumed that all of the buildings located in the treatment areas will be demolished but will not require decontamination nor disposal at a hazardous waste landfill. It is estimated that approximately 3,700 cubic yards of debris would be generated by demolishing these buildings. The building debris would be transported off site by truck to a local landfill.

Because excavation will be occurring in the shallow groundwater zone, de-watering the excavation area is necessary. Groundwater extracted from the excavation area is likely to be contaminated. Therefore it would require off-site disposal or treatment. For cost estimating purposes, it is assumed that extracted groundwater would be treated on site then discharged to the storm sewer. The excavation area would be de-watered using two trash pumps that pump water to a rented 21,000-gallon storage tank. Water from the storage tank would then be transferred to a carbon adsorption treatment system identical to the system developed for the ex-situ groundwater treatment element. The carbon adsorption system is described in Subsection C.3.1. Crew costs were not added for operating the carbon adsorption system while de-watering the excavation area.

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[1] These two tanks were emptied and cleaned during the 1997-1998 removal action.

Contaminated soil excavated during the 1997-1998 removal action was transported via rail to the Envirosafe Services of Idaho landfill located in Grand View, Idaho. In Alternative 3, all excavated soil would be transported off site to a RCRA Subtitle C landfill. In the cost estimate for Alternative 3, it was assumed that all contaminated soil excavated as part of the remedial action would be transported via rail to the US Ecology Idaho landfill[2] in Grand View, Idaho. In Alternative 5, it was assumed that only the dioxin-contaminated soil would be transported via rail to the US Ecology Idaho landfill. The remaining soil would be treated on site with bioremediation. Costs associated with bioremediation are discussed in Section C.4.

An important aspect to Alternatives 3 and 5 is confirming that all soil contamination above the cleanup levels is removed from the site. Confirming removal of contamination is done by collecting confirmation samples. Under Alternative 3, it is assumed that a sampling crew consisting of two people would be on site 8 hours per week for 3 months. An additional 40 hours is added to this estimate for mobilization/demobilization activities. It was assumed that a total of 100 samples would be collected under Alternative 3. Because soil would require segregation under Alternative 5, more confirmation samples would need to be collected. Therefore, the crew time was increased by four weeks, and the number of samples to be collected under Alternative 5 was increased to 200. All confirmation samples would be submitted to a commercial laboratory for dioxin and semi-volatile organic compound (SVOC) analysis with a standard turnaround time[3]. It was assumed one cooler would hold 10 soil samples and weigh 60 pounds. For quality assurance/quality control (QA/QC) review and reporting, it was assumed that it would take 8 hours to review the results of 20 samples.

C.2.2 O&M Costs

Discussion of O&M costs associated with excavation is not applicable because once excavation is complete and the areas are backfilled, no further actions are required to maintain the area.

[2] US Ecology Idaho formerly was known as Envirosafe Services of Idaho.

[3] Standard turnaround time typically is two weeks for verbal results and four weeks for hard copy results. Expediting sample turnaround time at a commercial laboratory can increase the per sample analytical cost by as much as 100% but waiting for analytical results during the excavation can increase the project length, and thus the overall project cost. Use of a mobile laboratory to analyze soil samples for SVOCs may be warranted in order to expedite sample turnaround time; however, soil samples cannot be analyzed for dioxin in a mobile laboratory.

C.3 Cost Assumptions for Ex-Situ Groundwater Treatment

C.3.1 Capital Costs

Because of the discontinuous nature of shallow groundwater, ex-situ groundwater treatment would be sporadic. Ex-situ groundwater treatment is included in Alternatives 4 and 5 for the primary purpose of de-watering the shallow groundwater zone. The purpose of de-watering the shallow groundwater zone is to prevent the potential downward migration of NAPL and prevent shallow groundwater contamination from migrating to the deep aquifer.

During the remedial investigation at Oeser, the sustainable pumping rates achieved while sampling the shallow groundwater were between 0.1 and 0.2 gallons per minute (gpm). The total volume of shallow groundwater available for extraction at the site was calculated to be approximately 120,000 gallons based on groundwater data collected from a 400 square foot area. Using this information, it is assumed that if water is drawn from a well for 8 hours per day, a total of 100 gallons would be removed per well per day. Assuming that water is extracted from 15 of the shallow wells on site, a total of 1,500 gallons of water would be removed per day. Assuming a total of 120,000 gallons of shallow groundwater would be extracted, it would take a total of 80 days to de-water the shallow groundwater zone.

Groundwater would be extracted through existing wells using 1/2-horsepower (hp) submersible pumps with a low-water indicator sensor attached to the pump. Extracted water would be pumped to a rented 6,000-gallon storage tank. In the cost estimate, it is assumed that a 2-person crew would operate the extraction system for 8 hours a day for 80 days. It is assumed that all 15 pumps will require maintenance once a month during the four-month treatment period.

Every other day, water in the 6,000-gallon storage tank would be sent through the carbon adsorption treatment system using a 1-hp transfer pump. The carbon adsorption treatment system, designed to treat 20 gpm, would begin with a mechanical pre-filter to remove large debris and particles, followed by two canisters containing granular activated carbon, then another 1-hp transfer pump would discharge the treated water to the storm sewer. In the cost estimate, it is assumed that a 2-person crew would operate the treatment system for 3 hours every other day, the duration of the project. Also included in the cost estimate are costs to repair the transfer pumps once a month, dispose of the carbon canisters, and the cost for sampling and analyzing the discharge water.

C.3.2 O&M Costs

Because the duration of ex-situ groundwater treatment is assumed to last a total of four months, long-term O&M costs were not determined for this element.

C.4 Cost Assumptions for Bioremediation

C.4.1 Capital Costs

Field data indicate that a one-foot layer of soil can be treated through land farming techniques. The total volume of cPAH-contaminated soil is approximately 35,260 cubic yards, or 23.5 acre-feet. Therefore, 23.5 acres would be required to remediate the contaminated soil that is not transported off-site. Because of the large space requirements, it is assumed that multiple operational cycles will be used to treat the contaminated soil in a smaller land treatment unit. The assumption is made in the cost estimate that each 1-acre batch would treat 1,500 cubic yards within 6 months. For the cost estimate, the land treatment unit was sized at four acres and assumed to treat a total of 6,000 cubic yards of soil every six months.

After contaminated soil is excavated, it would be stockpiled and covered. The waste pile cover was sized at four acres. The land treatment unit would be constructed as follows. First a 6-inch layer of clay would be spread over 4 acres; then a french drain would be constructed to collect excess water and convey it to a storage tank to be re-applied to the land treatment unit. A 1-foot layer of sand would be placed on top of the french drain followed by a 60 mil High-Density Polyethylene (HDPE) liner. Because the HDPE liner would be used throughout the bioremediation process, a 2-foot layer of unclassified fill would be placed on top of the liner to prevent damage to the liner. A irrigation system then would be set up in the treatment unit. It is estimated that a total of 36 full-circle sprinkler heads with a coverage area 80-feet in diameter would be necessary to cover the four-acre treatment unit. The irrigation system would be fed with water stored in a 6,000-gallon tank.

After constructing the land treatment unit, contaminated soil then would be placed in the land treatment unit. Microorganisms that degrade heavy petroleum and creosote would then be applied to the soil at an application rate of 90 pounds per acre followed by the application of fertilizer and pH control. The soil would then be tilled for 4 hours per day for two weeks to stimulate the activity of the microorganisms. Once the land treatment unit has been constructed, it then switches into operations. The land treatment unit will be utilized throughout for the entire bioremediation process.

Following treatment, the treated soil will have some residual contamination. There are many options available for the final disposal of the treated soil; however, for cost estimating purposes, it is assumed that all of the treated soil will be shipped off site to a local landfill. However, before soil can be sent to the local landfill, the landfill would require analytical data and other profile information. If the local landfill cannot accept the treated soil, then the soil would have to be transported to another landfill that can, or disposed of in a lined cell on site.

C.4.2 O&M Costs

O&M costs associated with bioremediation include landfarm operations and confirmation sampling. Landfarm operations include soil tilling and applying fertilizer. Application of fertilizer is assumed to occur once every two months. Soil tilling is assumed to be carried out by a D-9 dozer. Tilling the four acre treatment cell is assumed to take 4 hours and is carried out daily for the first 2 weeks of each new treatment cycle. Then tilling is assumed to take place weekly for the next 22 weeks of the 24-week treatment cycle.

At the completion of the treatment cycle, the treated soil in the treatment cell is transferred to an on-site waste disposal cell, then the landfarm cell is replenished with more contaminated soil. This operation is carried out with a front-end loader and estimated to take 40 hours to accomplish. After the soil in the treatment cell has been replaced, fertilizer, bioculture, and pH control are applied to the treatment cell. In the cost estimate, batch turnaround is assumed to occur twice a year.

Confirmation sampling is assumed to occur once every three months by a one-person sampling crew. Each sampling event is estimated to last 8 hours and result in the collection of 20 soil samples. The 20 soil samples are submitted to a commercial laboratory for SVOC analysis with standard turnaround time.

C.5 Cost Assumptions for Shallow and Deep Groundwater Monitoring

C.5.1 Capital Costs

There are no capital costs associated with monitoring the shallow or the deep groundwater at the site.

C.5.2 O&M Costs

Shallow Groundwater Monitoring. Under Alternatives 2 and 4, monitoring would be conducted to determine contamination in shallow groundwater.

For cost estimating purposes, monitoring for NAPL is assumed to take place twice annually for the life of the project. It is anticipated that a two-person crew would spend one day at the site, twice a year, monitoring for the presence of NAPL; removing and replacing absorbent booms from wells suspected of containing NAPL, and properly dispose of the used absorbent.

Shallow groundwater sampling is assumed to take place twice a year for the first five years of the project, then occur once a year until the end of the project. For the cost estimate, it is assumed that a two-person crew would collect shallow groundwater samples from 6 wells and submit them for SVOC and dioxin analysis with standard turnaround time. QA/QC review and reporting is assumed to take eight hours per 20 samples. Sample shipment costs were determined by assuming that each cooler holds 5 water samples and weighs 60 pounds. Combining shallow groundwater monitoring events with the deep groundwater monitoring events, it is estimated that each sampling event for Alternatives 2 and 4 would last a total of two 8-hour days including time to mobilize and demobilize.

Deep Groundwater Monitoring. Because the source of shallow groundwater contamination would be removed under Alternatives 3 and 5, monitoring associated with these two alternatives include collecting samples only from the deep aquifer. For Alternatives 2 and 4, deep groundwater samples will be collected during the shallow groundwater monitoring events.

Deep groundwater monitoring for each action alternative will consist of collecting samples from 6 wells and submitting the samples for dioxin and SVOC analysis with standard turnaround time. Deep groundwater monitoring would occur twice a year for the first five years then would occur once per year for the life of the project. For Alternatives 3 and 5, collecting samples from the 6 deep wells is assumed to take a crew of 2 people 12 hours to complete including mobilization and demobilization.

ALTERNATIVE 2

Cost Worksheet

Alternative: 2
Element: Capping

Site: The Oeser Company Superfund Site
Location: Bellingham, Washington
Phase: Feasibility Study (-30% to +50%)
Base Year: 2002

Work Statement:

This alternative involves installing a multilayer cap to prevent direct contact with contaminated surfaces soils and prevent the vertical migration of contaminants by inhibiting stormwater infiltration. The proposed cap consists of (from top to bottom) a 3-inch layer of Class B Asphalt Concrete Paving, paving fabric, a 3-inch layer of environmental asphalt concrete paving, a 2-inch asphalt stabilized top course layer, a 10-inch crushed rock base placed on top of geotextile that overlies the native soil. All construction and monitoring work will be conducted in Level D PPE.

Description	Unit Cost	Unit	Qty	Total	Notes/References
CAPITAL COSTS					
Mobilization/Demobilization					
Construction equipment	$ 500	LS	1	$ 500	Engineering Estimate
Temporary Office 32'X8'	$ 239.68	mo	1	$ 240	RSERCD 2002 99 14 0102
Temporary Storage Trailer 28'X10'	$ 106.40	mo	1	$ 106	RSERCD 2002 99 14 0202
Temporary Utilities & Hookups	$ 300	mo	1	$ 300	Engineering Estimate
Capping					
Existing Cap Improvements					
Seal Coating (3 coats) 0.28/sy each	$ 0.84	sy	28,943	$ 24,312	RSERCD 2002 18 01 0311
Asphalt Concrete 3" Wearing Course	$ 6.75	sy	28,943	$ 195,367	Vendor Quote 1
Cold-spray Applied Membrane and Fabric	$ 11.70	sy	28,943	$ 338,635	Note 1/Vendor Quote 2
Tack Coat	$ 0.29	sy	28,943	$ 8,394	RSERCD 2002 18 01 0311
Additional Capping					
Seal Coating (3 coats) 0.28/sy each	$ 0.84	sy	22,845	$ 19,190	RSERCD 2002 18 01 0311
Asphalt Concrete 3" Wearing Course	$ 6.75	sy	22,845	$ 154,202	Vendor Quote 1
Cold-spray Applied Membrane and Fabric	$ 11.70	sy	22,845	$ 267,284	Note 1/Vendor Quote 2
Tack Coat	$ 0.29	sy	22,845	$ 6,625	RSERCD 2002 18 01 0311
Asphalt Concrete 3" Wearing Course	$ 6.75	sy	22,845	$ 154,202	Vendor Quote 1
Paving Fabric	$ 2.00	sy	22,845	$ 45,690	Vendor Quote 1
3" Environmental Asphalt Concrete Paving	$ 9.39	sy	22,845	$ 214,513	RSERCD 2002 18 01 0312
2" Asphalt Stabilized Base Course	$ 1.85	sy	22,845	$ 42,263	RSERCD 2002 18 01 0105
10" Crushed Gravel Base	$ 6.60	sy	22,845	$ 150,776	RSERCD 2002 18 01 0102
6 oz. Non-Woven Geotextile	$ 1.06	sy	22,845	$ 24,215	RSERCD 2002 33 08 0531
Drainage Improvements over Capping Areas					
North Treatment Area:					
Area drains with grates, 6' deep	$ 2,450	ea	1	$ 2,450	RSERCD 2002 18 02 0202
8" dia., Corrugated HDPE Type S piping with gaskets	$ 6.00	lf	200	$ 1,200	RSSWLCD 2002 02600 1020
South Pole Yard:					
Area drains with grates, 6' deep	$ 2,450	ea	2	$ 4,901	RSERCD 2002 18 02 0202
8" dia., Corrugated HDPE Type S piping with gaskets	$ 6.00	lf	600	$ 3,600	RSSWLCD 2002 02600 1020
Treated Pole Area:					
Area drains with grates, 6' deep	$ 2,450	ea	1	$ 2,450	RSERCD 2002 18 02 0202
8" dia., Corrugated HDPE Type S piping with gaskets	$ 6.00	lf	200	$ 1,200	RSSWLCD 2002 02600 1020
Capital Cost Subtotal:				**$ 1,662,600**	

Cost Worksheet

Alternative: 2
Element: Capping

Site: The Oeser Company Superfund Site
Location: Bellingham, Washington
Phase: Feasibility Study (-30% to +50%)
Base Year: 2002

Work Statement:

This alternative involves installing a multilayer cap to prevent direct contact with contaminated surfaces soils and prevent the vertical migration of contaminants by inhibiting stormwater infiltration. The proposed cap consists of (from top to bottom) a 3-inch layer of Class B Asphalt Concrete Paving, paving fabric, a 3-inch layer of environmental asphalt concrete paving, a 2-inch asphalt stabilized top course layer, a 10-inch crushed rock base placed on top of geotextile that overlies the native soil. All construction and monitoring work will be conducted in Level D PPE.

Description	Unit Cost	Unit	Qty	Total	Notes/References
Direct Capital Costs					
Total Construction cost				$ 1,662,600	
Subcontracting Overhead			10%	$ 166,260	Engineering Estimate
Bid and Scope Contingency (15% + 15%)			30%	$ 548,658	Engineering Estimate
Total Direct Capital Costs (rounded to $100)				**$ 2,377,500**	
Indirect Capital Costs					
Legal Fees and License/Permit Costs			1%	$ 23,775	Engineering Estimate
Engineering and Design			6%	$ 142,650	EPA 2000
Project Management			5%	$ 118,875	EPA 2000
Contractor Reporting Requirements			3%	$ 71,325	Engineering Estimate
Construction Oversight			6%	$ 142,650	EPA 2000
Total Indirect Capital Costs (Rounded to $100)				**$ 499,300**	
TOTAL CAPITAL COSTS:				**$ 2,876,800**	

Description	Unit Cost	Unit	Qty	Total	Notes/References
OPERATIONS & MAINTENANCE COSTS					
Institutional Controls					
Total Annual Monitoring Cost for Years 1-5	$ 33,200	year	1	$ 33,200	See Capping Alternative Groundwater Monitoring Cost Worksheet
Total Annual Monitoring Cost for Years 6 - 30	$ 16,600	year	1	$ 16,600	See Capping Alternative Groundwater Monitoring Cost Worksheet
Repairs & Maintenance					
Top seal coating - once every 2 yrs	$ 0.35	sy	51,788	$ 18,130	RSERCD 2001 18 01 0310
Patching ACPs & Paving Fabric 3% annually	$ 17.44	sy	1,550	$ 27,030	Vendor Quote 1; Years 1 to 10
Patching ACPs & Paving Fabric 6% annually	$ 17.44	sy	3,110	$ 54,240	Vendor Quote 1; Years 11 to 20
Patching ACPs & Paving Fabric 10% annually	$ 17.44	sy	5,180	$ 90,340	Vendor Quote 1; Years 21 to 30
NAPL Removal					
Crew	$ 150	hr	16	$ 2,400	Engineering Estimate
Oil-only SOC (flexible absorbent tube)	$ 48.18	case	1	$ 48.18	Note 2/Vendor Quote 3
Disposal of absorbent material	$ 0.36	lb	44	$ 15.84	Note 3/Vendor Quote 4
Annual NAPL Removal Costs				**$ 2,500**	

Notes

Note 1 — This layer consists of (from top to bottom): Petromat (a geotextile), cold-spray-applied membrane, and another layer of geotextile.
Note 2 — Oil-only SOC is 3" by 12' and absorbs 12 gallons/11 pounds of oil. Each case contains 4 absorbent booms.
Note 3 — Cost is for incineration. Unit cost of $0.12/lb was tripled to reflect extra cost incurred by not meeting BTU values.

References

EPA 2000 — U.S Environmental Protection Agency, July 2000, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, EPA 540/R/00/002.
RSERCD — RS Means, 2002, *Environmental Remediation Cost Data, 8th Annual Edition*, Environmental Cost Handling Options and Solutions LLC.
RSSWLCD — RS Means, 2002, *Site Work & Landscape Cost Data, 21st Annual Edition*, Environmental Cost Hanling Options and Solutions LLC.
Vendor Quote 1 — Bert Hanson, Wilder Construction, Bellingham, Washington [(360) 676-2450]

Cost Worksheet

Alternative: 2

Element: Capping

Site: The Oeser Company Superfund Site

Location: Bellingham, Washington

Phase: Feasibility Study (-30% to +50%)

Base Year: 2002

Work Statement:

This alternative involves installing a multilayer cap to prevent direct contact with contaminated surfaces soils and prevent the vertical migration of contaminants by inhibiting stormwater infiltration. The proposed cap consists of (from top to bottom) a 3-inch layer of Class B Asphalt Concrete Paving, paving fabric, a 3-inch layer of environmental asphalt concrete paving, a 2-inch asphalt stabilized top course layer, a 10-inch crushed rock base placed on top of geotextile that overlies the native soil. All construction and monitoring work will be conducted in Level D PPE.

Vendor Quote 2	LBI Technologies, Inc., Anaheim, California [(714) 384-0111]
Vendor Quote 3	Air Gas Direct Industrial Safety Products, Bristol, Pennsylvania [(800) 827-2338]
Vendor Quote 4	Rainer Elias, Philip Service Corporation, Redmond, Washington [(425) 227-0311]

PRESENT WORTH ANALYSIS

ALTERNATIVE 2: CAPPING
THE OESER COMPANY SUPERFUND SITE
BELLINGHAM, WASHINGTON

Year	Cost Factor	Capital	Annual NAPL Removal	Cap Maintenance	Replace Top Seal Coat	Environmental Monitoring	CERCLA Review	Total Annual Costs	Discounted Annual Costs
0	1	$ 2,876,800						$ 2,876,800	$ 2,876,800
1	0.952		$ 2,500	$ 27,030		$ 33,200		$ 62,730	$ 59,743
2	0.907		$ 2,500	$ 27,030	$ 18,130	$ 33,200		$ 80,860	$ 73,342
3	0.864		$ 2,500	$ 27,030		$ 33,200		$ 62,730	$ 54,189
4	0.823		$ 2,500	$ 27,030	$ 18,130	$ 33,200		$ 80,860	$ 66,524
5	0.784		$ 2,500	$ 27,030		$ 33,200	$ 25,000	$ 87,730	$ 68,739
6	0.746		$ 2,500	$ 27,030	$ 18,130	$ 16,600		$ 64,260	$ 47,952
7	0.711		$ 2,500	$ 27,030		$ 16,600		$ 46,130	$ 32,784
8	0.677		$ 2,500	$ 27,030	$ 18,130	$ 16,600		$ 64,260	$ 43,494
9	0.645		$ 2,500	$ 27,030		$ 16,600		$ 46,130	$ 29,736
10	0.614		$ 2,500	$ 27,030	$ 18,130	$ 16,600	$ 25,000	$ 89,260	$ 54,798
11	0.585		$ 2,500	$ 54,240		$ 16,600		$ 73,340	$ 42,880
12	0.557		$ 2,500	$ 54,240	$ 18,130	$ 16,600		$ 91,470	$ 50,934
13	0.530		$ 2,500	$ 54,240		$ 16,600		$ 73,340	$ 38,894
14	0.505		$ 2,500	$ 54,240	$ 18,130	$ 16,600		$ 91,470	$ 46,199
15	0.481		$ 2,500	$ 54,240		$ 16,600	$ 25,000	$ 98,340	$ 47,303
16	0.458		$ 2,500	$ 54,240	$ 18,130	$ 16,600		$ 91,470	$ 41,903
17	0.436		$ 2,500	$ 54,240		$ 16,600		$ 73,340	$ 31,998
18	0.416		$ 2,500	$ 54,240	$ 18,130	$ 16,600		$ 91,470	$ 38,008
19	0.396		$ 2,500	$ 54,240		$ 16,600		$ 73,340	$ 29,023
20	0.377		$ 2,500	$ 54,240	$ 18,130	$ 16,600	$ 25,000	$ 116,470	$ 43,896
21	0.359		$ 2,500	$ 90,340		$ 16,600		$ 109,440	$ 39,283
22	0.342		$ 2,500	$ 90,340	$ 18,130	$ 16,600		$ 127,570	$ 43,610
23	0.326		$ 2,500	$ 90,340		$ 16,600		$ 109,440	$ 35,631
24	0.310		$ 2,500	$ 90,340	$ 18,130	$ 16,600		$ 127,570	$ 39,555
25	0.295		$ 2,500	$ 90,340		$ 16,600	$ 25,000	$ 134,440	$ 39,701
26	0.281		$ 2,500	$ 90,340	$ 18,130	$ 16,600		$ 127,570	$ 35,878
27	0.268		$ 2,500	$ 90,340		$ 16,600		$ 109,440	$ 29,313
28	0.255		$ 2,500	$ 90,340	$ 18,130	$ 16,600		$ 127,570	$ 32,542
29	0.243		$ 2,500	$ 90,340		$ 16,600		$ 109,440	$ 26,588
30	0.231		$ 2,500	$ 90,340	$ 18,130	$ 16,600	$ 25,000	$ 152,570	$ 35,301
								Present Worth	**$ 4,177,000**
								Present Worth of Annual Costs	**$ 1,300,000**

Cost Worksheet

Alternative: 2 & 4
Element: Capping
Subelement Groundwater Monitoring

Site: The Oeser Company Superfund Site
Location: Bellingham, Washington
Phase: Feasibility Study (-30% to +50%)
Base Year: 2002

Work Statement:

Groundwater monitoring will take place in order to determine whether shallow groundwater contamination is migrating to the deep aquifer and to ensure that deep groundwater, if contaminated, is not migrating off site. It is assumed that a two person team will conduct the groundwater monitoring twice a year for the first five years, then once a year for the next 25. Each monitoring activity is assumed to take 2 days total and includes mobilization and demobiliation. Groundwater samples will be collected from 6 deep wells and 6 shallow wells, for a total of 12 samples. Each sample will be submitted for dioxin and SVOC analysis. All work will be conducted in Level D PPE.

Annual Monitoring Costs for Years 1-5

Description	Unit Cost	Unit	Qty	Total	Notes/References
Sampling Crew -2 person team	$ 150	hr	32	$ 4,800	Engineering Estimate
Dioxin Analysis (EPA 8290), Std Turnaround, Std. QC, soil	$ 740	sample	24	$ 17,760	Vendor Quote 1
Base, Neutral, Acid (EPA 8270C), Std Turnaround, Std. QC, soil	$ 253	sample	24	$ 6,072	Vendor Quote 2
Sampling Supplies	$ 20	sample	24	$ 480	Engineering Estimate
Sample Shipment	$ 2.08	lb	288	$ 599	RSERCD 2002 33 02 2043
QA/QC Review and Reporting	$ 50.20	hr	9.6	$ 482	RSERCD 2002 33 22 0110
			Subtotal	$ 30,200	
ODCs	10%			$ 3,020	Engineering Estimate
Total Annual Cost for Years 1-5				**$ 33,200**	

Annual Monitoring Costs for Years 6 - 30

Description	Unit Cost	Unit	Qty	Total	Notes/References
Sampling Crew -2 person team	$ 150	hr	16	$ 2,400	Engineering Estimate
Dioxin Analysis (EPA 8290), Std Turnaround, Std. QC, soil	$ 740	sample	12	$ 8,880	Vendor Quote 1
Base, Neutral, Acid (EPA 8270C), Std Turnaround, Std. QC, soil	$ 253	sample	12	$ 3,036	Vendor Quote 2
Sampling Supplies	$ 20	sample	12	$ 240	Engineering Estimate
Sample Shipment	$ 2.08	lb	144	$ 300	RSERCD 2002 33 02 2043
QA/QC Review and Reporting	$ 50.20	hr	4.8	$ 241	RSERCD 2002 33 22 0110
			Subtotal	$ 15,100	
ODCs	10%			$ 1,510	Engineering Estimate
Total Annual Cost for Years 6 - 30				**$ 16,600**	

Vendor Quote 1 — Michael King, Pace Analytical, Minneapolis, Minnesota [(612) 607-1700]
Vendor Quote 2 — Mingta Lin, Columbia Analytical Services, Kelso, Washington [(360) 577-7222]

ALTERNATIVE 3

Cost Worksheet

Alternative: 3
Element: Soil Excavation

Site: The Oeser Company Superfund Site
Location: Bellingham, Washington
Phase: Feasibility Study (-30% to +50%)
Base Year: 2002

Work Statement:

This alternative includes excavation and off-site disposal of soil contaminated with contaminants greater than Cleanup Levels. The use of heavy equipment would be required and all operational buildings located above areas of contamination would need to be demolished, cleaned, and disposed of off site. Other materials requiring off-site disposal and/or treatment include product in storage tanks. Institutional controls would restrict the use of deep groundwater. All excavation work would carried out in Level D PPE. Tank cleaning would be carried out in Level C PPE.

Description	Unit Total	Unit	Qty	Total	Notes/References
CAPITAL COSTS					
Mobilization/Demobilization					
Construction equipment	$ 2,500	LS	1	$ 2,500	Engineering Estimate
Temporary Office 32'X8'	$ 239.68	mo	3	$ 719	RSERCD 2002 99 14 0102
Temporary Storage Trailer 28'X10'	$ 106.40	mo	3	$ 319	RSERCD 2002 99 14 0202
Temporary Utilities & Hookups	$ 300	mo	3	$ 900	Engineering Estimate
Excavation and Loading					
Excavate All Areas	$ 2.20	cy	40,600	$ 89,320	Note 1/Vendor Quote 1
Digital Dust Sampler, Monthly Rental	$ 850	mo	6	$ 5,100	Note 2/RSERCD 2002 33 02 0312
Dewatering Excavation Area					
2" Diameter Contractor's Trash Pump, 75 gpm, 1.5 hp	$ 47.94	day	180	$ 8,629	Note 2/RSERCD 2002 17 03 1002
Saturation Indicator	$ 45.00	ea	1	$ 45	RSERCD 2002 33 02 1501
21,000 gallon, Polyethylene Aboveground Wastewater Holding Tank, Rental	$ 1,150	mo	4	$ 4,600	RSERCD 2002 19 04 0406
20 GPM, 250 lb fill, HDPE, Disposable (GAC filter unit)	$ 1,126	ea	2	$ 2,252	RSERCD 2002 33 13 2005
Prefilter/Postfilter Housing & Cartridge to 20 GPM	$ 328.54	ea	1	$ 329	RSERCD 2002 33 13 2041
20 GPM, 1 HP, Transfer Pump with Motor, Valves, Piping	$ 1,318	ea	2	$ 2,636	RSERCD 2002 33 29 0118
Removal, Transport, Regeneration of Spent Carbon	$ 0.60	lb	500	$ 300	RSERCD 2002 33 19 0107
Electrical Charge	$ 0.06	kwh	1,791	$ 107	RSERCD 2002 33 42 0101
Pump & Motor Maintenance/Repair	$ 444.16	ea	12	$ 5,330	Note 9/RSERCD 2002 33 41 0101
Sampling & Analytical Costs for Discharge Water	$ 1,000	sample	3	$ 3,000	Note 10/Engineering Estimate
Backfill					
Haul, Place, and Compact	$ 13.60	cy	40,600	$ 552,160	Note 1/Vendor Quote 1
Topsoil, 6" lifts, off-site source	$ 25.32	cy	4,840	$ 122,549	RSERCD 2002 18 05 0301
Seeding, Vegetative Cover	$ 3,480	acre	6	$ 20,029	RSERCD 2002 18 05 0402

Description	Unit Total	Unit	Qty	Total	Notes/References
Transportation & Disposal					
Excavated Soil	$ 110	ton	61,935	$ 6,812,900	Note 3/Vendor Quote 2
Product Incineration	$ 0.12	lb	375,401	$ 45,048	Note 4/Vendor Quote 3
Transport product to incinerator	$ 675	load	11	$ 7,425	Note 5/Vendor Quote 3
Clean four tanks	$ 22,000	LS	1	$ 22,000	Note 6/Vendor Quote 3
Remove tank insulation	$ 9,900	LS	1	$ 9,900	Note 6/Vendor Quote 3
Demolish six tanks	$ 51,000	LS	1	$ 51,000	Note 7/Vendor Quote 3

Cost Worksheet

Alternative: 3
Element: Soil Excavation

Site: The Oeser Company Superfund Site
Location: Bellingham, Washington
Phase: Feasibility Study (-30% to +50%)
Base Year: 2002

Work Statement:

This alternative includes excavation and off-site disposal of soil contaminated with contaminants greater than Cleanup Levels. The use of heavy equipment would be required and all operational buildings located above areas of contamination would need to be demolished, cleaned, and disposed of off site. Other materials requiring off-site disposal and/or treatment include product in storage tanks. Institutional controls would restrict the use of deep groundwater. All excavation work would carried out in Level D PPE. Tank cleaning would be carried out in Level C PPE.

Multi-level, Masonry, Nonexplosive, Building Demolition	$ 0.08	cf	100,000	$ 8,000	RSERCD 2002 17 02 0103
32 CY, Semi Dump	$ 95.44	hr	120	$ 11,453	Note 8/RSERCD 2002 17 03 0289
Disposal of Demolition Debris	$ 12.00	cy	3,704	$ 44,448	Vendor Quote 7
Confirmation Sampling					
Sampling Crew	$ 150	hrs	136	$ 20,400	Engineering Estimate
Dioxin Analysis (EPA 8290), Std Turnaround, Std. QC, soil	$ 740	sample	100	$ 74,000	Vendor Quote 4
Base, Neutral, Acid (EPA 8270C), Std Turnaround, Std. QC, soil	$ 253	sample	100	$ 25,300	Vendor Quote 5
Sampling Supplies	$ 20.00	sample	100	$ 2,000	Engineering Estimate
Sample Shipment	$ 2.08	lb	600	$ 1,248	RSERCD 2002 33 02 2043
QA/QC Review and Reporting	$ 50.20	hr	40	$ 2,008	RSERCD 2002 33 22 0110
CONSTRUCTION SUBTOTAL				**$ 7,958,000**	
Direct Capital Costs					
Total Construction Cost				$ 7,958,000	
Subcontracting Overhead	10%			$ 795,800	Engineering Estimate
Scope and Bid Contingency (15% + 15%)	30%			$ 2,387,400	EPA 2000
Total Direct Capital Costs (rounded to $100)				**$ 11,141,200**	
Indirect Capital Costs					
Legal Fees and License/Permit Costs	1%			$ 111,412	Engineering Estimate
Engineering and Design	6%			$ 668,472	EPA 2000
Project Management	5%			$ 557,060	EPA 2000
Contractor Reporting Requirements	3%			$ 334,236	Engineering Estimate
Construction Oversight	6%			$ 668,472	EPA 2000
Total Indirect Capital Costs (Rounded to $100)				**$ 2,339,700**	
TOTAL CAPITAL COSTS:				**$ 13,481,000**	

OPERATIONS & MAINTENANCE COSTS

Description	Unit Total	Unit	Qty	Total	Notes/References
Institutional Controls					
Total Annual Monitoring Cost for Years 1-5	$ 17,900	yr	1	$ 17,900	See Excavation Alternative Groundwater Monitoring Cost Worksheet
Total Annual Monitoring Cost for Years 6 - 30	$ 8,900	yr	1	$ 8,900	See Excavation Alternative Groundwater Monitoring Cost Worksheet

Cost Worksheet

Alternative:	3
Element:	Soil Excavation
Site:	The Oeser Company Superfund Site
Location:	Bellingham, Washington
Phase:	Feasibility Study (-30% to +50%)
Base Year:	2002

Work Statement:

This alternative includes excavation and off-site disposal of soil contaminated with contaminants greater than Cleanup Levels. The use of heavy equipment would be required and all operational buildings located above areas of contamination would need to be demolished, cleaned, and disposed of off site. Other materials requiring off-site disposal and/or treatment include product in storage tanks. Institutional controls would restrict the use of deep groundwater. All excavation work would carried out in Level D PPE. Tank cleaning would be carried out in Level C PPE.

Notes

Note 1	Includes labor, equipment, materials, and mob/demob
Note 2	Assumes the rental of 2 units for 3 months.
Note 3	Includes delivery of empty gondola cars, tarps and liners, transportation by rail from Bellingham, WA to final disposal facility in Grand View, ID, tracking of shipments, direct disposal at the disposal facility, and tax. Weight of soil estimated to be 113 pounds per cubic foot.
Note 4	Cost for incineration assuming the heating value parameters are met (Heating value > 12,000 BTUs)
Note 5	Transport by truck to incinerator. Hourly cost per truck is $75/hr. Roundtrip is approximately 9 hours, one truck holds 4,500 gallons. Total number of trips is 11.
Note 6	Four tanks include the three 40,000-gallon PCP/Carrier Oil tanks and one wastewater storage tank. Four tanks assumed to have insulation also requiring removal.
Note 7	Six tanks include the four tanks noted in Note 6 and the two tanks located in the East Treatment Area that previously stored creosote.
Note 8	Landfill located 12.5 miles one way from site, estimated RT time/truck = 1 hour.
Note 9	Assume maintenance will be required once per month during treatment.
Note 10	Cost per sample reflects analytical costs for dioxin and SVOCs. Assume 1 sample collected per month of treatment.

References

EPA 2000	U.S Environmental Protection Agency, July 2000, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* , EPA 540/R/00/002.
RSERCD 2002	RS Means, 2002, *Environmental Remediation Cost Data, 8th Annual Edition* , Environmental Cost Handling Options and Solutions LLC.
Vendor Quote 1	Bert Hanson, Wilder Construction, Bellingham, Washington [(360) 676-2450]
Vendor Quote 2	Steve Welling, US Ecology Idaho, Grandview, Idaho [(916) 939-0967]
Vendor Quote 3	Rainer Elias, Philip Service Corporation, Redmond, Washington [(425) 227-0311]
Vendor Quote 4	Michael King, Pace Analytical, Minneapolis, Minnesota [(612) 607-1700]
Vendor Quote 5	Mingta Lin, Columbia Analytical Services, Kelso, Washington [(360) 577-7222]

Cost Worksheet

Alternative: 3 & 5
Element: Excavation
Subelement Groundwater Monitoring

Site: The Oeser Company Superfund Site
Location: Bellingham, Washington
Phase: Feasibility Study (-30% to +50%)
Base Year: 2002

Work Statement:

Groundwater monitoring will take place to ensure that deep groundwater, if contaminated, is not migrating off site. It is assumed that a two person team will conduct the groundwater monitoring twice a year for the first five years, then once a year for the next 25. Each monitoring activity is assumed to take 1.5 days total including mobilization and demobiliation. Groundwater samples will be collected from 6 deep wells, for a total of 6 samples. Each sample will be submitted for dioxin and SVOC analysis. All work will be conducted in Level D PPE.

Annual Monitoring Costs for Years 1-5

Description	Unit Cost	Unit	Qty	Total	Notes/References
Sampling Crew -2 person team	$ 150	hr	24	$ 3,600	Engineering Estimate
Dioxin Analysis (EPA 8290), Std Turnaround, Std. QC, soil	$ 740	sample	12	$ 8,880	Vendor Quote 1
Base, Neutral, Acid (EPA 8270C), Std Turnaround, Std. QC, soil	$ 253	sample	12	$ 3,036	Vendor Quote 2
Sampling Supplies	$ 20	sample	12	$ 240	Engineering Estimate
Sample Shipment	$ 2.08	lb	144	$ 300	RSERCD 2002 33 02 2043
QA/QC Review and Reporting	$ 50.20	hr	4.8	$ 241	RSERCD 2002 33 22 0110
			Subtotal	$ 16,300	
ODCs	10%			$ 1,630	
Total Annual Cost for Years 1-5				**$ 17,900**	

Annual Monitoring Costs for Years 6 - 30

Description	Unit Cost	Unit	Qty	Total	Notes/References
Sampling Crew -2 person team	$ 150	hr	12	$ 1,800	Engineering Estimate
Dioxin Analysis (EPA 8290), Std Turnaround, Std. QC, soil	$ 740	sample	6	$ 4,440	Vendor Quote 1
Base, Neutral, Acid (EPA 8270C), Std Turnaround, Std. QC, soil	$ 253	sample	6	$ 1,518	Vendor Quote 2
Sampling Supplies	$ 20	sample	6	$ 120	Engineering Estimate
Sample Shipment	$ 2.08	lb	72	$ 150	RSERCD 2002 33 02 2043
QA/QC Review and Reporting	$ 50.20	hr	2.4	$ 120	RSERCD 2002 33 22 0110
			Subtotal	$ 8,100	
ODCs	10%			$ 810	Engineering Estimate
Total Annual Cost for Years 6 - 30				**$ 8,900**	

Vendor Quote 1 — Michael King, Pace Analytical, Minneapolis, Minnesota [(612) 607-1700]
Vendor Quote 2 — Mingta Lin, Columbia Analytical Services, Kelso, Washington [(360) 577-7222]

PRESENT WORTH ANALYSIS

ALTERNATIVE 3: EXCAVATION & OFF-SITE DISPOSAL
THE OESER COMPANY SUPERFUND SITE
BELLINGHAM, WASHINGTON

Year	Cost Factor	Capital Cost	Environmental Monitoring	CERCLA Review	Total Annual Cost	Discounted Annual Cost
0	1	$ 13,481,000			$ 13,481,000	$ 13,481,000
1	0.952		$ 17,900		$ 17,900	$ 17,048
2	0.907		$ 17,900		$ 17,900	$ 16,236
3	0.864		$ 17,900		$ 17,900	$ 15,463
4	0.823		$ 17,900		$ 17,900	$ 14,726
5	0.784		$ 17,900	$ 25,000	$ 42,900	$ 33,613
6	0.746		$ 8,900		$ 8,900	$ 6,641
7	0.711		$ 8,900		$ 8,900	$ 6,325
8	0.677		$ 8,900		$ 8,900	$ 6,024
9	0.645		$ 8,900		$ 8,900	$ 5,737
10	0.614		$ 8,900	$ 25,000	$ 33,900	$ 20,812
11	0.585		$ 8,900		$ 8,900	$ 5,204
12	0.557		$ 8,900		$ 8,900	$ 4,956
13	0.530		$ 8,900		$ 8,900	$ 4,720
14	0.505		$ 8,900		$ 8,900	$ 4,495
15	0.481		$ 8,900	$ 25,000	$ 33,900	$ 16,306
16	0.458		$ 8,900		$ 8,900	$ 4,077
17	0.436		$ 8,900		$ 8,900	$ 3,883
18	0.416		$ 8,900		$ 8,900	$ 3,698
19	0.396		$ 8,900		$ 8,900	$ 3,522
20	0.377		$ 8,900		$ 8,900	$ 3,354
21	0.359		$ 8,900		$ 8,900	$ 3,195
22	0.342		$ 8,900		$ 8,900	$ 3,042
23	0.326		$ 8,900		$ 8,900	$ 2,898
24	0.310		$ 8,900		$ 8,900	$ 2,760
25	0.295		$ 8,900	$ 25,000	$ 33,900	$ 10,011
26	0.281		$ 8,900		$ 8,900	$ 2,503
27	0.268		$ 8,900		$ 8,900	$ 2,384
28	0.255		$ 8,900		$ 8,900	$ 2,270
29	0.243		$ 8,900		$ 8,900	$ 2,162
30	0.231		$ 8,900	$ 25,000	$ 33,900	$ 7,844
					Present Worth	**$ 13,717,000**
					Present Worth of Annual Costs	**$ 236,000**

ALTERNATIVE 4

Cost Worksheet

Alternative: 4
Element: Capping and Ex-Situ Groundwater Treatment

Site: The Oeser Company Superfund Site
Location: Bellingham, Washington
Phase: Feasibility Study (-30% to +50%)
Base Year: 2002

Work Statement:

This alternative involves installing a multilayer cap as described in Alternative 2 and treating contaminated shallow groundwater. The duration of ex-situ treatment of shallow groundwater is anticipated to last 80 days, so O&M costs were not included with this estimate for the on-going operation of a groundwater treatment system. All construction and monitoring work will be conducted in Level D PPE.

Description	Unit Cost	Unit	Qty	Total	Notes/References
CAPITAL COSTS					
Mobilization/Demobilization					
Construction equipment	$ 500	LS	1	$ 500	Engineering Estimate
Temporary Office 32'X8'	$ 239.68	mo	1	$ 240	RSERCD 2002 99 14 0102
Temporary Storage Trailer 28'X10'	$ 106.40	mo	1	$ 106	RSERCD 2002 99 14 0202
Temporary Utilities & Hookups	$ 300	mo	1	$ 300	Engineering Estimate
Capping					
Existing Cap Improvements					
Seal Coating (3 coats) 0.28/sy each	$ 0.84	sy	28,943	$ 24,312	RSERCD 2002 18 01 0311
Asphalt Concrete 3" Wearing Course	$ 6.75	sy	28,943	$ 195,367	Vendor Quote 1
Cold-spray Applied Membrane and Fabric	$ 11.70	sy	28,943	$ 338,635	Note 1/Vendor Quote 2
Tack Coat	$ 0.29	sy	28,943	$ 8,394	RSERCD 2002 18 01 0311
Additional Capping					
Seal Coating (3 coats) 0.28/sy each	$ 0.84	sy	22,845	$ 19,190	RSERCD 2002 18 01 0311
Asphalt Concrete 3" Wearing Course	$ 6.75	sy	22,845	$ 154,202	Vendor Quote 1
Cold-spray Applied Membrane and Fabric	$ 11.70	sy	22,845	$ 267,284	Note 1/Vendor Quote 2
Tack Coat	$ 0.29	sy	22,845	$ 6,625	RSERCD 2002 18 01 0311
Asphalt Concrete 3" Wearing Course	$ 6.75	sy	22,845	$ 154,202	Vendor Quote 1
Paving Fabric	$ 2.00	sy	22,845	$ 45,690	Vendor Quote 1
3" Environmental Asphalt Concrete Paving	$ 9.39	sy	22,845	$ 214,513	RSERCD 2002 18 01 0312
2" Asphalt Stabilized Base Course	$ 1.85	sy	22,845	$ 42,263	RSERCD 2002 18 01 0105
10" Crushed Gravel Base	$ 6.60	sy	22,845	$ 150,776	RSERCD 2002 18 01 0102
6 oz Non-Woven Geotextile	$ 1.06	sy	22,845	$ 24,215	RSERCD 2002 33 08 0531
Drainage Improvement over Capping Areas					
North Treatment Area:					
Area drains with grates, 6' deep	$ 2,450	ea	1	$ 2,450	RSERCD 2002 18 02 0202
8" dia., Corrugated HDPE Type S piping with gaskets	$ 6.00	lf	200	$ 1,200	RSSWLCD 2002 02600 1020
South Pole Yard:					
Area drains with grates, 6' deep	$ 2,450	ea	2	$ 4,901	RSERCD 2002 18 02 0202
8" dia., Corrugated HDPE Type S piping with gaskets	$ 6.00	lf	600	$ 3,600	RSSWLCD 2002 02600 1020
Treated Pole Area:					
Area drains with grates, 6' deep	$ 2,450	ea	1	$ 2,450	RSERCD 2002 18 02 0202
8" dia., Corrugated HDPE Type S piping with gaskets	$ 6.00	lf	200	$ 1,200	RSSWLCD 2002 02600 1020

Cost Worksheet

Alternative: 4
Element: Capping and Ex-Situ Groundwater Treatment

Site: The Oeser Company Superfund Site
Location: Bellingham, Washington
Phase: Feasibility Study (-30% to +50%)
Base Year: 2002

Work Statement:

This alternative involves installing a multilayer cap as described in Alternative 2 and treating contaminated shallow groundwater. The duration of ex-situ treatment of shallow groundwater is anticipated to last 80 days, so O&M costs were not included with this estimate for the on-going operation of a groundwater treatment system. All construction and monitoring work will be conducted in Level D PPE.

Description	Unit Cost	Unit	Qty	Total	Notes/References
Ex-Situ Groundwater Treatment					
Extraction System					
Crew	$ 200	hr	640	$ 128,000	Note 2/Engineering Estimate
4" well submersible pump, 1/2-hp	$ 600	ea	15	$ 9,000	Vendor Quote 3
In-well low water indicator sensor	$ 300	ea	15	$ 4,500	Vendor Quote 3
Electrical Charge	$ 0.06	kwh	3,600	$ 216	RSERCD 2002 33 42 0101
Pump & Motor Maintenance/Repair	$ 444.16	ea	45	$ 19,987	Note 4/RSERCD 2002 33 41 0101
Carbon Adsorption System					
Crew	$ 200	hr	120	$ 24,000	Note 3/Engineering Estimate
Saturation Indicator	$ 45.00	ea	1	$ 45.00	RSERCD 2002 33 02 1501
6,000 gallon, Polyethylene Aboveground Wastewater Holding Tank, Rental	$ 600	mo	5	$ 3,000.00	RSERCD 2002 19 04 0405
20 GPM, 250 lb fill, HDPE, Disposable (GAC filter unit)	$ 1,126	ea	2	$ 2,252	RSERCD 2002 33 13 2005
Prefilter/Postfilter Housing & Cartridge to 20 GPM	$ 328.54	ea	1	$ 328.54	RSERCD 2002 33 13 2041
20 GPM, 1 HP, Transfer Pump with Motor, Valves, Piping	$ 1,318	ea	2	$ 2,636	RSERCD 2002 33 29 0118
Removal, Transport, Regeneration of Spent Carbon	$ 0.60	lb	500	$ 300	RSERCD 2002 33 19 0107
Pump & Motor Maintenance/Repair	$ 444.16	ea	6	$ 2,665	Note 4/RSERCD 2002 33 41 0101
Sampling & Analytical Costs for Discharge Water	$ 1,000	sample	4	$ 4,000	Note 5/Engineering Estimate
Electrical Charge	$ 0.06	kwh	100	$ 6	RSERCD 2002 33 42 0101
Capital Cost Subtotal:				**$ 1,863,600**	

Cost Worksheet

Alternative: 4
Element: Capping and Ex-Situ Groundwater Treatment

Site: The Oeser Company Superfund Site
Location: Bellingham, Washington
Phase: Feasibility Study (-30% to +50%)
Base Year: 2002

Work Statement:

This alternative involves installing a multilayer cap as described in Alternative 2 and treating contaminated shallow groundwater. The duration of ex-situ treatment of shallow groundwater is anticipated to last 80 days, so O&M costs were not included with this estimate for the on-going operation of a groundwater treatment system. All construction and monitoring work will be conducted in Level D PPE.

Direct Capital Costs			
Total Construction Cost		$ 1,863,600	
Subcontracting Overhead	10%	$ 186,360	Engineering Estimate
Bid and Scope Contingency (15% + 15%)	30%	$ 614,988	Engineering Estimate
Total Direct Capital Costs (rounded to $100)		**$ 2,664,900**	
Indirect Capital Costs			
Legal Fees and License/Permit Costs	1%	$ 26,649	Engineering Estimate
Engineering and Design	6%	$ 159,894	EPA 2000
Project Management	5%	$ 133,245	EPA 2000
Contractor Reporting Requirements	3%	$ 79,947	Engineering Estimate
Construction Oversight	6%	$ 159,894	EPA 2000
Total Indirect Capital Costs (Rounded to $100)		**$ 559,600**	
TOTAL CAPITAL COSTS:		**$ 3,224,500**	

Description	Unit Cost	Unit	Qty	Total	Notes/References
OPERATIONS & MAINTENANCE COSTS					
Institutional Controls					
Total Annual Monitoring Cost for Years 1-5	$ 33,200	year	1	$ 33,200	See Capping Alternative Groundwater Monitoring Cost Worksheet
Total Annual Monitoring Cost for Years 6 - 30	$ 16,600	year	1	$ 16,600	See Capping Alternative Groundwater Monitoring Cost Worksheet
Repairs & Maintenance					
Top seal coating - once every 2 yrs	$ 0.35	sy	51,788	$ 18,130	RSERCD 2001 18 01 0310
Patching ACPs & Paving Fabric 3% annually	$ 17.44	sy	1,550	$ 27,030	Vendor Quote 1; Years 1 to 10
Patching ACPs & Paving Fabric 6% annually	$ 17.44	sy	3,110	$ 54,240	Vendor Quote 1; Years 11 to 20
Patching ACPs & Paving Fabric 10% annually	$ 17.44	sy	5,180	$ 90,340	Vendor Quote 1; Years 21 to 30
NAPL Removal					
Crew	$ 150	hr	16	$ 2,400	Engineering Estimate
Oil-only SOC (flexible absorbent tube)	$ 48.18	case	1	$ 48.18	Note 6/Vendor Quote 4
Disposal of absorbent material	$ 0.36	lb	44	$ 15.84	Note 7/Vendor Quote 5

Cost Worksheet

Alternative:	4
Element:	Capping and Ex-Situ Groundwater Treatment
Site:	The Oeser Company Superfund Site
Location:	Bellingham, Washington
Phase:	Feasibility Study (-30% to +50%)
Base Year:	2002

Work Statement:

This alternative involves installing a multilayer cap as described in Alternative 2 and treating contaminated shallow groundwater. The duration of ex-situ treatment of shallow groundwater is anticipated to last 80 days, so O&M costs were not included with this estimate for the on-going operation of a groundwater treatment system. All construction and monitoring work will be conducted in Level D PPE.

Annual NAPL Removal Costs **$ 2,500**

Notes

Note 1	This layer consists of (from top to bottom): Petromat (a geotextile), cold-spray-applied membrane, and another layer of geotextile.
Note 2	Assume 1 crew of 2 people for 8 hours per day for 80 days monitor pumping.
Note 3	Assume 1 crew of 2 people for 2 hours 40 days to operate the carbon adsorption system.
Note 4	Assume maintenance will be required once a month for each pump during treatment.
Note 5	Cost per sample reflects analytical costs for dioxin and SVOCs. Assume 1 sample collected per week of treatment.
Note 6	Oil-only SOC is 3" by 12' and absorbs 12 gallons/11 pounds of oil. Each case contains 4 absorbent booms.
Note 7	Cost is for incineration. Unit cost of $0.12/lb was tripled to reflect extra cost incurred by not meeting heating values.

References

E&E 2001	Ecology & Environment, August 2001, *Engineering Evaluation/Cost Analysis, Garland Creosoting Company Site* , prepared for US Environmental Protection Agency, Region 6, Dallas, Texas, under Contract Number DACA56-00-D-2024,
EPA 2000	U.S Environmental Protection Agency, July 2000, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* , EPA 540/R/00/002.
RSERCD	RS Means, 2002, *Environmental Remediation Cost Data, 8th Annual Edition* , Environmental Cost Handling Options and Solutions LLC.
RSSWLCD	RS Means, 2002, *Site Work & Landscape Cost Data, 21st Annual Edition* , Environmental Cost Hanling Options and Solutions LLC.
Vendor Quote 1	Bert Hanson, Wilder Construction, Bellingham, Washington [(360) 676-2450]
Vendor Quote 2	LBI Technologies, Inc., Anaheim, California [(714) 384-0111]
Vendor Quote 3	Goulds Pumps, Seattle, Washington [(206) 767-6700]
Vendor Quote 4	Air Gas Direct Industrial Safety Products, Bristol, Pennsylvania [(800) 827-2338]
Vendor Quote 5	Rainer Elias, Philip Service Corporation, Redmond, Washington [(425) 227-0311]

Cost Worksheet

Alternative: 2 & 4
Element: Capping
Subelement Groundwater Monitoring

Site: The Oeser Company Superfund Site
Location: Bellingham, Washington
Phase: Feasibility Study (-30% to +50%)
Base Year: 2002

Work Statement:

Groundwater monitoring will take place in order to determine whether shallow groundwater contamination is migrating to the deep aquifer and to ensure that deep groundwater, if contaminated, is not migrating off site. It is assumed that a two person team will conduct the groundwater monitoring twice a year for the first five years, then once a year for the next 25. Each monitoring activity is assumed to take 2 days total and includes mobilization and demobiliation. Groundwater samples will be collected from 6 deep wells and 6 shallow wells, for a total of 12 samples. Each sample will be submitted for dioxin and SVOC analysis. All work will be conducted in Level D PPE.

Annual Monitoring Costs for Years 1-5

Description	Unit Cost	Unit	Qty	Total	Notes/References
Sampling Crew -2 person team	$ 150	hr	32	$ 4,800	Engineering Estimate
Dioxin Analysis (EPA 8290), Std Turnaround, Std. QC, soil	$ 740	sample	24	$ 17,760	Vendor Quote 1
Base, Neutral, Acid (EPA 8270C), Std Turnaround, Std. QC, soil	$ 253	sample	24	$ 6,072	Vendor Quote 2
Sampling Supplies	$ 20	sample	24	$ 480	Engineering Estimate
Sample Shipment	$ 2.08	lb	288	$ 599	RSERCD 2002 33 02 2043
QA/QC Review and Reporting	$ 50.20	hr	9.6	$ 482	RSERCD 2002 33 22 0110
			Subtotal	$ 30,200	
ODCs	10%			$ 3,020	Engineering Estimate
Total Annual Cost for Years 1-5				**$ 33,200**	

Annual Monitoring Costs for Years 6 - 30

Description	Unit Cost	Unit	Qty	Total	Notes/References
Sampling Crew -2 person team	$ 150	hr	16	$ 2,400	Engineering Estimate
Dioxin Analysis (EPA 8290), Std Turnaround, Std. QC, soil	$ 740	sample	12	$ 8,880	Vendor Quote 1
Base, Neutral, Acid (EPA 8270C), Std Turnaround, Std. QC, soil	$ 253	sample	12	$ 3,036	Vendor Quote 2
Sampling Supplies	$ 20	sample	12	$ 240	Engineering Estimate
Sample Shipment	$ 2.08	lb	144	$ 300	RSERCD 2002 33 02 2043
QA/QC Review and Reporting	$ 50.20	hr	4.8	$ 241	RSERCD 2002 33 22 0110
			Subtotal	$ 15,100	
ODCs	10%			$ 1,510	Engineering Estimate
Total Annual Cost for Years 6 - 30				**$ 16,600**	

Vendor Quote 1	Michael King, Pace Analytical, Minneapolis, Minnesota [(612) 607-1700]
Vendor Quote 2	Mingta Lin, Columbia Analytical Services, Kelso, Washington [(360) 577-7222]

PRESENT WORTH ANALYSIS

ALTERNATIVE 4: CAPPING AND EX-SITU GROUNDWATER TREATMENT
THE OESER COMPANY SUPERFUND SITE
BELLINGHAM, WASHINGTON

Year	Cost Factor	Capital	Annual NAPL Removal	Cap Maintenance	Replace Top Seal Coat	Environmental Monitoring	CERCLA Review	Total Annual Costs	Discounted Annual Costs
0	1	$ 3,224,500						$ 3,224,500	$ 3,224,500
1	0.952		$ 2,500	$ 27,030		$ 33,200		$ 62,730	$ 59,743
2	0.907		$ 2,500	$ 27,030	$ 18,130	$ 33,200		$ 80,860	$ 73,342
3	0.864		$ 2,500	$ 27,030		$ 33,200		$ 62,730	$ 54,189
4	0.823		$ 2,500	$ 27,030	$ 18,130	$ 33,200		$ 80,860	$ 66,524
5	0.784		$ 2,500	$ 27,030		$ 33,200	$ 25,000	$ 87,730	$ 68,739
6	0.746		$ 2,500	$ 27,030	$ 18,130	$ 16,600		$ 64,260	$ 47,952
7	0.711		$ 2,500	$ 27,030		$ 16,600		$ 46,130	$ 32,784
8	0.677		$ 2,500	$ 27,030	$ 18,130	$ 16,600		$ 64,260	$ 43,494
9	0.645		$ 2,500	$ 27,030		$ 16,600		$ 46,130	$ 29,736
10	0.614		$ 2,500	$ 27,030	$ 18,130	$ 16,600	$ 25,000	$ 89,260	$ 54,798
11	0.585		$ 2,500	$ 54,240		$ 16,600		$ 73,340	$ 42,880
12	0.557		$ 2,500	$ 54,240	$ 18,130	$ 16,600		$ 91,470	$ 50,934
13	0.530		$ 2,500	$ 54,240		$ 16,600		$ 73,340	$ 38,894
14	0.505		$ 2,500	$ 54,240	$ 18,130	$ 16,600		$ 91,470	$ 46,199
15	0.481		$ 2,500	$ 54,240		$ 16,600	$ 25,000	$ 98,340	$ 47,303
16	0.458		$ 2,500	$ 54,240	$ 18,130	$ 16,600		$ 91,470	$ 41,903
17	0.436		$ 2,500	$ 54,240		$ 16,600		$ 73,340	$ 31,998
18	0.416		$ 2,500	$ 54,240	$ 18,130	$ 16,600		$ 91,470	$ 38,008
19	0.396		$ 2,500	$ 54,240		$ 16,600		$ 73,340	$ 29,023
20	0.377		$ 2,500	$ 54,240	$ 18,130	$ 16,600	$ 25,000	$ 116,470	$ 43,896
21	0.359		$ 2,500	$ 90,340		$ 16,600		$ 109,440	$ 39,283
22	0.342		$ 2,500	$ 90,340	$ 18,130	$ 16,600		$ 127,570	$ 43,610
23	0.326		$ 2,500	$ 90,340		$ 16,600		$ 109,440	$ 35,631
24	0.310		$ 2,500	$ 90,340	$ 18,130	$ 16,600		$ 127,570	$ 39,555
25	0.295		$ 2,500	$ 90,340		$ 16,600	$ 25,000	$ 134,440	$ 39,701
26	0.281		$ 2,500	$ 90,340	$ 18,130	$ 16,600		$ 127,570	$ 35,878
27	0.268		$ 2,500	$ 90,340		$ 16,600		$ 109,440	$ 29,313
28	0.255		$ 2,500	$ 90,340	$ 18,130	$ 16,600		$ 127,570	$ 32,542
29	0.243		$ 2,500	$ 90,340		$ 16,600		$ 109,440	$ 26,588
30	0.231		$ 2,500	$ 90,340	$ 18,130	$ 16,600	$ 25,000	$ 152,570	$ 35,301
								Present Worth	**$ 4,524,000**
								Present Worth of Annual Costs	**$ 1,300,000**

ALTERNATIVE 5

Cost Worksheet

Alternative: 5
Element: Excavation , Bioremediation, and Groundwater Treatment

Site: The Oeser Company Superfund Site
Location: Bellingham, Washington
Phase: Feasibility Study (-30% to +50%)
Base Year: 2002

Work Statement:

This alternative includes excavation and off-site disposal of soil contaminated with dioxin and the on-site treatment of soil contaminated only with B(a)P equivalents. The use of heavy equipment would be required and all operational buildings located above areas of contamination would need to be demolished, cleaned, and disposed of off site. Other materials requiring off-site disposal and/or treatment include product in storage tanks and decontamination water. Institutional controls would restrict the use of deep groundwater. All excavation work would take place in Level D PPE. Tank cleaning would likely take place in Level C PPE.

Description	Unit Total	Unit	Qty	Total	Notes/References
CAPITAL COSTS					
Mobilization/Demobilization					
Construction equipment	$ 2,500	LS	1	$ 2,500	Engineering Estimate
Temporary Office 32'X8'	$ 239.68	mo	36	$ 8,628	RSERCD 2002 99 14 0102
Temporary Storage Trailer 28'X10'	$ 106.40	mo	36	$ 3,830	RSERCD 2002 99 14 0202
Temporary Utilities & Hookups	$ 300	mo	36	$ 10,800	Engineering Estimate
Excavation & Loading					
Excavate All Areas	$ 2.20	cy	40,600	$ 89,320	Note 1/Vendor Quote 1
Digital Dust Sampler, Monthly Rental	$ 850	mo	8	$ 6,800	Note 2/RSERCD 2002 33 02 0312
Dewatering Excavation Area					
2" Diameter Contractor's Trash Pump, 75 gpm, 1.5 hp	$ 47.94	day	240	$ 11,506	Note 2/RSERCD 2002 17 03 1002
Saturation Indicator	$ 45.00	ea	1	$ 45	RSERCD 2002 33 02 1501
21,000 gallon, Polyethylene Aboveground Wastewater Holding Tank, Rental	$ 1,150	mo	5	$ 5,750	RSERCD 2002 19 04 0406
20 GPM, 250 lb fill, HDPE, Disposable (GAC filter unit)	$ 1,126	ea	2	$ 2,252	RSERCD 2002 33 13 2005
Prefilter/Postfilter Housing & Cartridge to 20 GPM	$ 328.54	ea	1	$ 328.54	RSERCD 2002 33 13 2041
20 GPM, 1 HP, Transfer Pump with Motor, Valves, Piping	$ 1,318	ea	2	$ 2,636	RSERCD 2002 33 29 0118
Removal, Transport, Regeneration of Spent Carbon	$ 0.60	lb	500	$ 300	RSERCD 2002 33 19 0107
Electrical Charge	$ 0.06	kwh	2,687	$ 161	RSERCD 2002 33 42 0101
Pump & Motor Maintenance/Repair	$ 444.16	ea	16	$ 7,107	Note 10/RSERCD 2002 33 41 0101
Sampling & Analytical Costs for Discharge Water	$ 1,000	sample	4	$ 4,000	Note 11/Engineering Estimate

Cost Worksheet

Alternative: 5
Element: Excavation , Bioremediation, and Groundwater Treatment

Site: The Oeser Company Superfund Site
Location: Bellingham, Washington
Phase: Feasibility Study (-30% to +50%)
Base Year: 2002

Work Statement:

This alternative includes excavation and off-site disposal of soil contaminated with dioxin and the on-site treatment of soil contaminated only with B(a)P equivalents. The use of heavy equipment would be required and all operational buildings located above areas of contamination would need to be demolished, cleaned, and disposed of off site. Other materials requiring off-site disposal and/or treatment include product in storage tanks and decontamination water. Institutional controls would restrict the use of deep groundwater. All excavation work would take place in Level D PPE. Tank cleaning would likely take place in Level C PPE.

Description	Unit Total	Unit	Qty	Total	Notes/References
Backfill					
Haul, place, and compact	$ 13.60	cy	40,600	$ 552,160	Note 1/Vendor Quote 1
Topsoil, 6" lifts, off-site source	$ 25.32	cy	4,840	$ 122,549	RSERCD 2002 18 05 0301
Seeding, Vegetative Cover	$ 3,480	acre	6	$ 20,880	RSERCD 2002 18 05 0402
Transportation & Disposal					
Dioxin-containing Soil	$ 110	ton	8,146	$ 896,100	Note 3/Vendor Quote 2
Product Incineration	$ 0.12	lb	375,401	$ 45,048	Note 4/Vendor Quote 3
Transport product to incinerator	$ 675	load	11	$ 7,425	Note 5/Vendor Quote 3
Clean four tanks	$ 22,000	LS	1	$ 22,000	Note 13/Vendor Quote 3
Remove tank insulation	$ 9,900	LS	1	$ 9,900	Note 13/Vendor Quote 3
Demolish six tanks	$ 51,000	LS	1	$ 51,000	Note 13/Vendor Quote 3
Multi-level, Masonry, Nonexplosive, Building Demolition	$ 0.08	cf	100,000	$ 8,000	RSERCD 2002 17 02 0103
32 CY, Semi Dump	$ 95.44	hr	120	$ 11,453	Note 6/RSERCD 2002 17 03 0289
Disposal of Demolition Debris	$ 12.00	cy	3,704	$ 44,448	Vendor Quote 7
Confirmation Sampling During Excavation					
Sampling Crew	$ 150	hr	168	$ 25,200	Engineering Estimate
Dioxin Analysis (EPA 8290), Std Turnaround, Std. QC, soil	$ 740	sample	200	$ 148,000	Vendor Quote 4
Base, Neutral, Acid (EPA 8270C), Std Turnaround, Std. QC, soil	$ 253	sample	200	$ 50,600	Vendor Quote 5
Sampling Supplies	$ 20.00	sample	200	$ 4,000	Engineering Estimate
Sample Shipment	$ 2.08	lb	1,200	$ 2,496	RSERCD 2002 33 02 2043
QA/QC Review and Reporting	$ 50.20	hr	80	$ 4,016	RSERCD 2002 33 22 0110

Cost Worksheet

Alternative: 5

Element: Excavation , Bioremediation, and Groundwater Treatment

Site: The Oeser Company Superfund Site

Location: Bellingham, Washington

Phase: Feasibility Study (-30% to +50%)

Base Year: 2002

Work Statement:

This alternative includes excavation and off-site disposal of soil contaminated with dioxin and the on-site treatment of soil contaminated only with B(a)P equivalents. The use of heavy equipment would be required and all operational buildings located above areas of contamination would need to be demolished, cleaned, and disposed of off site. Other materials requiring off-site disposal and/or treatment include product in storage tanks and decontamination water. Institutional controls would restrict the use of deep groundwater. All excavation work would take place in Level D PPE. Tank cleaning would likely take place in Level C PPE.

Description	Unit Total	Unit	Qty	Total	Notes/References
Bioremediation - 4 acre landfarm					
Clay 10E-7, 6" Lifts, Off-Site	$ 20.59	cy	3,227	$ 66,400	RSERCD 2002 33 08 0507
12" x 12" Underground French Drain	$ 3.29	lf	1,700	$ 5,600	RSERCD 2002 19 02 0601
Sand, 6" Lifts, Off-Site	$ 11.21	cy	6,454	$ 72,300	RSERCD 2002 17 03 0426
60 Mil Polymeric Liner, HDPE	$ 2.14	sf	174,240	$ 372,900	RSERCD 2002 33 08 0572
Unclassified Fill, 6" Lifts, Off-site Source	$ 8.36	cy	12,908	$ 107,911	RSERCD 2002 17 03 0423
Waste Pile Cover, 250 Lb Tear, 4 - 5 year Life	$ 3.57	sy	19,360	$ 69,100	RSERCD 2002 33 08 0592
Full Circle Sprinkler Head, 80' Diameter	$ 298.41	ea	36	$ 10,743	RSERCD 2002 18 05 0704
2", Class 200, PVC piping	$ 4.72	lf	2,496	$ 11,781	RSERCD 2002 19 01 0204
Control Box	$ 1,428	ea	1	$ 1,428	RSERCD 2002 18 05 0705
50 GPM, 100' Head, 3HP, Centrifugal Pump	$ 813	ea	2	$ 1,600	RSERCD 2002 33 29 0103
6,000-Gallon Horizontal Plastic Sump with 6" NPT connection	$ 4,980	ea	1	$ 4,980	RSERCD 2002 19 04 0625
32 CY, Semi Dump	$ 95.44	hr	1,102	$ 105,163	Note 6/RSERCD 2002 17 03 0289
Disposal of Treated Soil	$ 12.00	cy	35,260	$ 423,120	Note 15/Vendor Quote 7

Cost Worksheet

Alternative: 5
Element: Excavation , Bioremediation, and Groundwater Treatment

Site: The Oeser Company Superfund Site
Location: Bellingham, Washington
Phase: Feasibility Study (-30% to +50%)
Base Year: 2002

Work Statement:

This alternative includes excavation and off-site disposal of soil contaminated with dioxin and the on-site treatment of soil contaminated only with B(a)P equivalents. The use of heavy equipment would be required and all operational buildings located above areas of contamination would need to be demolished, cleaned, and disposed of off site. Other materials requiring off-site disposal and/or treatment include product in storage tanks and decontamination water. Institutional controls would restrict the use of deep groundwater. All excavation work would take place in Level D PPE. Tank cleaning would likely take place in Level C PPE.

Description		Unit Total	Unit	Qty		Total	Notes/References
Groundwater Treatment							
Extraction System							
Crew	$	200	hr	640	$	128,000	Note 7/Engineering Estimate
4" well submersible pump, 1/2-hp	$	600	ea	15	$	9,000	Vendor Quote 6
In-well low water indicator sensor	$	300	ea	15	$	4,500	Vendor Quote 6
Electrical Charge	$	0.06	kwh	3,600	$	216	RSERCD 2002 33 42 0101
Pump & Motor Maintenance/Repair	$	444.16	ea	60	$	26,650	Note 10/RSERCD 2002 33 41 0101
Carbon Adsorption System							
Crew	$	200	hr	120	$	24,000	Note 8/Engineering Estimate
Saturation Indicator	$	45.00	ea	1	$	45	RSERCD 2002 33 02 1501
6,000 gallon, Polyethylene Aboveground Wastewater Holding Tank, Rental	$	600	mo	5	$	3,000	RSERCD 2002 19 04 0405
20 GPM, 250 lb fill, HDPE, Disposable (GAC filter unit)	$	1,126	ea	2	$	2,252	RSERCD 2002 33 13 2005
Prefilter/Postfilter Housing & Cartridge to 20 GPM	$	328.54	ea	1	$	328.54	RSERCD 2002 33 13 2041
20 GPM, 1 HP, Transfer Pump with Motor, Valves, Piping	$	1,318	ea	2	$	2,636	RSERCD 2002 33 29 0118
Removal, Transport, Regeneration of Spent Carbon	$	0.60	lb	500	$	300	Note 9/RSERCD 2002 33 19 0107
Pump & Motor Maintenance/Repair	$	444.16	ea	8	$	3,553	Note 10/RSERCD 2002 33 41 0101
Sampling & Analytical Costs for Discharge Water	$	1,000	sample	4	$	4,000	Note 11/Engineering Estimate
Electrical Charge	$	0.06	kwh	100	$	6	RSERCD 2002 33 42 0101
CONSTRUCTION SUBTOTAL					**$**	**3,642,800**	

Cost Worksheet

Alternative: 5
Element: Excavation , Bioremediation, and Groundwater Treatment

Site: The Oeser Company Superfund Site
Location: Bellingham, Washington
Phase: Feasibility Study (-30% to +50%)
Base Year: 2002

Work Statement:

This alternative includes excavation and off-site disposal of soil contaminated with dioxin and the on-site treatment of soil contaminated only with B(a)P equivalents. The use of heavy equipment would be required and all operational buildings located above areas of contamination would need to be demolished, cleaned, and disposed of off site. Other materials requiring off-site disposal and/or treatment include product in storage tanks and decontamination water. Institutional controls would restrict the use of deep groundwater. All excavation work would take place in Level D PPE. Tank cleaning would likely take place in Level C PPE.

Direct Capital Costs						
Total Construction Cost	$ 3,642,800			$	3,642,800	
Subcontracting Overhead	10%			$	364,280	Engineering Estimate
Scope and Bid Contingency (20% + 15%)	35%			$	1,274,980	EPA 2000
Total Direct Capital Costs (rounded to $100)				**$**	**5,282,100**	
Indirect Capital Costs						
Bench Scale Treatability Test	$ 50,000	Lump Sum	1	$	50,000	Engineering Estimate
Pilot Scale Treatability Test	$ 150,000	Lump Sum	1	$	150,000	Engineering Estimate
Legal Fees and License/Permit Costs	1%			$	52,821	Engineering Estimate
Engineering and Design	6%			$	316,926	EPA 2000
Project Management	5%			$	264,105	EPA 2000
Contractor Reporting Requirements	3%			$	158,463	Engineering Estimate
Construction Oversight	6%			$	316,926	EPA 2000
Total Indirect Capital Costs (Rounded to $100)				**$**	**1,309,200**	
TOTAL CAPITAL COSTS:				**$**	**6,591,000**	

OPERATION & MAINTENANCE COSTS

Description	**Unit Total**	**Unit**	**Qty**	**Total**	**Notes/References**
Bioremediation (Costs on a Per Batch Basis)					
Landfarm Operations					
Soil Tilling, D-9 Dozer with Tiller Attachment	$ 225.58	hr	128	$ 28,874	RSERCD 2002 33 11 0304
Fertilize, 800 Lbs/Acre, Spray from Truck	$ 148.87	acre	12	$ 1,800	RSERCD 2002 18 05 0410
Purchase and Spread Dry Granular Limestone for pH Control	$ 0.04	sy	19,360	$ 800	RSERCD 2002 18 05 0412
Heavy Petroleum Hydrocarbon/Creosote Degraders, Microorganisms	$ 17.00	lb	360	$ 6,100	RSERCD 2002 33 11 9905
Application of Bioculture to Contaminated Soil	$ 60.70	acre	4	$ 200	RSERCD 2002 33 11 9901
996, 4.0 CY, Wheel Loader	$ 96.94	hr	80	$ 7,755	Note 12/RSERCD 2002 17 03 0224
Confirmation Sampling					
Sampling Crew	$ 75.00	hr	16	$ 1,200	Engineering Estimate
Base, Neutral, Acid (EPA 8270C), Std Turnaround, Std. QC, soil	$ 253	sample	40	$ 10,120	Vendor Quote 5
Sampling Supplies	$ 10	sample	40	$ 400	Engineering Estimate
Sample Shipment	$ 2.08	lb	240	$ 499	RSERCD 2002 33 02 2043
QA/QC Review and Reporting	$ 50.20	hr	16	$ 803	RSERCD 2002 33 22 0110
Bioremediation O&M Cost per Batch				**$ 58,600**	

Cost Worksheet

Alternative: 5
Element: Excavation , Bioremediation, and Groundwater Treatment

Site: The Oeser Company Superfund Site
Location: Bellingham, Washington
Phase: Feasibility Study (-30% to +50%)
Base Year: 2002

Work Statement:

This alternative includes excavation and off-site disposal of soil contaminated with dioxin and the on-site treatment of soil contaminated only with B(a)P equivalents. The use of heavy equipment would be required and all operational buildings located above areas of contamination would need to be demolished, cleaned, and disposed of off site. Other materials requiring off-site disposal and/or treatment include product in storage tanks and decontamination water. Institutional controls would restrict the use of deep groundwater. All excavation work would take place in Level D PPE. Tank cleaning would likely take place in Level C PPE.

Description	Unit Total	Unit	Qty	Total	Notes/References
Institutional Controls					
Total Annual Monitoring Cost for Years 1-5	$ 17,900	yr	1	$ 17,900	See Excavation Alternative Groundwater Monitoring Cost Worksheet
Total Annual Monitoring Cost for Years 6 - 30	$ 8,900	yr	1	$ 8,900	See Excavation Alternative Groundwater Monitoring Cost Worksheet

Notes

Note 1	Includes labor, equipment, mob/demob
Note 2	Assumes the rental of 2 units for 4 months.
Note 3	Includes delivery of empty gondola cars, tarps and liners, transportation by rail from Bellingham, WA to final disposal facility in Grand View, ID, tracking of shipments, direct disposal at the disposal facility, and tax. Weight of soil estimated to be 113 pounds per cubic foot.
Note 4	Cost for incineration assuming the heating value parameters are met (Heating value > 12,000 BTUs)
Note 5	Transport by truck to incinerator. Hourly cost per truck is $75/hr. Roundtrip is approximately 9 hours, one truck holds 4,500 gallons. Total number of trips is 11.
Note 6	Landfill located 12.5 miles one way from site, estimated RT time/truck = 1 hour.
Note 7	Assume 1 crew of 2 people for 8 hours per day for 80 days monitor pumping.
Note 8	Assume 1 crew of 2 people for 2 hours 40 days to operate the carbon adsorption system.
Note 9	Cost for disposal of carbon.
Note 10	Assume maintenance will be required for each pump once per month during treatment.
Note 11	Cost per sample reflects analytical costs for dioxin and SVOCs. Assume 1 sample collected per week of treatment.
Note 12	One loader used to transfer treated soil from treatment cell to final disposal cell. The loader is then used to transfer contaminated soil to treatment cell.
Note 13	Four tanks include the three 40,000-gallon PCP/Carrier Oil tanks and one wastewater storage tank. Four tanks assumed to have insulation also requiring removal.
Note 14	Six tanks include the four tanks noted in Note 13 and the two tanks located in the East Treatment Area that previously stored creosote.
Note 15	Vendor can accept treated soil as long as they have analytical results and paperwork that indicates that the soil is acceptable for disposal at this particular landfill.

References

EPA 2000	U.S Environmental Protection Agency, July 2000, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, EPA 540/R/00/002.
RSERCD 2002	RS Means, 2002, *Environmental Remediation Cost Data, 8th Annual Edition*, Environmental Cost Handling Options and Solutions LLC.
Vendor Quote 1	Bert Hanson, Wilder Construction, Bellingham, Washington [(360) 676-2450]
Vendor Quote 2	Steve Welling, US Ecology, Grand View, Idaho [(916) 939-0967]
Vendor Quote 3	Rainer Elias, Philip Service Corporation, Redmond, Washington [(425) 227-0311]
Vendor Quote 4	Michael King, Pace Analytical, Minneapolis, Minnesota [(612) 607-1700]
Vendor Quote 5	Mingta Lin, Columbia Analytical Services, Kelso, Washington [(360) 577-7222]
Vendor Quote 6	Goulds Pumps, Seattle, Washington [(206) 767-6700]
Vendor Quote 7	County Construction Recyclers, Everson, Washington [(360) 398-8098]

Cost Worksheet

Alternative: 3 & 5
Element: Excavation
Subelement Groundwater Monitoring

Site: The Oeser Company Superfund Site
Location: Bellingham, Washington
Phase: Feasibility Study (-30% to +50%)
Base Year: 2002

Work Statement:

Groundwater monitoring will take place to ensure that deep groundwater, if contaminated, is not migrating off site. It is assumed that a two person team will conduct the groundwater monitoring twice a year for the first five years, then once a year for the next 25. Each monitoring activity is assumed to take 1.5 days total including mobilization and demobiliation. Groundwater samples will be collected from 6 deep wells, for a total of 6 samples. Each sample will be submitted for dioxin and SVOC analysis. All work will be conducted in Level D PPE.

Annual Monitoring Costs for Years 1-5

Description	Unit Cost	Unit	Qty	Total	Notes/References
Sampling Crew -2 person team	$ 150	hr	24	$ 3,600	Engineering Estimate
Dioxin Analysis (EPA 8290), Std Turnaround, Std. QC, soil	$ 740	sample	12	$ 8,880	Vendor Quote 1
Base, Neutral, Acid (EPA 8270C), Std Turnaround, Std. QC, soil	$ 253	sample	12	$ 3,036	Vendor Quote 2
Sampling Supplies	$ 20	sample	12	$ 240	Engineering Estimate
Sample Shipment	$ 2.08	lb	144	$ 300	RSERCD 2002 33 02 2043
QA/QC Review and Reporting	$ 50.20	hr	4.8	$ 241	RSERCD 2002 33 22 0110
			Subtotal	$ 16,300	
ODCs	10%			$ 1,630	
Total Annual Cost for Years 1-5				**$ 17,900**	

Annual Monitoring Costs for Years 6 - 30

Description	Unit Cost	Unit	Qty	Total	Notes/References
Sampling Crew -2 person team	$ 150	hr	12	$ 1,800	Engineering Estimate
Dioxin Analysis (EPA 8290), Std Turnaround, Std. QC, soil	$ 740	sample	6	$ 4,440	Vendor Quote 1
Base, Neutral, Acid (EPA 8270C), Std Turnaround, Std. QC, soil	$ 253	sample	6	$ 1,518	Vendor Quote 2
Sampling Supplies	$ 20	sample	6	$ 120	Engineering Estimate
Sample Shipment	$ 2.08	lb	72	$ 150	RSERCD 2002 33 02 2043
QA/QC Review and Reporting	$ 50.20	hr	2.4	$ 120	RSERCD 2002 33 22 0110
			Subtotal	$ 8,100	
ODCs	10%			$ 810	Engineering Estimate
Total Annual Cost for Years 6 - 30				**$ 8,900**	

Vendor Quote 1 — Michael King, Pace Analytical, Minneapolis, Minnesota [(612) 607-1700]
Vendor Quote 2 — Mingta Lin, Columbia Analytical Services, Kelso, Washington [(360) 577-7222]

PRESENT WORTH ANALYSIS

ALTERNATIVE 5: ON-SITE BIOREMEDIATION & EX-SITU GROUNDWATER TREATMENT
THE OESER COMPANY SUPERFUND SITE
BELLINGHAM, WASHINGTON

Year	Cost Factor	Capital Cost	Bioremediation O&M	Environmental Monitoring	CERCLA Review	Total Annual Cost	Discounted Annual Cost
0	1	$ 6,591,000				$ 6,591,000	$ 6,591,000
1	0.952		$ 117,200	$ 17,900		$ 135,100	$ 128,667
2	0.907		$ 117,200	$ 17,900		$ 135,100	$ 122,540
3	0.864		$ 117,200	$ 17,900		$ 135,100	$ 116,704
4	0.823			$ 17,900		$ 17,900	$ 14,726
5	0.784			$ 17,900	$ 25,000	$ 42,900	$ 33,613
6	0.746			$ 8,900		$ 8,900	$ 6,641
7	0.711			$ 8,900		$ 8,900	$ 6,325
8	0.677			$ 8,900		$ 8,900	$ 6,024
9	0.645			$ 8,900		$ 8,900	$ 5,737
10	0.614			$ 8,900	$ 25,000	$ 33,900	$ 20,812
11	0.585			$ 8,900		$ 8,900	$ 5,204
12	0.557			$ 8,900		$ 8,900	$ 4,956
13	0.530			$ 8,900		$ 8,900	$ 4,720
14	0.505			$ 8,900		$ 8,900	$ 4,495
15	0.481			$ 8,900	$ 25,000	$ 33,900	$ 16,306
16	0.458			$ 8,900		$ 8,900	$ 4,077
17	0.436			$ 8,900		$ 8,900	$ 3,883
18	0.416			$ 8,900		$ 8,900	$ 3,698
19	0.396			$ 8,900		$ 8,900	$ 3,522
20	0.377			$ 8,900	$ 25,000	$ 33,900	$ 12,777
21	0.359			$ 8,900		$ 8,900	$ 3,195
22	0.342			$ 8,900		$ 8,900	$ 3,042
23	0.326			$ 8,900		$ 8,900	$ 2,898
24	0.310			$ 8,900		$ 8,900	$ 2,760
25	0.295			$ 8,900	$ 25,000	$ 33,900	$ 10,011
26	0.281			$ 8,900		$ 8,900	$ 2,503
27	0.268			$ 8,900		$ 8,900	$ 2,384
28	0.255			$ 8,900		$ 8,900	$ 2,270
29	0.243			$ 8,900		$ 8,900	$ 2,162
30	0.231			$ 8,900	$ 25,000	$ 33,900	$ 7,844
						Present Worth	**$ 7,155,000**
						Present Worth of Annual Costs	**$ 564,000**