Quendall Terminals Superfund Site, Operable Unit 2 Proposed Plan

Renton, Washington **September 2019**

U.S. Environmental Protection Agency, Region 10

Proposed Plan for Public Comment

1. Introduction

The U.S. Environmental Protection Agency (EPA) is proposing a plan for the cleanup of the Quendall Terminals Superfund Site (Quendall Site or Site) and is inviting the public to review and comment on the Proposed Plan. The Site is a former creosote-manufacturing facility located on Lake Washington near Renton, Washington (**Figure 1-1**[1]). Facility operations, including transport of raw materials in, and finished creosote product out of the Site, have resulted in contamination of soil, groundwater, and sediment.

This Proposed Plan provides background information on the Site and the cleanup process for Operable Unit 2 (OU2), describes the cleanup alternatives that were evaluated, identifies EPA's Preferred Alternative, and explains the reasons for this preference. The topics covered by this Proposed Plan are shown in the inset box below.

Inside this Proposed Plan:

Public Comment Period: Now through October 9, 2019

Where to review the Proposed Plan:

The Administrative Record, which contains the Proposed Plan and other documents that support the basis for the Preferred Alternative, is available for public review at the following locations:

- **Renton Public Library**
  100 Mill Avenue South
  Renton, WA 98057
  425-430-6610 (call for hours)
- **EPA Superfund Records Center**
  1200 Sixth Avenue
  Seattle, WA 98101
  800-424-4372, extension 4494 (call for appointment)
- **Online:** https://www.epa.gov/superfund/quendall-terminal

How to Comment on the Proposed Plan:

Written comments may be submitted at any time during the public comment period (now through October 9, 2019) by U.S. mail or email to one of the following recipients:

- **U.S. Mail:** Kathryn Cerise, US EPA Region 10, 1200 Sixth Avenue, Suite 155, ECL Mail Code 122, Seattle WA 98101
- **Email:** quendallcomments@epa.gov

Public Meeting, Tuesday, September 24, 2019:

EPA will hold a public meeting to present the information provided in this Proposed Plan, take comments from the public, and provide the public the opportunity to ask EPA questions. EPA will accept oral and written comments at the public meeting.

Tuesday, September 24, 2019,
4:00-6:30 p.m.—Open House
6:30 p.m.—Presentation and Public Comment
Stan Head Cultural Center
Aegis Gardens Newcastle
13056 SE 76th Street
Newcastle, WA 98056

Additional meeting information will be published in the *Renton Reporter* and *Bellevue Reporter*, as well as on EPA's website.[2]

[1] Tables and figures are located at the end of this document.

[2] https://www.epa.gov/superfund/quendall-terminal

The Site is located on the southeast shore of Lake Washington, near the northernmost limits of the City of Renton, Washington (**Figure 1-1**). The Site includes two OUs: OU1 comprises the upland portion of the Site and OU2 comprises the portion of the Site extending into the sediments of Lake Washington. This Proposed Plan identifies EPA's Preferred Alternative for OU2 to address contamination in sediment in the aquatic portion of the Site. The Proposed Plan for EPA's Preferred Alternative for OU1 will be provided in a separate document.

A Proposed Plan is a document that EPA is required to issue under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as Superfund, and the regulations that implement CERCLA, known as the National Contingency Plan (NCP). By issuing the Proposed Plan, EPA fulfills the statutory and regulatory requirements of CERCLA § 117(a) and the NCP § 300.430(f)(2).

EPA is the lead agency at the Quendall Site and the State of Washington Department of Ecology (Ecology) is the supporting agency. EPA, in consultation with Ecology, may modify the Preferred Alternative or select another response action presented in this Proposed Plan based on new information or public comment. The Muckleshoot Tribe has been invited to consult.

This Proposed Plan highlights key information from the remedial investigation (RI) and feasibility study (FS) reports. The reader should consult the RI/FS reports and documents in the administrative record for more information regarding the proposed remedial action.

EPA is inviting input and new information from the public on all alternatives and on the rationale for the Preferred Alternative. Public comments are important and can help shape the cleanup plan. EPA wants to hear from you and will consider public comments before making a final cleanup decision for the Site. EPA will accept comments through October 9, 2019.

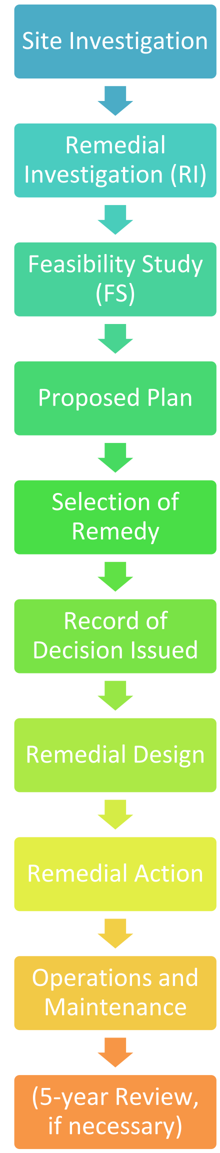
EPA will consider comments received and present the selected remedial actions in a Record of Decision (ROD). EPA's response to public comments will be provided in a Responsiveness Summary, which will be part of the ROD.

Information on how to provide comments or questions to EPA is presented in the inset on page 1.

The Superfund Process

The Superfund process, as established by CERCLA and the NCP, is structured to guide the cleanup of contaminated sites. The process includes defined steps, illustrated at right, leading from discovery of a site, through investigation, remedy selection, and implementation of a remedy. The NCP includes procedures, expectations, and program management principles to guide the process. EPA has developed technical guidance and policy on a range of issues so that decisions are based on sound science and to ensure that cleanup actions will ultimately be protective of human health and the environment.

Steps in the Superfund Cleanup Process



Summary of Preferred Alternative

EPA proposes to remove (dredge) sediments along the lake shore and along the former T-Dock containing dense nonaqueous phase liquid (DNAPL) at the Site. The DNAPL is the source of contaminants of concern (COCs) that are found in lake sediment and have dissolved into groundwater beneath the lake. The DNAPL is from coal tar and creosote that has either been spilled into the lake or has migrated into the lake from the uplands. Consistent with EPA guidance, this Preferred Alternative, along with the alternative being proposed for OU1 eliminate, to the extent practicable, the release of contaminants from direct and indirect continuing sources to Lake Washington.

The Preferred Alternative also includes sediment covers and caps. Following removal of the contaminant source (DNAPL), a reactive sediment cover would be placed over the dredged area (near the sediment surface) to manage residual contamination, if necessary. An engineered cap would be placed over sediments outside DNAPL areas that are within a zone of upwelling groundwater from the upland portion of the Site. This cap would be maintained and monitored until upland groundwater meets its cleanup levels. The remaining contaminated sediments, which exhibit lower concentrations of COCs and are located away from the upwelling groundwater, would be addressed with a thin (6-inch) sand cover, described as enhanced natural recovery. Monitoring would be conducted to verify the remedy is performing as intended (that is, COC concentrations are decreasing over time). These proposed remedial actions are estimated to cost approximately $39.9 million dollars using a present value 7 percent discount rate.

2. Site Background

This section summarizes the Site history and associated releases of contamination, emphasizing Site features and characteristics that informed EPA's selection of the Preferred Alternative presented in this Proposed Plan.

Site History

The Quendall Site (**Figure 2-1**) is located on Lake Washington in the northernmost limits of the City of Renton, within a former industrial area that now includes residential and commercial uses. The physical address is 4503 Lake Washington Boulevard North. The Site borders approximately 1,500 feet of Lake Washington shoreline. Shoreline properties immediately adjacent to the Site include Conner Homes to the south (the former Barbee Mill site) and Football Northwest to the north (a former J.H. Baxter & Company property). Interstate 405 (I-405) is located approximately 500 feet to the east. In addition to the portion of the Site owned by Quendall Terminals (referred to as the Quendall property), the Site also includes the Burlington Northern Railroad right-of-way to the east (referred to as the Railroad property) and state-owned aquatic lands to the west.

The upland portion of the Site encompasses approximately 22 acres, is relatively flat, and occupies the middle portion of a roughly 70-acre alluvial plain that has been modified over the last 90 years by filling and grading. Shortly after the lowering of Lake Washington in 1916 to construct the Lake Washington Ship Canal, the Site, including newly exposed portions of the former May Creek delta, was developed into a creosote manufacturing facility. May Creek originally ran through the Site to Lake Washington until it was diverted to the south of the property prior to 1936. From 1969 to approximately 1983, some of the aboveground storage tanks at the Site were used intermittently for storage of crude oil, waste oil, and diesel fuel. From 1975 to 2009, the Site was used primarily for log sorting and storage. The Site is currently vacant and fenced. The aquatic portion of the Site, which is the subject of this Proposed Plan, encompasses approximately 29 acres.

Historical Releases of Contaminants

Contaminant releases at the Site are primarily related to historical creosote-manufacturing processes and associated activities. Creosote manufacturing was conducted at the Site from 1916 through 1969. Coal and oil-gas tar residues (collectively referred to as coal tars) were distilled into three fractions that were shipped off the Site for a variety of uses or transported to the neighboring J.H. Baxter & Co. site for use in wood-treating operations. The light distillate fraction was typically used as a feedstock in chemical manufacturing. The middle distillate fraction was used in the wood-preserving industry. The bottom fraction, or "pitch," was used for applications such as roofing tar (Hart Crowser, 1994 as referenced in Aspect and Arcadis, 2016). At Site locations where product transport, production, storage, and/or disposal were performed, coal tars and distillate products were released to the environment.. **Figure 2-2** shows the locations of historical Site features referenced below, and **Figure 2-3** presents a timeline of Site operations. Releases of coal tars and distillate products occurred in six areas as follows:

- Offshore, along the former T-Dock, coal-tar feedstock was offloaded and transferred to Site uplands through a pipeline located on the deck of the dock. A large spill of coal-tar feedstock (reportedly 30,000 to 40,000 gallons) occurred sometime between 1930 and 1940 at the western end of the T-Dock during vessel offloading. Elevated concentrations of polycyclic aromatic hydrocarbons (PAHs) in surface sediments along the main stem of the T-Dock indicate there also may have been spills from leaks in the piping.
- Coal tar was distilled, and creosote and light distillates were transferred to surrounding tanks via piping in the vicinity of the former Still House. A pipeline was present between the tanks west of the former Still House and the property to the north of the Site (formerly occupied by J.H. Baxter & Company, which operated a wood treatment plant at that location from 1955 until 1982). This pipeline was used to transport creosote for wood-treatment processes. Reported releases include product spills and leaks directly onto the earthen floor of the Still House (CH2M, 1983 and Ecology, 1989 as referenced in Aspect and Arcadis, 2016).
- Apparent historical spills occurred at the former railroad tank car loading area east of the Still House. The loading area was situated on a trestle built over May Creek. A solid material-loading platform was located further north along the tracks.
- Wastes from historical operations were released into the former May Creek Channel, located south of the

former Still House and storage tanks. Wastes from nearby tanks were reportedly placed in the eastern portion of the former channel, and the western portion of the channel reportedly received creosote wastes discharged from the former Still House sewer outfall. Waste from the former May Creek Channel area has migrated into adjacent Lake Washington.

- The former Still House cooling lines released influent into the north and south sumps; this effluent sometimes contained creosote and tars. Shortly after the plant shut down, approximately 50 truckloads of material were excavated from the north sump and disposed of at the Coal Creek Landfill. The south sump was reportedly filled in before 1950 (Hart Crowser, 1994 as referenced in Aspect and Arcadis, 2016). There were no reports that any materials were removed from the south sump before it was filled in.
- Quendall Pond, located near the shoreline, was constructed in 1972 as an area where tank bottoms from nearby storage tanks were placed. This area also received wastes from north sump overflows. Waste from the Quendall Pond area has migrated into adjacent Lake Washington through the subsurface and possibly by overland surface water flow.

Some solid wastes produced in the manufacturing process were also disposed of at the Site. Heavy tar produced by the distillation process was cooled and solidified in pitch bays located north of the Still House. The waste pitch, also called Saturday coke, was chiseled out and reportedly placed near the Site shoreline (CH2M, 1983, as referenced in Aspect and Arcadis, 2016). Solid tar products have also been observed in shallow soils around the northern railroad loading area, where solid products were loaded onto railcars.

After the creosote plant was closed in 1969, all structures except for six aboveground storage tanks and the office were demolished. Petroleum was stored at the Quendall Site using the remaining tanks for approximately 13 years—from 1969 to 1982. While spills of petroleum product were reported around the aboveground storage tanks, investigations have not indicated the presence of free-phase light nonaqueous phase liquid at the Site.

3. Site Characteristics

This section describes the physical setting, current and potential future uses, and natural habitat functions, and the volume and type of contamination at the Site.

Physical Setting

The Site is located within the Puget Sound Lowland. Much of what is now the upland portion of the Site was formerly the lakebed of Lake Washington before the lake was lowered 9 feet in 1916, which exposed the alluvial delta of May Creek.

Two aquifers are recognized at the Site:

- **Shallow Aquifer** occurs to depths of approximately 30 to 50 feet below ground surface (bgs). The groundwater table is typically encountered at 6 to 8 feet bgs.
- **Deep Aquifer** occurs at depths of approximately 50 to 140 feet bgs.

Groundwater generally flows horizontally across the Site from east to west, ultimately discharging to Lake Washington.

Current and Future Site Uses

Currently, the upland portion of the Site (OU1) is vacant and unused and has been fenced and access is restricted. Land use surrounding the Site is commercial and residential. The aquatic lands of the Site (OU2) immediately offshore to the inner harbor line (property line) are privately owned, and those outside the inner harbor are state-owned aquatic lands, managed by the Washington State Department of Natural Resources (DNR).

Groundwater beneath the Site and surface water from Lake Washington are designated as potable water; however, neither is currently used as a source of drinking water.[3] Lake Washington has not been available for consumptive appropriation since 1979 when it was closed to further withdrawals under Chapter 173-508 of the Washington Administrative Code (WAC). Site facilities and all surrounding properties are served by City of Renton and Coal Creek Water District. Lake Washington designated uses also include aquatic life use (core summer salmonid habitat); recreational use (extraordinary primary contact recreation); and water supply (domestic, agriculture, industrial, and stock water).

The Site is located on prime upland and shoreline property that is one of the last developable properties on Lake Washington in an urban area with high development pressures. The current owners will likely work with a third party to redevelop the Site for residential and commercial uses after cleanup. A development plan (Century Pacific LLLP, 2012), including multifamily housing, retail space, restaurant space, and parking, is under consideration.

[3] The potable water supply designation is a consideration for future cleanup activities.

The Site is located within the Usual and Accustomed fishing grounds used by the Muckleshoot Tribe. Recreational fishing also occurs offshore from the property. While there are some fish advisories for certain species (northern pikeminnow, carp, yellow perch, and cutthroat trout), there are no restrictions for sockeye salmon, rainbow trout, or pumpkinseed.

Natural Habitat Functions of the Site

Upland vegetation consists primarily of early successional species and invasive species, including large stands of Himalayan blackberry and Scotch broom. Because of the most recent log-handling and storage uses in the uplands, large deposits of wood debris cover access roads and storage areas. Riparian vegetation is generally present across the Site shoreline. Aquatic vegetation consists mostly of dense beds of Eurasian milfoil. Fish that may use the Site include Chinook salmon, steelhead, and bull trout, all of which are listed as threatened species under the Endangered Species Act (ESA). The area of the lake adjacent to the property is considered prime habitat for the rearing of juvenile salmonid stocks; however, steelhead are more likely to remain in their natal streams until they migrate directly to Puget Sound.

Several wetlands are present at the Site (**Figure 3-1**), many within 100-feet of the shoreline (defined as the "habitat area"). These are addressed as part of OU1.

Contamination in Site Media

The primary product manufactured at the Site was creosote—a thick, oily liquid distilled from coal tar. Creosote contains several hundred individual chemicals, including benzene, naphthalene, and benzo(a)pyrene. Most creosote in the sediment is in the form of an oily DNAPL, which is present within the shallow alluvium (delta deposits) to depths up to approximately 10 feet beneath the lake mudline. Approximately 67,600 gallons of DNAPL are estimated to be present within an estimated 2.7 of the 29 acres that encompass OU2. **Figure 3-2** illustrates the estimated areal extent of Site DNAPL occurrences.

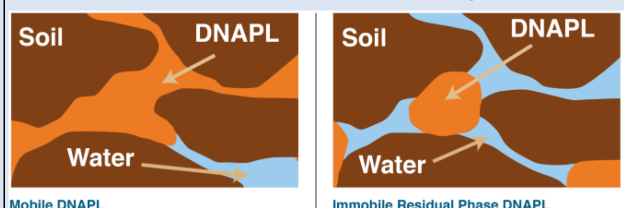
Carcinogenic polycyclic aromatic hydrocarbons (cPAHs) and benzene are the primary COCs for OU2. These COCs originated from creosote and coal-tar releases. The COCs associated with DNAPL are found in lake sediment and have dissolved into the groundwater beneath the lake. Contaminant concentrations measured in OU2 media are summarized in **Table 3-1** (sediment) and **Table 3-2** (surface water/porewater).

The greatest COC concentrations in OU2 sediments and surface water/porewater are associated with DNAPL that has migrated into the lakebed from historical releases of creosote and coal-tar products in the uplands and from historical spills and pipeline leaks along the former T-Dock. Sediments near the shoreline are also impacted by contaminated groundwater that flows through upland DNAPL areas prior to discharging to Lake Washington (**Figure 3-3**). The inner harbor line (property line) represents the extent of upwelling groundwater.

Beyond the inner harbor line, the extent of OU2 and the Site boundary are defined by cPAH concentrations exceeding a Site-specific cPAH sediment background threshold value (BTV) (**Figure 3-4**). The BTV was calculated to differentiate Site-related cPAH contamination in Lake Washington from contamination associated with human activities unrelated to releases from the Site (such as urban stormwater runoff) near the Site.

What are NAPLs?

Nonaqueous phase liquids (NAPLs) *are contaminants like oil, gasoline, and petroleum products that do not dissolve in or easily mix with water. Dense NAPLs (DNAPLs) are liquids more dense than water and will sink in water or groundwater.*



NAPLs can be found in two different forms: mobile, or free-phase, which is a continuous mass of NAPL that can migrate through the saturated soil; and immobile, or residual phase, which is NAPL sorbed to soil particles that will continue to dissolve into the aquifer and is difficult to physically remove without removing soil.

Source: Interstate Technology & Regulatory Council. 2015. Integrated DNAPL Site Characterization and Tools Selection. www.itrcweb.org/DNAPL-ISC_tools-selection

Principal Threat Waste

CERCLA regulations establish the expectation that treatment will be used to address the principal threats posed by a site whenever practicable. EPA guidance defines principal threat waste (PTW) as those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. EPA has determined that DNAPL and DNAPL-impacted soil and sediment (that is, either oil-wetted or oil-coated materials) such as those present at the Site are to be considered PTW based on the large mass present, the mobility of the DNAPL, and/or the toxicity of the chemicals found in the DNAPL.

4. Scope and Role of Operable Unit 2

This Proposed Plan identifies EPA's Preferred Alternative and other cleanup alternatives considered for OU2. The OU2 remediation will address shallow sediments containing DNAPL from historical spills along the T-Dock, deeper sediments near the shoreline containing DNAPL that has migrated through the subsurface from the uplands), surface sediments contaminated with PAHs from groundwater that passes through DNAPL in the uplands and discharges into the lakebed, and surface sediments with lower-level site-related PAH concentrations that are not affected by the upwelling groundwater (**Figure 2-1**). OU1 cleanup will address DNAPL-contaminated soil and groundwater in the adjacent uplands. EPA split the Site into two OUs because each OU represents distinctly different geographic areas. Different but complementary cleanup strategies will be employed in the two OUs, and different factors may influence the timing of remedy implementation in each OU. EPA's Preferred Alternative for OU1 is addressed in a separate Proposed Plan. It is likely that the OU1 and OU2 remedies will be implemented concurrently, with OU1 beginning construction first. It will be important to address upland DNAPL sources prior to remediating OU2 to avoid recontamination of the sediment.

5. Summary of Site Risks

Baseline human health and ecological risk assessments were performed as part of the RI for the Site following standard EPA guidance. Multiple exposure pathways by which people (human receptors) or wildlife (plants and animals, or ecological receptors) could be exposed to contamination at the Site were evaluated.

Human Health Risks

The baseline human health risk assessment (HHRA) evaluated the following potential exposure scenarios:

- Current and Future Recreational Beach Users – adults and children playing or wading in shallow water near the Site shoreline
- Current and Future Recreational Fish/Shellfish Consumers – sport anglers catching and eating fish or shellfish from the lake, within the Site boundary
- Current and Future Subsistence Fish/Shellfish Consumers – fishers catching and eating fish or shellfish from the lake, within the Site boundary, as the main part of their diet

EPA default exposure assumptions were used to evaluate these scenarios, including the subsistence-fishing scenario using the *Estimated Per Capita Fish Consumption in the United States* by EPA (2002). Tribal consumption rates were not used in the initial HHRA (for reasons described below). The HHRA evaluated the potential cancer and noncancer effects to humans (see text box).

The results of the human health risk characterization indicated that excess lifetime cancer risk (ELCR) estimates exceed 1×10^{-4} for all three of the above-referenced scenarios using Site data, ranging from 2×10^{-4} (for both recreational beach user and recreational fish/shellfish consumers) to 5×10^{-3} (subsistence fish/shellfish consumer scenario) (**Table 5-1**). The primary chemicals contributing to risk are cPAHs and benzene. The noncancer hazard index (HI) ranges from 0.01 (recreational fish/shellfish consumer) to 3 (subsistence fish/shellfish consumers. Since risks to subsistence fish/shellfish consumers exceeded EPA's acceptable risk range, EPA and the Muckleshoot Tribe assume that if tribal consumption rates were identified and used in the HHRA, that the risks would also be unacceptable.

How does EPA Assess Risk?

Human health and ecological risk assessments estimate the health risks to people and the environment from exposure to contaminants either now or in the future. For EPA studies, "risk" is the possible harm to people or wildlife from exposure to chemicals. Two types of health risks for people are evaluated: (1) the risks that can cause cancer and (2) the risks that can cause other health effects. EPA evaluates only noncancer risks to wildlife.

EPA uses the results of a risk assessment to evaluate whether the contamination at a site poses an unacceptable risk to human health or the environment under CERCLA. The CERCLA regulations provide a range of risk numbers to evaluate if cleanup of a site is necessary. EPA established an "acceptable" extra cancer risk range, from 1 in 10,000 (1×10^{-4}) to 1 in 1,000,000 (1×10^{-6}) of developing cancer from exposure to site contaminants at a site over a person's lifetime.

For noncancer health effects, EPA calculates a hazard quotient (HQ) or hazard index (HI) for both humans and wildlife. A hazard index is the sum of the hazard quotient for several chemicals that have the same or similar effects. The noncancer hazard index of 1 is a threshold below which EPA does not expect any noncancer health effects. If the hazard quotient or hazard index is 1 or higher, then exposure to site contaminants could be a risk to human or wildlife health.

Ecological Risks

For the baseline Ecological Risk Assessment (ERA), representative aquatic species from groups including plants, invertebrates, fish, shellfish, birds, and mammals were selected as receptors of concern and further evaluated to determine whether and to what degree they may be at risk from contaminated media at the Site.

Ecological hazard quotients (HQs) were estimated using multiple lines of evidence including comparison of surface water/porewater concentrations (for fish and aquatic plants) to screening levels and use of an exposure model approach that compared estimated total dietary intakes with literature toxicity reference values. Benthic invertebrate risk was also assessed directly via sediment bioassays.

Results of the ERA indicated that risks for aquatic plants and fish (which would include ESA-listed Chinook salmon, steelhead, and bull trout), some birds (sandpiper, ducks) and mammals (otter) exceed an HQ of 1. The primary risk drivers are PAHs in sediment and sediment porewater. HQs did not exceed 1 for bald eagles and great blue herons.

The ERA also found that site sediments pose a PAH-related risk to benthic macroinvertebrates in the T-Dock and nearshore Site areas adjacent to Quendall Pond. Benthic toxicity measured in sediment bioassays correlated closely with porewater PAH concentrations and are corroborated by other data evaluations.

Basis for Proposing a Remedy

EPA's judgment is that the Preferred Alternative, or one of the other active measures considered in this Proposed Plan, is necessary to protect public health or welfare and the environment from actual or threatened releases of hazardous substances into the environment.

A significant volume of DNAPL is estimated to be present in Site sediment (approximately 67,600 gallons). The primary basis for taking action in OU2 is to address DNAPL source materials in sediment, prevent exposure to contaminants in sediment by people and wildlife, and protect Lake Washington by preventing further releases of DNAPL and the associated contaminants to sediment and surface water.

For media and pathways that pose a human health risk, the individual chemicals that pose an ELCR of 1 in 1 million (that is, 1×10^{-6}) or greater were identified as human health COCs. Chemicals that exceeded an HQ of 1 for either human or ecological receptors were also identified as COCs. **Table 6-1** provides a list of the COCs by medium. The primary human health risk drivers throughout the Site are cPAHs and benzene. The greatest risks are for subsistence and recreational fish consumers, and recreational beach users from exposure to sediment (incidental ingestion). The primary ecological risk drivers throughout the Site are PAHs, represented as both individual chemicals and as total PAHs, with the greatest risks to aquatic plants and fish, and lesser risk for small birds and mammals from exposure to surface sediments (ingestion of sediment and aquatic invertebrates).

6. Remedial Action Objectives and Preliminary Remediation Goals

Remedial Action Objectives

In accordance with the NCP, EPA developed remedial action objectives (RAOs) to describe what the cleanup is expected to accomplish to protect human health and the environment. RAOs help focus the development and evaluation of remedial alternatives and form the basis for establishing preliminary remediation goals (PRGs). Final RAOs and cleanup levels will be included in the ROD.

One of the expectations to be considered by EPA is the ability of remedial alternatives to address PTW to the extent practicable. PTW is defined at this Site as <u>all DNAPL, including oil-coated and oil-wetted soil/sediment</u>. The RAO for PTW is listed below first, followed by RAOs for sediment and surface water/porewater.

Following are the RAOs for OU2:

- **RAO 1—**Reduce migration of COCs from DNAPL to sediment to levels that allow restoration of sediment to meet PRGs.
- **RAO 2**—Reduce to acceptable levels the risk to adults and children from ingestion of resident fish and shellfish taken from the Site.
- **RAO 3**—Reduce to acceptable levels the risk to future beach users from playing or wading in shallow water near shore resulting in incidental ingestion or/and dermal exposure to contaminated sediments.
- **RAO 4**—Reduce concentration of COCs in sediment that may migrate to surface water to meet surface water applicable or relevant and appropriate requirements (ARARs).
- **RAO 5**—Reduce to acceptable levels the risk to aquatic organisms (benthos, aquatic plants, and fish) and aquatic-dependent wildlife (sediment probing birds and piscivorous mammals) from direct contact and/or incidental ingestion of COCs in sediment, surface water/porewater, and prey.

Preliminary Remediation Goals

PRGs are numeric contaminant-specific concentrations for environmental media (such as sediment or surface water) that serve as target goals during the initial development, analysis, and selection of cleanup alternatives. PRGs were developed during the Site investigation and cleanup planning process and are based on ARARs or risk-based concentrations (RBCs). Key chemical-specific ARARs for Site sediments include Washington State Sediment Management Standards (SMS, Chapter 173-204 WAC). Site remediation will also need to ensure compliance with State Water Quality Criteria (Chapter 173-201 WAC). ARARs are briefly discussed in the section titled "Compliance with Applicable or Relevant and Appropriate Requirements." ARARs will be outlined in detail in the ROD.

PRGs are intended to protect human health and the environment by achieving risk reductions associated with each RAO. New or different requirements may be identified during the public review process that may modify the PRGs. Remediation goals are considered preliminary until the ROD, at which time they may be revised or adopted as final cleanup levels. PRGs were identified based on the most stringent ARAR, or if no ARAR is available, the lowest RBC based on either carcinogenic effects or noncarcinogenic effects, as described below.

PRGs for sediment and surface water/porewater are listed in **Table 6-1**. They are intended to reduce risk and comply with ARARs as follows:

- **Sediment**—The PRGs for sediment are primarily human health RBCs, calculated using the exposure assumptions of the HHRA recreational beach user (nearshore sediment) and subsistence fish/shellfish consumer (site-wide sediment). Also included are ecological RBCs, back-calculated from the ecological risk assessment, when they are lower than HHRA-based PRGs. The PRG for total PAHs is based on the state SMS sediment cleanup objective (SCO) for protection of the benthic community in freshwater sediment (WAC 173-204-563).

  Sediment PRGs are consistent with the SCO level under the Washington State SMS (WAC 173-204-560). Under the SMS, sediment PRGs are initially set at the SCO and may be adjusted upward to the Cleanup Screening Level (CSL) if it is not technically possible to achieve the SCO or if achieving the SCO will result in a net adverse environmental impact. The SCO for each COC is established as the highest (least stringent) of risk-based concentrations, natural background concentrations, and practical quantitation limits. The risk-based criteria are the lowest (most stringent) of:

  - Concentrations protective of human health (based on an excess cancer risk of 1 x 10^{-6} for individual carcinogens, 1 x 10^{-5} for carcinogens cumulatively, or a noncancer HQ or HI of 1.0)
  - Concentrations showing no adverse effects to the benthic community
  - Concentrations resulting in no adverse impacts to higher trophic level species

  The SMS also includes definitions for, and the applicability of, both natural and regional background sediment concentrations for use in site characterization and cleanup efforts. Regional background can be used to set cleanup levels at the CSL when risk-based levels are lower than regional background.

- **Surface water/porewater**—The PRGs for surface water/porewater are ARARs that include National Toxic Rule human health criteria based on cancer risk of cancer risk of 1 x 10^{-6} and an HQ of 1, for water and organisms, per state surface water criteria (WAC 173-201A), Clean Water Act Section 304(a), and revisions of certain federal water quality criteria applicable to Washington.[4]

While RAOs and ARARs have been included for surface water and porewater, remedial actions for OU2 are targeted on DNAPL and contaminated sediment. Monitoring will be required to ensure that surface water ARARs are met. Sediment actions are described in the following section.

7. Remedial Alternatives

Several technologies were considered for use at this Site, and are incorporated into the remedial alternatives that were evaluated in the FS (Aspect and Arcadis, 2016):

- For sediments containing DNAPL, three technologies were included:
  - **Removal (dredging).** Depending on the depth of the DNAPL, sediments would be either hydraulically dredged (vacuumed, for shallow DNAPL like that observed along the T-Dock) or mechanically dredged (with a traditional clamshell-type bucket, for deeper DNAPL like that observed near the shoreline). Residuals generated by dredging would be managed using a post-dredge residuals cover composed of a 6-inch layer of 10 percent organoclay and 90 percent coarse sand by weight. Following placement of the residuals cover, the dredged areas would be backfilled with sand to existing grade. Depending on the volume of dredged sediment, it would

[4] Per 40 Code of Federal Regulations 131.45.

either be dewatered and transported offsite for disposal or treated onsite (using a thermal technology) and managed onsite.

 - **Amended sand caps.** The caps would sorb DNAPL and COCs from DNAPL in upwelling groundwater and prevent exposure to contaminated sediment. The amended sand cap would consist of alternating layers of clean sand, with a layer of organoclay in between, topped with 6-inches of clean sand for bioturbation/ habitat layer. This would make the amended sand cap about 4.5 feet thick. Along the shoreline in areas with less than 15 feet of water depth, the amended sand cap would require erosion protection from wave energy as described below for the engineered sand cap.
 - **Reactive core mat (RCM) caps.** RCM caps would also sorb DNAPL and COCs from DNAPL in upwelling groundwater, control DNAPL migration (when present in near surface) and prevent exposure to contaminated sediment and porewater. RCMs could be used in areas where DNAPL is relatively limited in volume, is expected to be relatively immobile due to weathering (e.g., in the T-Dock area) or where the shoreline bathymetry needs to be maintained. The RCM cap would consist of an organoclay RCM overlain by 6-inches of clean sand to provide a bioturbation layer. The RCM consists of an approximately 0.25-inch-thick organoclay layer sandwiched between two geotextiles layers stitched together. Along the shoreline in areas with less than 15 feet of water depth, the RCM cap may require erosion protection from wave energy. In addition, the RCM layer would be permanently secured on the banks using an anchoring system.

- For sediment outside DNAPL areas that exceed PRGs and are impacted by upwelling contaminated groundwater (approximately 350 feet lakeward from the shoreline), a 1.5-foot thick engineered sand cap would be used to prevent exposure to contaminated sediment and porewater and reduce concentrations of COCs entering the lake. Modeling done during the FS that considered various chemical and physical processes indicated that a 1.5-foot thickness would be adequate; however, the actual thickness of the cap would be determined during RD.

  From the shoreline to approximately 75 feet offshore, approximately 1.5 feet of sediment would be removed prior to capping to maintain the existing elevation and profile of the near-shore area.
- For the areas within the OU2 remediation area beyond the nearshore zone of upwelling groundwater that are not otherwise covered, enhanced natural recovery (ENR) would be used. This technology places a thin layer of clean sand (approximately 0.5 feet) over the sediment to accelerate the rate of natural recovery by immediately reducing surface chemical concentrations and facilitating the re-establishment of benthic organisms.

These remedial technologies were packaged into five alternatives for OU2. EPA evaluated these, as outlined below, along with the baseline No Action Alternative (Alternative 1):[5]

- Alternative 1—No Action.
- Alternative A—Amended sand cap, RCM cap, engineered sand cap, and ENR.
- Alternative B—Targeted DNAPL removal (T-Dock [TD] DNAPL Area), amended sand cap, RCM cap, engineered sand cap, and ENR.
- Alternative C—Targeted DNAPL removal (TD and Quendall Pond Sediment [QP-S] DNAPL Areas), RCM cap, engineered sand cap, and ENR.
- Alternative D—DNAPL removal, engineered sand cap, and ENR. **This is EPA's Preferred Alternative.**
- Alternative E—DNAPL and contaminated sediment removal/onsite thermal treatment, engineered sand cap, and ENR.

The cost analysis presented in this Proposed Plan includes operations and maintenance (O&M) for 100 years. A considerable amount of preparatory and general construction work will be required to implement any of the alternatives. A set of "common elements" are described first since they are included in all Alternatives except Alternative 1—No Action. The common elements for each alternative are briefly described in Section 7.1.

Common Elements

Following are components that are common to all remedial alternatives.

Sediment Remediation Area

The area of sediment contamination attributable to the Quendall Terminals Superfund site was determined using a statistical approach known as a background threshold

[5] The FS included 10 Sitewide alternatives, but only 5 unique approaches to address contamination in OU2. Alternative A equates to FS Alternatives 2 and 3; Alternative B equates to FS Alternative 4a; Alternative C equates to FS Alternatives 4, 5, and 6; Alternative D equates to FS Alternatives 7 and 8; and Alternative E equates to FS Alternatives 9 and 10.

value (BTV). The BTV was calculated to be 17.5 milligrams per kilogram normalized to organic carbon (mg/kg-OC), using sediment samples collected approximately a mile north and a mile south of the Site reflecting cPAH concentrations from human activities unrelated to releases from the Site (such as urban stormwater runoff) (Anchor QEA and Aspect, 2012).[6] The BTV for cPAHs was used to define the OU2 sediment remediation area for all remedial alternatives. The sediment remediation area encompasses sediment that exceed the risk-based sediment PRGs and the State of Washington Sediment Standards (SMS, Chapter 173-204 WAC) freshwater criterion for total PAHs of 17 mg/kg dry weight, based on protection of the benthic community. The SMS also includes definitions for, and the applicability of, both natural and regional background sediment concentrations for use in site characterization and cleanup efforts. The Quendall BTV is not intended to be used to define either natural or regional background as defined in the SMS.

Preconstruction Activities and Assumptions

Preconstruction activities include obtaining permits, developing health and safety and other work plans, mobilizing and demobilizing equipment, and developing 100-percent remedial design drawings and specifications. EPA assumes that the uplands portion of the Quendall Terminals Property will be redeveloped upon OU1 remedy completion, but a 100-foot corridor of beach habitat will be maintained along the entire shoreline at the Site.

Shoreline Habitat Considerations

Shoreline habitat is managed under OU1. Some of alternatives may require disturbance of the existing shoreline habitat. Pursuant to Clean Water Act Section 404(b)(1), impacts will be avoided or minimized to the extent practicable, and mitigation will be required to offset unavoidable impacts. All OU1 alternatives assume that the entire shoreline and the area landward 100 feet (the habitat area, see **Figure 3-2**) would be excavated and re-contoured to allow for development of functional wetland and riparian habitat following cleanup and would remain undeveloped (about 3.5 acres). Habitat mitigation plans will be developed in the remedial design phase of the cleanup process.

Remedial components planned and/or selected for the habitat area would need to consider potential access and use limitations. Accordingly, some potential remedial components of the FS alternatives may not be compatible with future habitat areas. For example, repair and replacement of sediment caps along the shoreline may require periodic use of heavy equipment that could cause degradation of the habitat area. EPA, the Muckleshoot Tribe, and natural resource agencies would need to agree that such access for purposes of installation, operation, and maintenance were acceptable. This is considered in the evaluation of alternatives.

In accordance with ESA, the habitat needs of juvenile Chinook salmon was an important focus when evaluating alternatives and will be a key element of the mitigation plan development during remedy design. The mitigation plan will be developed and approved in concert with EPA, the natural resource agencies, and the Muckleshoot Tribe.

- For alternative development and evaluation, the following assumptions regarding habitat were made:
- The habitat area of OU1 would consist of a 100-foot-wide corridor along the shoreline and must be preserved if remedial components for OU2 require future access for monitoring or maintenance.
- In-water work, such as sediment capping, dredging, backfilling, and sheet pile installation, would occur during the allowable in-water work window when ESA-protected juvenile Chinook salmon are not migrating through the area, which currently extends from July 16 to December 31 annually. However, dredging within sheet pile enclosures could occur outside of the in-water work window as the sheet pile isolates the dredge area from the lake.
- Remedy implementation would result in no net loss of aquatic habitat or function. For most alternatives, this is accomplished to maintain the existing bathymetry near the shoreline. For alternatives for OU2 with sediment caps along the shoreline, existing sediment would be removed to offset the cap thickness.

Cost Estimates and Discount Rates:

The cost estimates in this Proposed Plan are present-value costs, calculated using a 7 percent discount rate, as required by EPA policy and guidance. Applying a discount rate to calculate the present value of future construction costs impacts the overall cost estimate and has the greatest effect on alternatives with high costs in the future.

Potential Generation of Hazardous Waste During Remediation

Most of the sediment in proposed dredged areas has concentrations of contaminants that are lower than the

[6] The BTV is based on organic carbon normalized PAH data because it accounts for the way exposure takes place through bioaccumulation and is a better way to define the area where risk reduction is needed. For comparison, the bulk sediment cPAH BTV calculated using the same dataset is 0.321 mg/kg.

Resource Conservation and Recovery Act (RCRA) and Washington State dangerous waste criteria. For the FS cost estimates, it was assumed that none of the dredged material would be designated as a RCRA hazardous waste or Washington State dangerous waste.[7]

Institutional Controls

Institutional Controls are administrative and/or legal mechanisms intended to minimize the potential for people to be exposed to contamination by limiting land or resource use, and to maintain the integrity of the engineered components of the remedy. Institutional controls will be an important part of the overall Site remedy because varying degrees of contamination exceeding cleanup levels will remain onsite for all alternatives. EPA recommends that where it may provide greater protection, multiple institutional controls should be used in combination, referred to as "layering".

Many types of institutional controls may be applied at the Site to control human exposure pathways, including government controls, proprietary controls, enforcement and permit tools, and informational devices. For example, as noted above, there are some fish advisories for certain species in Lake Washington, but there are no restrictions for others, and no specific restrictions at the Quendall Site. At the Site, the larger the volume of contamination left in place, the more extensive the type and use of institutional controls will be, for example – prohibitions against sediment disturbing activities in capped areas and limitations on beach access, which will require coordination with both the private aquatic land owners and DNR for the state-owned aquatic lands.

Inspections, Monitoring, and Reporting

Short-term monitoring will be conducted during remedy construction. A long-term inspection and monitoring program will be developed during remedial design to include specific objectives for ensuring the remedy is functioning as intended and remains protective. At a minimum, long-term monitoring is expected to include bathymetric surveys to assess the integrity of sediment caps and covers and sampling to determine whether the sediment remedy continues to function as designed and meets performance criteria. Monitoring requirements will reflect the extent of contamination left on Site, the reliability of engineering controls, and repair and/or replacement frequency. For Alternatives A through C, it is assumed that 10 years of monitoring (following construction) will be required to confirm that these remedies are protective and that the RAOs are met. Monitoring is expected to be required in perpetuity for Alternatives A through C to ensure they remain protective, because hazardous substances will be left in place. For Alternatives D and E where extensive treatment or removal of hazardous substances will take place, limited long-term monitoring could potentially be implemented.

For all alternatives, all monitoring activities would also be conducted after significant natural events such as earthquakes; 5-year reviews will be required in perpetuity.

Accuracy of Cost Estimates:

Cost estimates in this Proposed Plan are based on conceptual designs presented in the FS and have an accuracy range of -30 to + 50 percent. For an item with an estimated cost $100,000, this means that the actual cost is expected be between $70,000 and $150,000.

Alternatives

This section describes the alternatives evaluated by EPA.[8] The first alternatives rely more on capping, while the later alternatives rely increasingly more on removal to address contamination at the Site. All area, depth, and volume estimates are based on information provided in the RI/FS and will be refined in the remedial design. The O&M costs and the total estimated present value costs were developed using a 7 percent discount rate. The construction durations presented in this discussion include time for the remedial design, and the time to meet RAOs includes construction time and confirmation monitoring to ensure that the remedies are protective (10 years after construction where some DNAPL is left in place, and 1 year where DNAPL is removed).

Alternative 1—No Action

Estimated Capital Costs: $0
Estimated O&M Costs: $0
Total Estimated Present Value: $0
Estimated Construction Timeframe: 0 years
Estimated Time to Meet RAOs: Not applicable

As required under CERCLA, a "no action" alternative is evaluated to compare cleanup alternatives with baseline Site conditions. Under Alternative 1, no further action would be taken for OU2. Alternative 1 is not considered protective and does not meet ARARs or achieve RAOs.

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[7] The FS noted that based on a review of available sediment data, most of the sediment has concentrations of total PAHs or benzene less than the RCRA and Washington State dangerous waste criteria. It is assumed that dredging, handling, and dewatering would dilute concentrations in the removed sediment so that all material for disposal would not designate as a RCRA or Washington State dangerous waste.

[8] The FS included Site-wide Alternatives 2 through 10, which included five unique combinations of offshore remedy components. These were renamed as Alternatives A through E.

Alternative A—Amended Sand Cap, RCM Cap, Engineered Sand Cap, and ENR

Estimated Capital Costs: $9,430,000
Estimated O&M Costs: $2,270,000
Total Estimated Present Value: $11,700,000
Estimated Construction Timeframe: 1.4 years, plus 100 years of cap maintenance and monitoring
Estimated Time to Meet RAOs: 12 years

Alternative A relies solely on capping for remediation and includes a conceptual shoreline modification that may be considered to mitigate for filling of wetlands in OU1. Alternative A includes the following components:

- Amended sand cap in DNAPL Area 6 (DA-6) (0.7 acre, 4.5 feet thick) to sorb COCs from DNAPL in upwelling groundwater and prevent exposure to contaminated sediment and porewater.
- RCM caps in remaining DNAPL areas (4.9 acres) to sorb COCs in upwelling groundwater, control DNAPL migration (when present in near surface) and prevent exposure to contaminated sediment and porewater.
- Engineered sand cap (6.2 acres, 1.5 feet thick) to address sediment outside DNAPL areas impacted by upwelling contaminated groundwater (erosion protection requirements determined during remedial design).
- Dredging in the nearshore area to maintain bathymetry beneath the RCM and engineered sand caps (2,800 CY).
- Onsite dewatering of dredged sediment (2,800 CY) and shipment offsite for disposal.
- ENR (17.6 acres, 6 inches thick) to remediate remaining areas within OU2.

Alternative 2 would not remove any DNAPL source material.

O&M would consist of sediment cap inspections and sampling, and RCM and sand cap shoreline maintenance. **Figure 7-1** provides an overview of Alternative A.

Alternative B—Targeted DNAPL Removal (TD DNAPL Area), Amended Sand Cap, RCM Cap, Engineered Sand Cap, and ENR

Estimated Capital Costs: $15,900,000
Estimated O&M Costs: $1,100,000
Total Estimated Present Value: $17,000,000
Estimated Construction Timeframe: 2.1 years active construction, plus 100 years of cap maintenance and monitoring
Estimated Time to Meet RAOs: 13 years

Alternative B includes the same application of the engineered sand cap and ENR as Alternative A, and the same shoreline modification. It also involves removal of targeted areas of shallow PTW. Alternative B includes the following components:

- Dredging in the TD (DA-1 and DA-2) DNAPL areas (2.7 acres) to remove targeted shallow PTW in lake sediments (12,200 cubic yards [CY]), with placement of a 6-inch reactive cover (organoclay/sand) over dredged areas to manage residuals if necessary. The DA-1 and DA-2 areas contain near-surface DNAPL deposits that are more likely to be disturbed by boating activities than other PTW areas.
- Amended sand cap in the QP-S (DA-6) DNAPL area (0.7 acre) to sorb COCs from DNAPL in upwelling groundwater and prevent exposure to contaminated sediment and porewater.
- RCM caps in other sediment DNAPL areas (2.0 acres) to sorb COCs in upwelling groundwater, control DNAPL migration (when present in near surface) and prevent exposure to contaminated sediment and porewater.
- Dredging in the nearshore area to maintain bathymetry beneath the RCM and engineered sand caps (2,700 CY).
- Onsite dewatering of dredged sediment and shipment offsite for disposal (2,700 CY).
- Engineered sand cap (6.2 acres, 1.5 feet thick) to address sediment outside DNAPL areas impacted by upwelling contaminated groundwater.
- ENR (17.6 acres, 6 inches thick) to remediate remaining areas within OU2.

Alternative B would remove approximately 33,700 gallons of DNAPL source material (50 percent of total volume) to a maximum depth of 2.4 feet below the sediment surface.

O&M would consist of sediment cap inspections and sampling, and RCM and sand cap shoreline maintenance. **Figure 7-2** provides an overview of Alternative B.

Alternative C—Targeted DNAPL Removal (TD and QP-S DNAPL Areas), RCM Cap, Engineered Sand Cap, and ENR

Estimated Capital Costs: $22,300,000
Estimated O&M Costs: $700,000
Total Estimated Present Value: $23,000,000
Estimated Construction Timeframe: 2.8 years active construction, plus 100 years of cap maintenance and monitoring
Estimated Time to Meet RAOs: 13 years

Alternative C includes the same application of the engineered sand cap and ENR as Alternative B, but with no shoreline modification. It also involves removal of targeted areas of DNAPL. Alternative C includes the following components:

- Dredging in the TD (DA-1 and DA-2) DNAPL areas (2.7 acres) to remove targeted shallow DNAPL in lake sediments (12,200 CY), with placement of a reactive cover to manage residuals, if necessary.
- Dredging in the QP-S (DA-6) area (0.7 acre, 11,000 CY) to remove DNAPL in lake sediments along the shoreline, including temporary sheet pile, and placement of a reactive cover to manage residuals.
- RCM caps in other sediment DNAPL areas (2.0 acres) to sorb COCs in upwelling groundwater, control DNAPL migration (when present in near surface) and prevent exposure to contaminated sediment and porewater.
- Dredging in the nearshore area to maintain bathymetry beneath the RCM and engineered sand cap (2,700 CY).
- Onsite dewatering of dredged sediment (25,900 CY) and shipment offsite for disposal.
- Engineered sand cap (6.4 acres, 1.5 feet thick) to address sediment outside DNAPL areas impacted by upwelling contaminated groundwater.
- ENR (17.6 acres, 6 inches thick) to remediate remaining areas within OU2.

Alternative C would remove approximately 59,600 gallons of DNAPL source material (80 percent of total volume) to a maximum depth of 8.2 feet below the sediment surface.

O&M would consist of sediment cap inspections and sampling, and RCM and sand cap shoreline maintenance. **Figure 7-3** provides an overview of Alternative C.

Alternative D—DNAPL Removal, Engineered Sand Cap, and ENR – EPA's Preferred Alternative

Estimated Capital Costs: $39,500,000
Estimated O&M Costs: $400,000
Total Estimated Present Value: $39,900,000
Estimated Construction Timeframe: 4.1 years active construction, plus 100 years of cap maintenance and monitoring
Estimated Time to Meet RAOs: 6 years

Alternative D includes the same application of the engineered sand cap and ENR as Alternative C but involves removal of DNAPL. Alternative D includes the following components:

- Dredging in the offshore (DA-1 through DA-4) DNAPL areas (3.3 acres, 15,200 CY) to remove shallow DNAPL in lake sediments, with placement of a reactive cover to manage residuals.
- Dredging in the nearshore (DA-5 through DA-8) DNAPL areas (3.1 acres, 41,200 CY) to eliminate DNAPL in lake sediments along the shoreline, including temporary sheet pile, and placement of a reactive cover to manage residuals.
- Dredging in the nearshore area, outside of DNAPL areas to maintain bathymetry beneath the engineered sand cap (1,900 CY).
- Onsite dewatering of dredged sediment (58,300 CY) and shipment offsite for disposal.
- Engineered sand cap (5.5 acres, 1.5 feet thick) to address sediment outside DNAPL areas impacted by upwelling contaminated groundwater.
- ENR (17.6 acres, 6 inches thick) to remediate remaining areas within OU2.

The intent of Alternative D is to remove DNAPL sources. Based on existing data, Alternative D would remove approximately 67,600 gallons of DNAPL source material (100 percent of total volume) to a maximum depth of 13 feet below the sediment surface. As part of the implementation strategy, the actual areas for dredging will be refined with additional pre-dredging characterization during remedial design to identify DNAPL source areas.

O&M would consist of sediment cap inspections and sampling, and sand cap shoreline maintenance. **Figure 7-4** provides an overview of Alternative D.

Alternative E—DNAPL and Contaminated Sediment Removal, Engineered Sand Cap, and ENR

Estimated Capital Costs: $96,000,000
Estimated O&M Costs: $400,000
Total Estimated Present Value: $96,400,000
Estimated Construction Timeframe: 7.6 years active construction, plus 100 years of cap maintenance and monitoring
Estimated Time to Meet RAOs: 9 years

Alternative E includes removal of DNAPL, and the same application of the engineered sand cap and ENR as Alternative D, but the nearshore dredge area is expanded to include the estimated area of groundwater and porewater exceeding maximum contaminant levels (MCLs). Alternative E includes the following components:

- Dredging in the offshore (DA-1 through DA-4) DNAPL areas (3.3 acres, 23,700 CY) to remove shallow DNAPL in lake sediments, with placement of a reactive cover to manage residuals.

- Dredging in the nearshore (NA-5 through NA-8) areas (4.7 acres, maximum depth of 27 feet below the sediment surface to remove 148,600 CY) to eliminate DNAPL in lake sediments along the shoreline, and remove additional contaminated sediment.
  It includes temporary sheet pile, and placement of a reactive cover to manage residuals.
- Dredging in the nearshore area, outside of DNAPL areas to maintain bathymetry beneath the engineered sand cap (800 CY).
- Onsite dewatering and *ex situ* thermal treatment of dredged sediment (173,100 CY). It is assumed that thermal treatment would remove DNAPL and achieve levels protective of groundwater such that it could be placed onsite; however, the treated sediment may still exceed soil PRGs and require containment (such as capping).
- Engineered sand cap (3.9 acres, 1.5 feet thick) to address sediment outside DNAPL areas impacted by upwelling contaminated groundwater
- ENR (17.6 acres, 6 inches thick) to remediate remaining areas within OU2.

Alternative E would remove approximately 67,600 gallons of DNAPL source material (100 percent of total volume) and contaminated sediment to a maximum depth of 27 feet below the sediment surface.

O&M would consist of sediment cap inspections and sampling, and sand cap shoreline maintenance. **Figure 7-5** provides an overview of Alternative E. Comparative Analysis of Alternatives

This section describes the criteria used by EPA to compare the alternatives, and the relative performance of each alternative against the criteria. More detailed analyses can be found in the FS report (Aspect and Arcadis, 2016).

8. Comparative Analysis of Alternatives

This section summarizes the comparative analysis of alternatives using the threshold and balancing criteria listed previously. More detailed analyses can be found in the FS report (Aspect and Arcadis, 2016).

Overall Protection of Human Health and the Environment

All alternatives, except Alternative 1, would protect human health and the environment through combinations of containment and removal of contaminated sediment, and through institutional controls.

Alternatives A through C will achieve the RAOs for human health that focus on protection of current and future beach users and fish/shellfish consumers (both recreational and subsistence) and aquatic and aquatic-dependent wildlife. However, the RAOs for these alternatives would not be deemed complete until at least 10 years of monitoring have been completed to confirm protectiveness. Institutional controls restricting activities that could cause damage to sediments caps would remain in place in perpetuity, as contaminants would remain in place to varying degrees.

Alternatives D and E remove DNAPL that is the contaminant source to sediment and surface water/porewater and the remaining areas with lower levels of contamination are addressed by capping and ENR. Alternative E further removes contaminated sediment beneath the lake where groundwater exceeds MCLs for benzo(a)pyrene, the most persistent contaminant. Alternatives D and E also include a sand cap in the nearshore and ENR offshore to reduce concentrations of contamination in sediment and surface water/porewater to meet PRGs with the remainder of OU2. These alternatives would be more protective in the long-term as there would be a lesser reliance on caps because DNAPL sources are removed from the aquatic environment.

Compliance with Applicable or Relevant and Appropriate Requirements

Preliminary ARARs are discussed in detail in the FS Report (Aspect and Arcadis, 2016). Key ARARs for OU2 include the Federal Clean Water Act, the Endangered Species Act, RCRA, Washington State Sediment Management Standards (SMS), and State Water Quality Standards (WQS). Identifying ARARs is an iterative process, which will continue until final ARAR determinations are made by EPA during preparation of the ROD.

Alternative 1 does not satisfy the threshold criteria for compliance with ARARs. Alternatives A through E would satisfy the threshold criterion for compliance with ARARs in that chemical-specific ARARs (state SMS and WQS) would be met, and ARARs specific to the remediation activities and location of the Site would also be complied with.

Nine Superfund Evaluation Criteria:

In accordance with CERCLA and Section 300.430(f)(5)(i) of the NCP, EPA evaluates remedial alternatives using the following nine criteria:

- **Threshold Criteria—**These criteria specify what an alternative must meet to be eligible for selection as a remedial action:
  - **Overall protection of human health and the environment—**Determines whether a remedial action eliminates, reduces, or controls threats to public health and the environment through treatment, engineering controls (such as fencing), or institutional controls (such as deed restrictions).
  - **Compliance with ARARs—**In addition to ensuring that human and ecological receptors are protected, remedial actions to cleanup a site must attain legally applicable, or relevant and appropriate federal, and state standards and requirements unless such ARARs are waived under CERCLA Section 121(d)(4).
- **Balancing Criteria—**These criteria represent technical considerations upon which the detailed analysis is based:
  - **Long-term effectiveness and permanence—**Considers the ability of a remedial alternative to maintain protection of human health and the environment over time and the reliability of such protection.
  - **Reduction of toxicity, mobility, and volume through treatment—**Evaluates using treatment to reduce the harmful effects of contaminants and the ability of contaminants to move in the environment. More specific considerations include the amount of hazardous substances that would be destroyed, treated, or recycled; the degree to which treatment is irreversible; and the degree to which treatment reduces the inherent hazards posed by principal threat waste.
  - **Short-term effectiveness—**Considers both the length of time required to implement a remedial alternative and the risk that constructing and maintaining the remedy would pose to workers, residents, and the environment until cleanup levels are achieved.
  - **Implementability—**Considers the technical and administrative feasibility of implementing a remedial alternative, such as relative availability of goods and services. This criterion also considers whether the technology has been used successfully at other similar sites.
  - **Cost—**Considers both estimated capital costs and long-term operations and maintenance costs. Costs are expected to be accurate within a range of +50 to -30 percent.
- **Modifying Criteria—**These criteria are evaluated at the end of the public review and comment period; they are not discussed in this Proposed Plan.
  - **State and Tribal acceptance—**Considers whether the state and tribes support EPA's analyses and recommendations of the FS report (Aspect and Arcadis, 2016) and the Proposed Plan.
  - **Community acceptance—**Considers whether the local community agrees with EPA's analyses and recommendations of the FS report (Aspect and Arcadis, 2016) and the Proposed Plan.

Long-term Effectiveness and Permanence

The long-term effectiveness and permanence rating is based on consideration of both the magnitude of residual risk associated with any contamination remaining at the Site following implementation of the remedy and the reliability of controls. The magnitude of residual risk was evaluated in the context of achieving RAOs and considered the total volume of DNAPL removed or treated in each alternative.

Alternatives A through C rely on passive controls to address DNAPL that is left in place. There is increasing field experience with installation of the RCM and amended sand caps that would be placed over the DNAPL for these alternatives; however, there is little field experience with maintenance and repair of these caps. The long-term effectiveness and sorption capacity of the reactive materials is also unknown because the nature of the contaminant when it contacts the material (either NAPL or dissolved-phase) influences both sorption and hydraulic conductivity through the RCM or amended sand cap. Additionally, these caps have the potential to be damaged through erosion and activities in Lake Washington, decreasing protectiveness. Alternative A is rated low because it removes no DNAPL. Alternatives B and C are rated moderate for this criterion because while they remove some DNAPL, the risk for continued contamination of sediment and surface water/porewater would remain as upwelling groundwater would continue to flow through it and mobilize COCs. High ratings are given to Alternatives D and E, which would remove

DNAPL. Alternative E removes more contaminated sediment, providing the greatest long-term effectiveness and permanence, but at the highest cost.

Reduction of Toxicity, Mobility, or Volume Through Treatment

This balancing criterion evaluates the degree to which each remedial alternative reduces toxicity, mobility, or volume through treatment. Alternatives A through C include RCM and/or amended caps in areas where DNAPL is left in place, which immobilize organic COCs through sorption. Alternatives B through E include reactive covers in areas that have been dredged, which also immobilize residual COCs through sorption. Alternative E includes ex situ thermal treatment of dredged sediment, which would remove DNAPL and achieve levels protective of groundwater such that it could be placed onsite; however, the treated sediment may still exceed soil PRGs and require containment (such as capping).

Alternative A is rated low with respect to this criterion because it includes only modest treatment and only immobilizes but does not reduce volume or toxicity. Alternatives B, C, and D are given moderate ratings as compared to Alternative A as they would include reactive caps or reactive covers in dredged areas. Alternative E is rated high in that it destroys contaminant mass through thermal treatment, providing the highest reduction of toxicity, mobility, and volume through treatment, but at the greatest cost.

Short-Term Effectiveness

The remedial design for each alternative would include measures to minimize impacts to workers, community, and environment during the remedy implementation phase. The primary difference between alternatives is the duration of construction and the potential for exposures if construction equipment and/or protective controls fail, a risk that generally increases with the quantity of contaminated material removed or handled.

Alternatives A and B receive a high rating for this criterion as they have relatively short construction durations (less than 1 year) and present the lowest risk to workers, the community, and the environment due to limited handling of DNAPL materials above ground. A moderate rating is given to Alternatives C and D. These alternatives have construction durations ranging from 1.3 to 2.6 years. Dredged DNAPL is disposed of offsite, which has less short-term impacts relative to the *ex situ* thermal treatment option for Alternative E, which receives a low rating for this criterion. In addition to the greater potential for exposure through a higher level of material handling for Alternative E, the construction period is also longer, estimated at 5.6 years.

Implementability

All alternatives pose technical implementation challenges. Except for the RCM and amended sand caps, the technologies used by all alternatives are proven technologies that have been implemented at other similar sites and could be implemented at the Quendall Site. While there is increasing field experience with the installation of RCM and amended sand caps, there is limited field information/experience regarding the maintenance/repair of such caps.

Alternatives A through C that involve RCM or amended sand caps would require ongoing maintenance and monitoring in perpetuity. Alternatives C through E that include mechanical dredging of DNAPL-containing sediments in the QP-S DNAPL area have increased complexity due to installation and removal of sheetpile shoring systems and removal of relatively deep sediments. Thermal treatment of sediment under Alternative E would require air emission controls and extensive monitoring.

During remedial design, all alternatives would require coordination with numerous federal and state regulatory agencies to ensure that all ARARs, policies, and regulations are met. Alternatives with longer construction durations and/or more construction elements would generally require more administrative coordination and have a greater potential for technical problems and schedule delays.

Alternatives A and B are rated high for implementability, as they involve mostly capping and no mechanical dredging. Alternatives C and D are rated moderate for implementability as they include greater challenges of shoring and dewatering sediments. Alternative E is rated low as it includes removal of significantly more sediment and provides on-site thermal treatment of a large volume of material. Longer duration of construction activities would also perpetuate severe technical and administrative challenges.

Cost

Table 8-1 presents costs for all alternatives. This table shows the present value cost of each alternative, calculated using a 7 percent discount rate.

9. Preferred Alternative

This section presents EPA's Preferred Alternative for OU2 (offshore) of the Quendall Terminals Superfund Site and the basis for the agency's selection. The goal of the remedy selection process, as stated in 40 Code of Federal

Regulations 300.430(a)(1)(i) of the NCP, is to select remedies that protect human health and the environment, maintain protection over time, and minimize untreated waste.

Preferred Alternative

EPA proposes Alternative D as the Preferred Alternative for OU2. The primary objective of Alternative D is to remove DNAPL that is a source of sediment and surface water/porewater contamination, which is consistent with EPA guidance (2005) that states that controlling sources is critical to the effectiveness of any Superfund sediment cleanup. Ongoing known sources should be eliminated to maintain protectiveness and that ensure that the caps and ENR will be effective. The estimates of areas, volumes, time to reach cleanup objectives and cost for the Preferred Alternative are based on RI/FS data and other information included in the Administrative Record. As part of the implementation strategy, the actual areas and depths for dredging will be refined with additional pre-dredging characterization during remedial design to identify DNAPL source areas. Results from remedial design sampling will also be used to refine delineation of areas of contaminated sediment to be remediated by each remediation technology.

Alternative D includes the following components for OU2:

- Dredging in the offshore (DA-1 through DA-4) DNAPL areas (3.3 acres, 15,200 CY) to remove shallow DNAPL in lake sediments, with placement of a reactive cover to manage residuals, if necessary.
- Dredging in the nearshore (DA-5 through DA-8) DNAPL areas (3.1 acres, 41,200 CY) to eliminate deeper DNAPL in lake sediments along the shoreline, including temporary sheet pile, and placement of a reactive cover to manage residuals.
- Dredging in the nearshore area, outside of DNAPL areas to maintain bathymetry beneath the engineered sand cap (1,900 CY).
- Onsite dewatering of dredged sediment (58,300 CY) and shipment offsite for disposal.
- Engineered sand cap (5.5 acres, 1.5 feet thick) to address sediment outside DNAPL areas impacted by upwelling contaminated groundwater.
- ENR (17.6 acres) to remediate remaining areas within OU2 with low levels of cPAH contamination.
- Institutional controls to help ensure the effectiveness of engineering controls.
- Monitoring to verify that the remedy is performing as intended.

The Preferred Alternative is presented in **Figure 9-1**. The estimated cost for Alternative D is $39.9 million.[9] The FS-level accuracy range, based on -30/+50 percent, using a discount rate of 7 percent is $28.1 million to $60.3 million.

Rationale for Selection of Preferred Alternative

To address the DNAPL and achieve the RAOs, Alternative D meets the threshold criteria, and provides the best tradeoffs among the balancing criteria, as compared to other upland FS alternatives as follows:

- Alternative D provides a high degree of protectiveness to human health and the environment and a higher level of long-term effectiveness and permanence than Alternatives A through C because the DNAPL source causing contamination of sediment and surface water/porewater would be removed under Alternative D.
- Alternative D will comply with ARARs.
- DNAPL identified during site investigations is removed, and fewer engineering controls are needed to protect contained contamination, less reliance is placed on institutional controls with Alternative D than with Alternatives A through C.
- Alternative D does not include treatment; however, DNAPL is removed from the environment and will no longer be a source of contamination to Lake Washington.
- Alternative E includes more expansive work that realizes a nominal incremental benefit beyond that provided by Alternative D with respect to overall protection of human health and the environment. Alternative E would cost more than twice that of Alternative D, and the construction duration would more than double.

Preferred Alternative Summary

Based on the information currently available, the Preferred Alternative described in this Proposed Plan is a final action which meets the threshold criteria and provides the best balance of tradeoffs with respect to the balancing and modifying criteria. EPA expects the Preferred Alternative to satisfy the following statutory requirements of CERCLA §121(b): (1) be protective of public health and the environment; (2) attain ARARs; (3) be cost-effective; (4) use permanent solutions and

[9] Calculated using a 7 percent discount rate, as required by EPA policy and guidance.

alternative treatment (or resource recovery) technologies to the maximum extent practicable. Although it will not satisfy the preference for treatment as a principal element, it will remove DNAPL from the shallow and deeper lakebed. The OU2 Preferred Alternative will achieve substantial risk reduction by both removing the DNAPL source materials constituting principal threats at the site and providing safe management of remaining material. EPA believes that this substantial reduction in risk, will result in a remedial action that meets all applicable risk-based criteria and background values. EPA will evaluate the cleanup during and after the remedial action is performed to confirm this belief.

10. References

Anchor QEA, LLC and Aspect Consulting, LLC (Anchor QEA and Aspect). September 2012. *Final Remedial Investigation Report, Quendall Terminals Site, Renton, Washington.* Prepared for U.S. Environmental Protection Agency, Region 10, on behalf of Altino Properties, Inc. and J.H Baxter & Company. Available at https://semspub.epa.gov/work/10/500010867.pdf.

Aspect Consulting, LLC and Arcadis US (Aspect and Arcadis). December 2016. *Feasibility Study, Quendall Terminals Site.* Prepared for: U.S. Environmental Protection Agency, Region 10 on behalf of Altino Properties and J.H. Baxter & Co. Available at https://semspub.epa.gov/work/10/100043827.pdf.

Century Pacific, LLLP. 2012. *Quendall Terminals: Environmental Cleanup, Habitat Restoration, Economic and Waterfront Sustainable Development*. Available at http://www.quendallterminals.com/contact.html.

Grette Associates, LLC (Grette). October 18, 2016. *Baseline Habitat Technical Memorandum for Quendall Terminals*.

Lampert, D. J. and D. Reible. 2009. An Analytical Modeling Approach for Evaluation of Capping of Contaminated Sediments, Soil and Sediment Contamination: An International Journal, 18:4, 470-488.

U.S. Environmental Protection Agency. 2005. Contaminated Sediment Remediation Guidance for Hazardous Waste Sites. EPA-540-R-05-012, OSWER 9355.0-85. December. Available at https://semspub.epa.gov/work/HQ/174471.pdf.

Acronyms and Abbreviations

§	Section
Anchor QEA	Anchor QEA LLC
ARAR	Applicable or Relevant and Appropriate Requirement
Arcadis	Arcadis US
Aspect	Aspect Consulting, LLC
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CH2M	CH2M HILL, Inc.
COC	contaminant of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSL	cleanup screening level
CY	cubic yards
DA	DNAPL Area
DNAPL	dense nonaqueous phase liquid
DNR	Department of Natural Resources
Ecology	Washington State Department of Ecology
ELCR	excess lifetime cancer risk
ENR	enhanced natural recovery
EPA	U.S. Environmental Protection Agency
ERA	Ecological Risk Assessment
ESA	Endangered Species Act
FS	Feasibility Study
HHRA	Human Health Risk Assessment
HI	hazard index
HQ	hazard quotient
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
mg/kg-OC	milligrams per kilogram normalized to organic carbon
NAPL	nonaqueous phase liquid
NCP	National Contingency Plan
O&M	operations and maintenance
OU	Operable Unit
PAH	polycyclic aromatic hydrocarbon
PRG	preliminary remediation goal
Proposed Plan	Proposed Plan for the Quendall Terminals Superfund Site, Operable Unit 2
PTW	principal threat waste
QP-S	Quendall Pond – Sediment (DNAPL Area)
RAO	remedial action objective
RBC	risk-based concentration
RCM	reactive core mat
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
ROD	Record of Decision
SCO	sediment cleanup objective
Site	Quendall Terminals Superfund Site
SMS	Washington State Sediment Management Standards
TD	T-Dock
WQS	Washington State Water Quality Standards

Glossary of Terms

Amended Cap: Remedial technology in which amendments are added to capping material. The amendments enhance the performance of the cap material.

Applicable or Relevant and Appropriate Requirements (ARARs):

Applicable requirements, as defined in 40 CFR § 300.5, are those clean-up standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by the state in a timely manner and that are more stringent than federal requirements may be applicable.

Relevant and appropriate requirements, as defined in 40 CFR § 300.5, means those clean-up standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well suited to the particular site. Only those state standards that are identified by the state in a timely manner and that are more stringent than federal requirements may be relevant and appropriate.

Aquitard: A geologic formation adjacent to an aquifer that only allows a small amount of liquid to pass through it.

Background Threshold Value (BTV): A concentration in media (soil, sediment, water) that is representative of sampling results and may be used to describe the background conditions for a specific area.

Benthic: The benthic zone is the region at the deepest portion of a body of water and typically includes the sediment surface and some sub-surface layers. Organisms living in this area may be referred to as the "benthic community".

Carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs): PAHs are compounds composed of only carbon and nitrogen and are composed of multiple aromatic rings. Carcinogenic PAHs are those compounds that have been determined to exhibit probable carcinogenicity (that is, may cause cancer).

Contaminants of concern (COCs): Site-specific chemicals that are identified for evaluation in the site assessment process that potentially poses unacceptable human health or ecological risks.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA): A federal law, commonly referred to as the "Superfund" Program. CERCLA provides for clean-up and emergency response in connection with existing inactive hazardous waste disposal sites that endanger public health and safety or the environment.

Dense Nonaqueous Phase Liquid (DNAPL): An organic substance in liquid form that is relatively insoluble in water and denser than water. DNAPLs tend to sink vertically through sand and gravel aquifers and pool above an underlying, less-permeable layer.

Discount Rate: An interest rate used to estimate the value of current payments in lieu of waiting until sometime in the future.

Distillate Fraction: Distillation is a process of separating mixtures of chemical compounds. The different mixtures, or fractions, have differing chemical properties (for example, the boiling point).

Effluent: Liquid waste discharged into a water body.

Enhanced Natural Recovery (ENR): Also referred to as enhanced monitored natural recovery, and refers to the use of monitored natural recovery in conjunction with remedial technologies including, but not limited to, thin-layer capping and introduction of reactive amendments to enhance ongoing natural recovery processes.

Excess Lifetime Cancer Risk (ELCR): Potential carcinogenic effects that are characterized by estimating the probability of cancer incidence in a population of individuals for a specific lifetime from projected intakes (and exposures) and chemical-specific dose-response data.

Exposure Pathway: The pathway for a chemical from the source of contamination to the exposed individual or receptor, such as dermal contact, ingestion, or inhalation.

Feasibility Study (FS): A comprehensive process to screen, develop, and evaluate potential alternatives for remediating contamination.

Free phase: A term to describe hydrocarbon contamination which is present as a discrete substance rather than mixed with water or soil.

Groundwater: Subsurface water that occurs in fully saturated soil and geologic formations (from infiltrating precipitation).

Hazard Index (HI): Summation of the noncancer risks to which an individual is exposed. An HI value of 1.0 or less indicates that noncancer adverse human health effects are unlikely to occur.

Hazard Quotient (HQ): The ratio of the potential exposure to a substance and the level at which no adverse effects are expected. If the HQ is calculated to be less than 1, then no adverse health effects are expected as a result of exposure.

Human Health Risk Assessment (HHRA): An assessment of the risks posed to human health through potential contaminant exposures, based on site-specific exposure scenarios.

Institutional Controls: Non-engineered controls, such as administrative and legal controls, that help minimize human exposure to contamination and/or protect the integrity of the remedy.

In Situ Solidification (ISS): A treatment process that immobilizes contaminants by mixing amendments into soil using a large-diameter auger. The amendments solidify the soil into a stabilized mass, similar to a concrete block.

Invasive Species: “Invasive species" is defined as a species that is: 1) non-native (or alien) to the ecosystem under consideration and. 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health.

Nonaqueous Phase Liquid (NAPL): An organic substance in liquid form that is relatively insoluble in water. These materials may be less dense than water (LNAPL) or more dense than water (DNAPL).

Operation and Maintenance (O&M): Activities conducted after the remedial action to maintain the effectiveness of the response action.

Operable Unit: A designation based on geography or other characteristics that defines a specific area of a site. The cleanup of a site can be divided into a number of operable units and enables the cleanup process to address geographical portions of the site, specific site problems, and proceed with cleanup at different times.

Principal Threat Wastes (PTW): Source materials that generally cannot be reliably contained or would present a significant risk to human health or the environment should an exposure occur.

Proposed Plan: A plan for site remedial action or other action that is available to the public for comment.

Receptors: Humans, animals, or plants that may be exposed to risks from contaminants present at a given site.

Reactive Core Mat (RCM): A patented permeable composite mat consisting of reactive material(s) encapsulated in a non-woven core matrix bound between two geotextiles. Through its innovative processing, RCM can combine two active materials, if required.

Record of Decision (ROD): A legal document that describes the clean-up action or alternative selected for a site, the basis for choosing that alternative, and public comments on the selected alternative.

Remedial Action Objectives (RAOs): Specific goals for protecting human health and the environment. RAOs are developed by evaluating ARARs protective of human health and the environment and the results of remedial investigations and risk assessments.

Preliminary Remediation Goals (PRGs): Clean-up goals developed during the cleanup planning process based on the ARARs. They also are used during analysis of remedial alternatives in the remedial investigation/feasibility study (RI/FS).

Remedial Investigation (RI): Extensive technical study conducted to characterize the nature and extent of contamination and the risks posed by contaminants present at a site.

Residual Risk: Hazards which remain on site after a remedial action has been completed.

Risk-based Concentrations (RBCs): The calculated chemical-specific concentration corresponding to a target risk level, usually a cancer risk level of 10-6 for carcinogens and a hazard index of 1.0 for noncarcinogenic effects. Also called risk-based criterion. RBCs are based on a specific set of exposure scenarios and pathways.

Sediment Management Standards: The Washington State Sediment Management Standards (SMS) Chapter 173-204 WAC were developed to reduce and ultimately eliminate adverse effects on biological resources and significant threats to human health from surface sediment contamination. The SMS are used to set standards for sediment quality; applied to reduce pollutant discharges, and provide a decision process for the cleanup of contaminated sediment sites.

Successional Species: Ecological succession is the process of change in the species structure of an ecological community over time. Successional species are those that are expected to appear during a given stage of ecological succession.

Usual and Accustomed fishing grounds: This treaty term was used in 12 treaties in the Northwestern United States. It describes lands adjacent to streams, rivers, or shorelines to which a tribe(s) usually traveled or was accustomed to travel for the purpose of taking fish.
As this term applies to National Forest Systems lands, these areas are outside reservation boundaries. Western Federal courts have either referred to or defined the term when deciding lawsuits about the extent of a tribe’s off-reservation treaty right to take fish. It has not been found by the courts to include hunting, gathering, grazing, or trapping. It is possible for “usual and accustomed areas” to extend beyond treaty area boundaries and to overlap large areas of a neighboring tribe, based on the specific treaty language. This designation has been found by the court to create a property interest in the land, an encumbrance on the site that remains regardless of land ownership.

U.S. Environmental Protection Agency (EPA): The federal agency responsible for administration and enforcement of CERCLA (and other environmental statutes and regulations), and with final approval authority for the selected remedial alternative.

Tables

Table 3-1. Contaminant Concentrations in Nearshore Sediment

Proposed Plan for the Quendall Terminals Superfund Site, Operable Unit 2

Contaminant of Concern	PRG (mg/kg)	PRG Source	Number of Detections/ Samples	Number of Detects Exceeding PRGs	Number of Non-detects Exceeding PRGs	Average Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)
Polycyclic Aromatic Hydrocarbons							
Benz(a)anthracene*	0.98	HHRA RBC 10^{-6}	10/10	5	--	2.5	8.2
Benzo(a)pyrene*	0.098	HHRA RBC 10^{-6}	10/10	9	--	6.8	23
Benzo(b)fluoranthene*	0.98	HHRA RBC 10^{-6}	10/10	4	--	7.8	29
Benzo(k)fluoranthene*	9.83	HHRA RBC 10^{-6}	10/10	3	--	4.9	17
Chrysene*	98.3	HHRA RBC 10^{-6}	10/10	--	--	5.2	19
Dibenz(a,h)anthracene*	0.098	HHRA RBC 10^{-6}	9/10	9	--	1.5	4.8
Indeno(1,2,3-c,d)pyrene*	0.98	HHRA RBC 10^{-6}	10/10	4	--	3.9	17
Total 10 of 16 HPAH (U = 1/2)	29	EcoRA RBC HQ=1	10/10	3	--	47	171
Total 16 PAH (U = 1/2)	17	Ecology SMS	10/10	5	--	56	231
Total cPAHs	0.098	HHRA RBC 10^{-6}	10/10	10	--	192	578

Notes:

Field duplicates processed using the maximum detected result or lowest method detection limit if applicable.

Samples represented in this table were collected from areas with water depths of less than 10 feet.

mg/kg = milligrams per kilogram

cPAH = carcinogenic PAH(s) – calculated based on benzo(a)pyrene equivalents (indicated by asterisk)

EcoRA RBC HQ=1 = Ecological Risk Assessment Risk-Based Concentration, based on noncancer hazard quotient of 1

Ecology SMS = Washington State Department of Ecology Sediment Management Standards (WAC 173-205-563, Table VI, Sediment Cleanup Objective)

HHRA RBC 10^{-6} = Human Health Risk Assessment Risk-Based Concentration, based on cancer risk of 1×10^{-6}

HPAH = high-molecular-weight PAH (benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene, chrysene, dibenz[a,h]anthracene, indeno[1,2,3-c,d]pyrene, fluoranthene, and pyrene)

PAH = polycyclic aromatic hydrocarbon

PRG = Preliminary Remediation Goal

U=1/2 = undetected chemicals were included as one-half the detection limit.

Table 3-2. Contaminant Concentrations in Site-wide Sediment

Proposed Plan for the Quendall Terminals Superfund Site, Operable Unit 2

Contaminant of Concern	PRG (mg/kg)	PRG Source	Number of Detections/ Samples	Number of Detects Exceeding PRGs	Number of Non-detects Exceeding PRGs	Average Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)
Polycyclic Aromatic Hydrocarbons							
Benz(a)anthracene*	5.35	HHRA RBC 10^{-6}	98/100	13	--	7.9	260
Benzo(a)pyrene*	1.62	HHRA RBC 10^{-6}	98/100	44	--	7.7	140
Benzo(b)fluoranthene*	16.2	HHRA RBC 10^{-6}	99/100	12	--	7.9	130
Benzo(k)fluoranthene*	162	HHRA RBC 10^{-6}	99/100	--	--	6.0	130
Chrysene*	530	HHRA RBC 10^{-6}	99/100	--	--	9.6	340
Dibenz(a,h)anthracene*	0.48	HHRA RBC 10^{-6}	93/100	37	--	1.2	17
Indeno(1,2,3-c,d)pyrene*	10.5	HHRA RBC 10^{-6}	99/100	9	--	3.0	34
Total 10 of 16 HPAH (U = 1/2)	29	EcoRA RBC HQ=1	100/100	25	--	79	2,004
Total 16 PAH (U = 1/2)	17	Ecology SMS	100/100	39	--	113	2,948
Total cPAHs	1.62	HHRA RBC 10^{-6}	99/100	97	1	185	2,910

Notes:

Field duplicates processed using the maximum detected result or lowest method detection limit if applicable.

mg/kg = milligrams per kilogram

cPAH = carcinogenic PAH(s) – calculated based on benzo(a)pyrene equivalents (indicated by asterisk)

EcoRA RBC HQ=1 = Ecological Risk Assessment Risk-Based Concentration, based on noncancer hazard quotient of 1

Ecology SMS = Washington State Department of Ecology Sediment Management Standards (WAC 173-205-563, Table VI, Sediment Cleanup Objective)

HHRA RBC 10^{-6} = Human Health Risk Assessment Risk-Based Concentration, based on cancer risk of 1×10^{-6}

HPAH = high-molecular-weight PAH (benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene, chrysene, dibenz[a,h]anthracene, indeno[1,2,3-c,d]pyrene, fluoranthene, and pyrene)

PAH = polycyclic aromatic hydrocarbon

PRG = Preliminary Remediation Goal

U=1/2 = undetected chemicals were included as one-half the detection limit.

Table 3-3. Contaminant Concentrations in Surface Water and Porewater

Proposed Plan for the Quendall Terminals Superfund Site, Operable Unit 2

Contaminant of Concern	PRG (µg/L)	PRG Source	Number of Detections/ Samples	Number of Detects Exceeding PRGs	Number of Non-detects Exceeding PRGs	Average Detected Concentration (µg/L)	Maximum Detected Concentration (µg/L)
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	30	40 CFR 131.45	49/96	10	--	36	266
Anthracene	100	40 CFR 131.45	41/96	--	--	2.9	25
Benz(a)anthracene*	0.00016	40 CFR 131.45	25/96	25	71	0.33	1.4
Benzo(a)pyrene*	0.000016	40 CFR 131.45	31/96	31	65	0.11	0.59
Benzo(b)fluoranthene*	0.00016	40 CFR 131.45	35/96	35	61	0.11	0.56
Benzo(k)fluoranthene*	0.016	40 CFR 131.45	33/96	28	63	0.11	0.58
Chrysene*	0.016	40 CFR 131.45	37/96	28	28	0.19	0.87
Dibenz(a,h)anthracene*	0.000016	40 CFR 131.45	8/96	8	88	0.032	0.092
Fluoranthene	6	40 CFR 131.45	46/96	7	--	3.6	54
Fluorene	10	40 CFR 131.45	46/96	8	--	15	170
Indeno(1,2,3-c,d)pyrene*	0.00016	40 CFR 131.45	16/96	16	80	0.051	0.15
Pyrene	8	40 CFR 131.45	50/96	5	--	2.2	29
Total cPAH	0.000016	40 CFR 131.45	52/96	52	44	0.11	0.83
Volatile Organics							
Benzene	0.44	NTR	16/54	16	30	159	1,200
Toluene	57	Section 304(a)	11/54	--	--	5.9	16

Notes:

Data include both surface water and porewater.

Field duplicates processed using the maximum detected result or lowest method detection limit if applicable.

µg/L = micrograms per liter

40 CFR 131.45 = 40 Code of Federal Regulations 131.45, Revisions of certain Federal water quality criteria applicable to Washington (water and organisms).

cPAH = carcinogenic PAH(s) – calculated based on benzo(a)pyrene equivalents (indicated by asterisk)

NTR = National Toxics Rule, human health criteria based on risk of 1 x 10^{-6} (for water and organisms) per Washington Administrative Code (WAC) 173-201A.

PAH = polycyclic aromatic hydrocarbon

PRGs = Preliminary Remediation Goals

Section 304(a) = Clean Water Act 33 United States Code (USC) 1314 (Section 304[a]) National Recommended Water Quality Criteria, human health criteria based on risk of 1 x 10^{-6} (for water and organisms).

Table 5-1. Summary of Risk and Hazard Estimates for Human Exposure Scenarios

Proposed Plan for the Quendall Terminals Superfund Site, Operable Unit 2

		Recreational Beach User		**Recreational Fishing**		**Subsistence Fishing**	
Exposure Medium	**Exposure Route**	**HI**	**ELCR**	**HI**	**ELCR**	**HI**	**ELCR**
Nearshore Sediment	Ingestion	0.004	2×10^{-4}	--	--	--	--
	Dermal	0.01	9×10^{-5}	--	--	--	--
	Total	0.02	3×10^{-4}	--	--	--	--
Site-wide Sediment	Ingestion	--	--	0.008	2×10^{-5}	0.01	4×10^{-5}
	Dermal	--	--	0.005	2×10^{-5}	0.01	3×10^{-5}
	Total	--	--	0.01	4×10^{-5}	0.02	6×10^{-5}
Site Surface Water	Ingestion	0.007	2×10^{-6}	--	--	--	--
	Dermal	0.02	2×10^{-6}	--	--	--	--
	Total	0.03	3×10^{-6}	--	--	--	--
Site Fish/Shellfish	Ingestion	--	--	0.4	2×10^{-4}	3	5×10^{-3}

Notes:

bgs = below ground surface

ELCR = excess lifetime cancer risk

HI = hazard index

Table 6-1. Preliminary Remediation Goals

Proposed Plan for the Quendall Terminals Superfund Site, Operable Unit 2

Chemical of Concern	Nearshore Sediment: Beach User		Site-wide Sediment: Subsistence Fish/Shellfish Consumer		Surface Water	
	PRG (mg/kg)	Source	PRG (mg/kg)	Source	PRG (µg/L)	Source
Acenaphthene	--	--	--	--	30	40 CFR 131.45
Anthracene	--	--	--	--	100	40 CFR 131.45
Benzene	--	--	--	--	0.44	NTR
Benz(a)anthracene*	0.98	HHRA RBC 10^{-6}	5.35	HHRA RBC 10^{-6}	0.00016	40 CFR 131.45
Benzo(a)pyrene*	0.098	HHRA RBC 10^{-6}	1.62	HHRA RBC 10^{-6}	0.000016	40 CFR 131.45
Benzo(b)fluoranthene*	0.98	HHRA RBC 10^{-6}	16.2	HHRA RBC 10^{-6}	0.00016	40 CFR 131.45
Benzo(k)fluoranthene*	9.83	HHRA RBC 10^{-6}	162	HHRA RBC 10^{-6}	0.016	40 CFR 131.45
Chrysene*	98.3	HHRA RBC 10^{-6}	530	HHRA RBC 10^{-6}	0.016	40 CFR 131.45
Dibenz(a,h)anthracene*	0.098	HHRA RBC 10^{-6}	0.48	HHRA RBC 10^{-6}	0.000016	40 CFR 131.45
Fluoranthene	--	--	--	--	6	40 CFR 131.45
Fluorene	--	--	--	--	10	40 CFR 131.45
Indeno(1,2,3-c,d)pyrene*	0.98	HHRA RBC 10^{-6}	10.5	HHRA RBC 10^{-6}	0.00016	40 CFR 131.45
Pyrene	--	--	--	--	8	40 CFR 131.45
Toluene	--	--	--	--	57	Section 304(a)
Total cPAHs	0.098	HHRA RBC 10^{-6}	1.62	HHRA RBC 10^{-6}	0.000016	40 CFR 131.45
Total HPAHs	29	ERA RBC HQ=1	--	--	--	--
Total PAHs	17	SMS	--	--	--	--

Notes:

Preliminary remediation goals (PRGs) for sediment and surface water were identified based on the most stringent Applicable or Relevant and Appropriate (ARAR). For sediment, if no ARAR is available, the lowest risk-based concentration (RBC) based on either carcinogenic effects or noncarcinogenic effects.

mg/kg = milligrams per kilogram

µg/L = micrograms per liter

-- = not a chemical of concern for medium listed

40 CFR 131.45 = 40 Code of Federal Regulations 131.45, Revisions of certain Federal water quality criteria applicable to Washington (water and organisms).

cPAH = carcinogenic PAH(s) – calculated based on benzo(a)pyrene equivalents (indicated by asterisk)

ERA RBC HQ=1 = Ecological Risk Assessment (ERA) Risk-Based Concentration, based on otter (Hazard Quotient = 1, back-calculated from ERA).

HHRA RBC 10^{-6} = Human Health Risk Assessment Risk-Based Concentration, based on risk of 1×10^{-6}.

HPAH = high-molecular-weight PAH (benz[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene, chrysene, dibenz[a,h]anthracene, indeno[1,2,3-c,d]pyrene, fluoranthene, and pyrene)

NTR = National Toxics Rule, human health criteria based on risk of 1×10^{-6} (for water and organisms) per Washington Administrative Code (WAC) 173-201A.

PAH = polycyclic aromatic hydrocarbon

Section 304(a) = Clean Water Act 33 United States Code (USC) 1314 (Section 304[a]) National Recommended Water Quality Criteria, human health criteria based on risk of 1×10^{-6} (for water and organisms).

SMS = Washington State Sediment Management Standards (WAC 173-205-563, Table VI, Sediment Cleanup Objective).

Table 8-1. Costs for the Operable Unit 2 Alternatives

Proposed Plan for the Quendall Terminals Superfund Site, Operable Unit 2

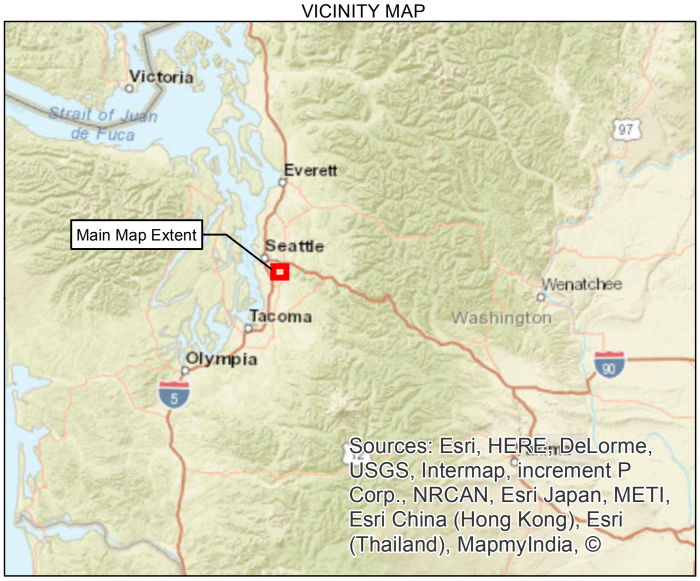
Alternative	Remedial Construction	Operations and Maintenance Using 7.0 Percent Discount Rate[a]	Total Present Value Using 7.0 Percent Discount Rate	FS-Level Accuracy Range (-30%)	FS-Level Accuracy Range (+50%)
A	9,430,000	2,270,000	11,700,000	8,200,000	17,600,000
B	15,900,000	1,100,000	17,000,000	11,900,000	25,500,000
C	22,300,000	700,000	23,000,000	16,100,000	34,500,000
D	39,500,000	400,000	39,900,000	27,900,000	59,900,000
E	96,000,000	400,000	96,400,000	67,400,000	144,000,000

Note:

[a] For estimating operations and maintenance cost, the FS cost estimate assumed that sediment sand cap inspections and sampling would be conducted for 10 years, and reactive cap (where applied) and sand cap shoreline maintenance would be conducted for 100 years.

Figures

VICINITY MAP



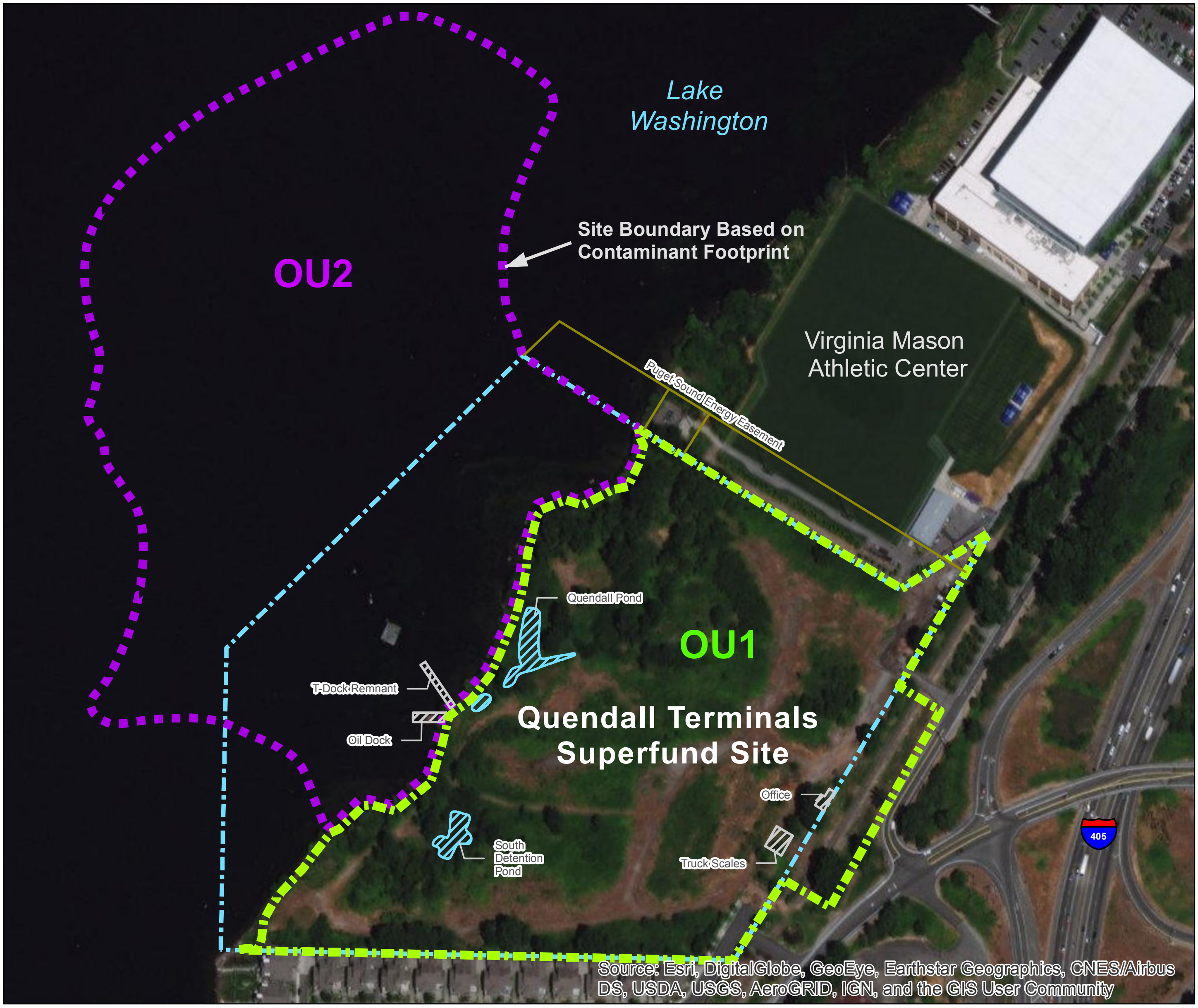
LEGEND

Quendall Terminals Site Boundary

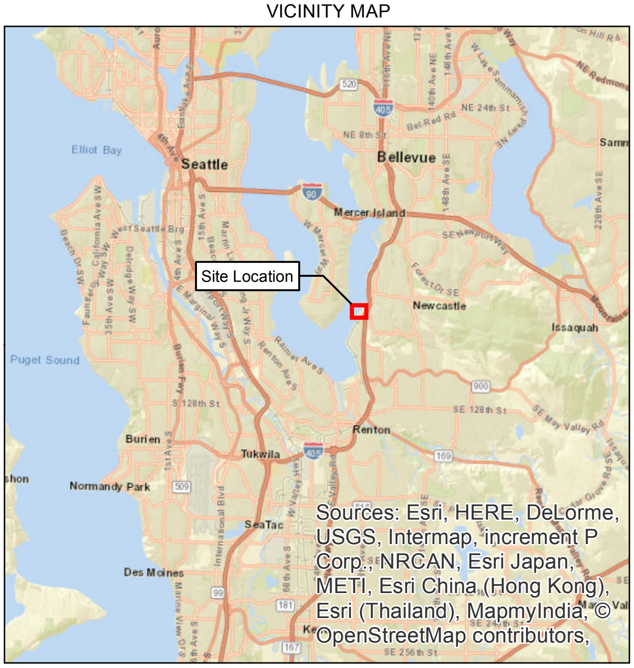
0 0.25 0.5 1 Miles

N

Figure 1-1
Quendall Terminals Site Location and Vicinity Map
Proposed Plan for the Quendall Terminals Superfund Site Operable Unit 2
Renton, Washington



VICINITY MAP



LEGEND

- OU1 Boundary
- OU2 Boundary
- Quendall Property Line
- Existing Structure

0 125 250 500 Feet

N

Figure 2-1
Current Site Features and Operable Units
Proposed Plan for the Quendall Terminals Superfund Site Operable Unit 2
Renton, Washington

EPA

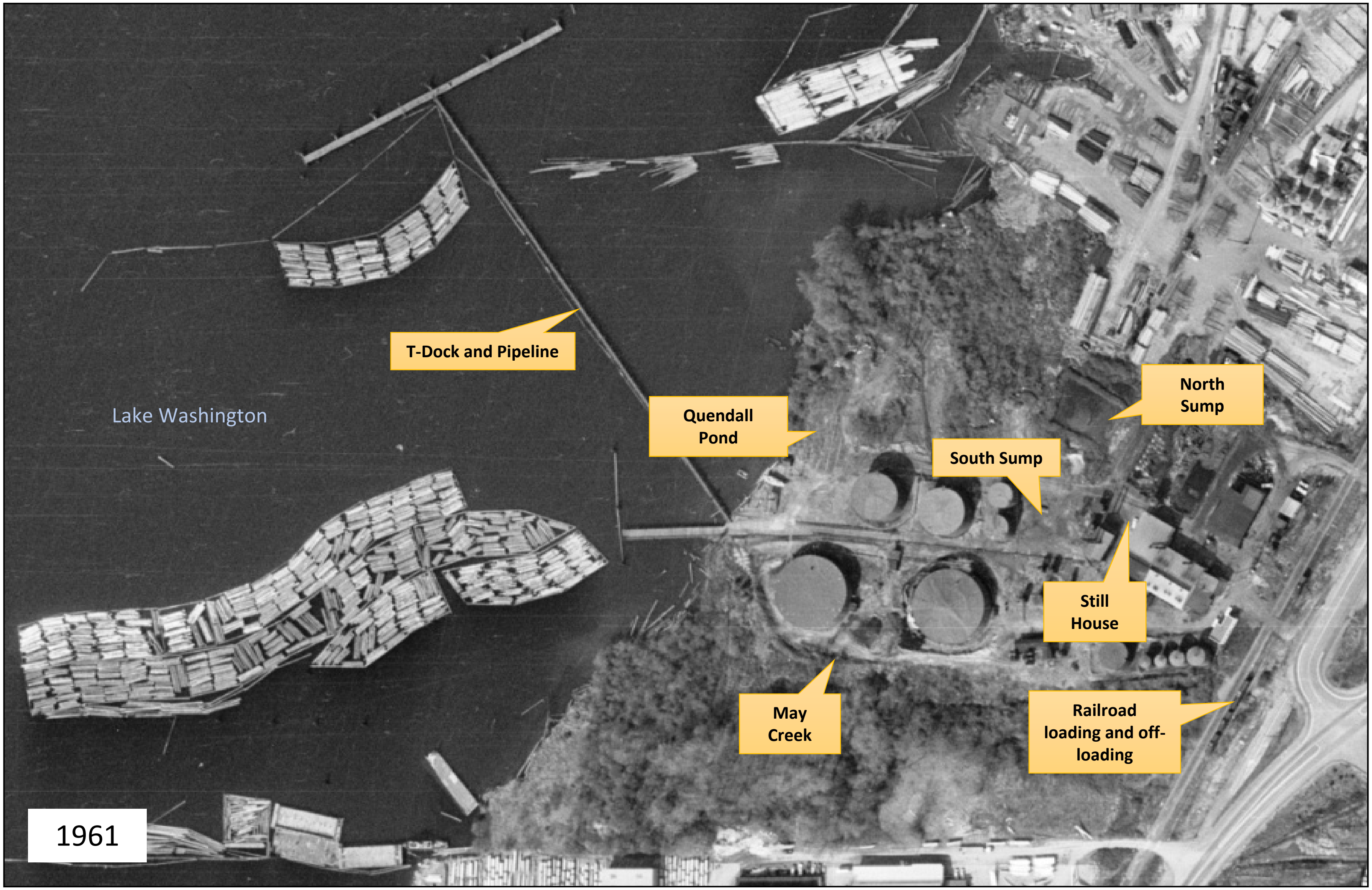


Figure 2-2
Summary of Historical Site Features
Proposed Plan for the Quendall Terminals Superfund Site Operable Unit 2
Renton, Washington

EPA

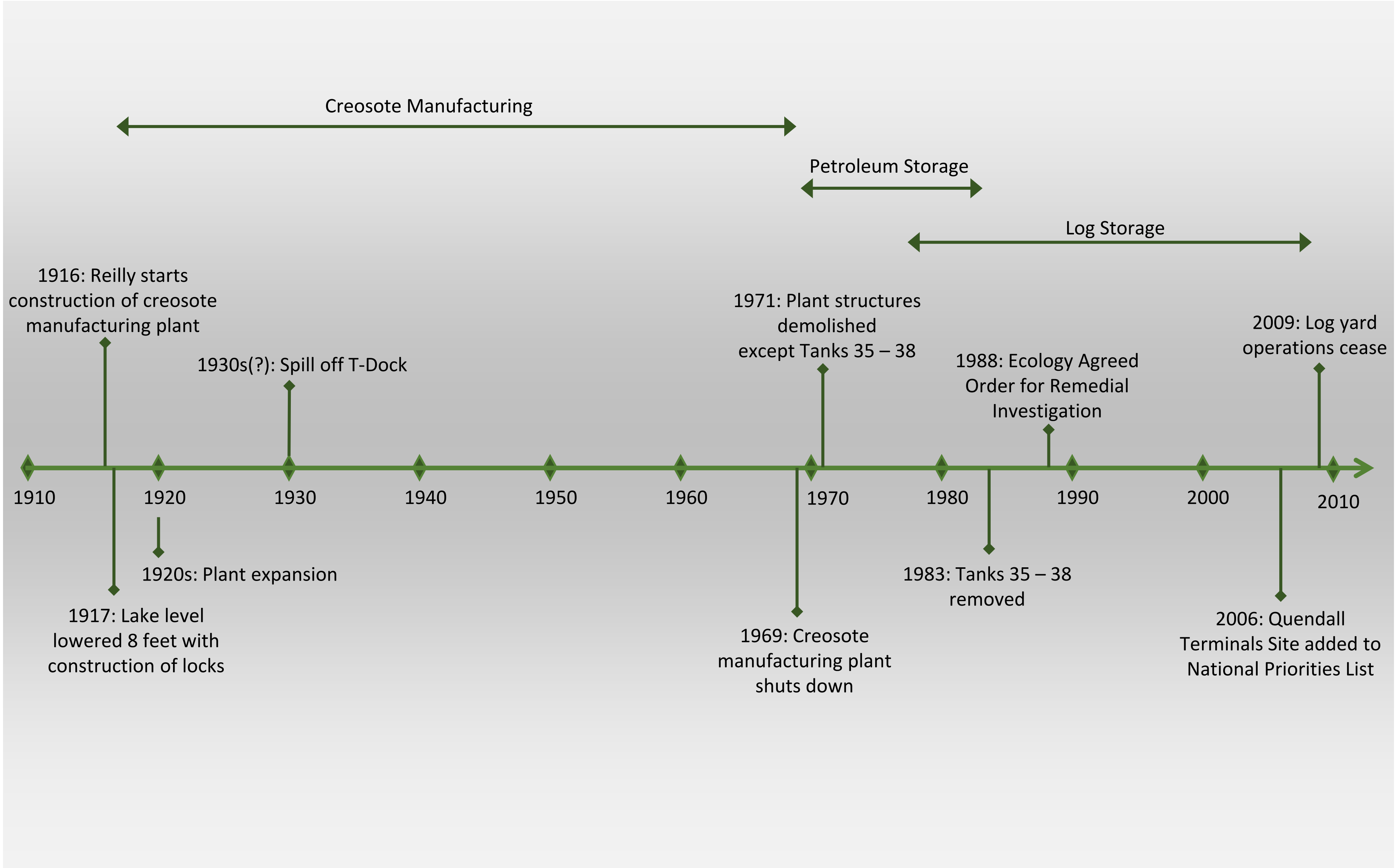


Figure 2-3
Timeline of Site Operations
Proposed Plan for the Quendall Terminals Superfund Site Operable Unit 2
Renton, Washington

VICINITY MAP

LEGEND

- Quendall Property Line
- Wetlands
- Habitat Area

Sources:
Wetlands digitized from *Quendall Terminals Baseline Habitat Technical Memorandum* (Grette Associates, 2016)

0 125 250 500 Feet

N

Figure 3-1
Habitat Area and Site Wetlands
Proposed Plan for the Quendall Terminals Superfund Site Operable Unit 2
Renton, Washington

EPA

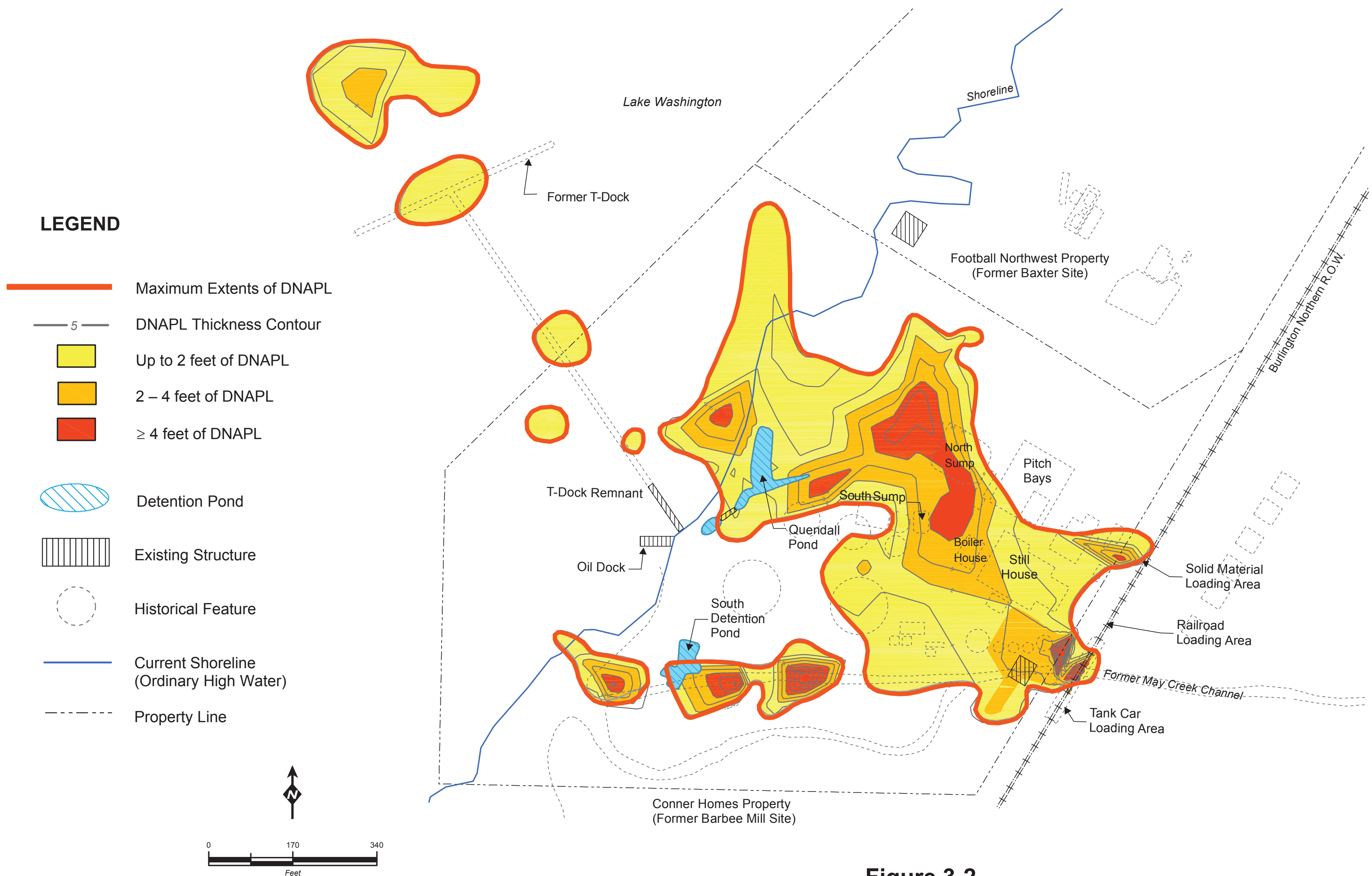
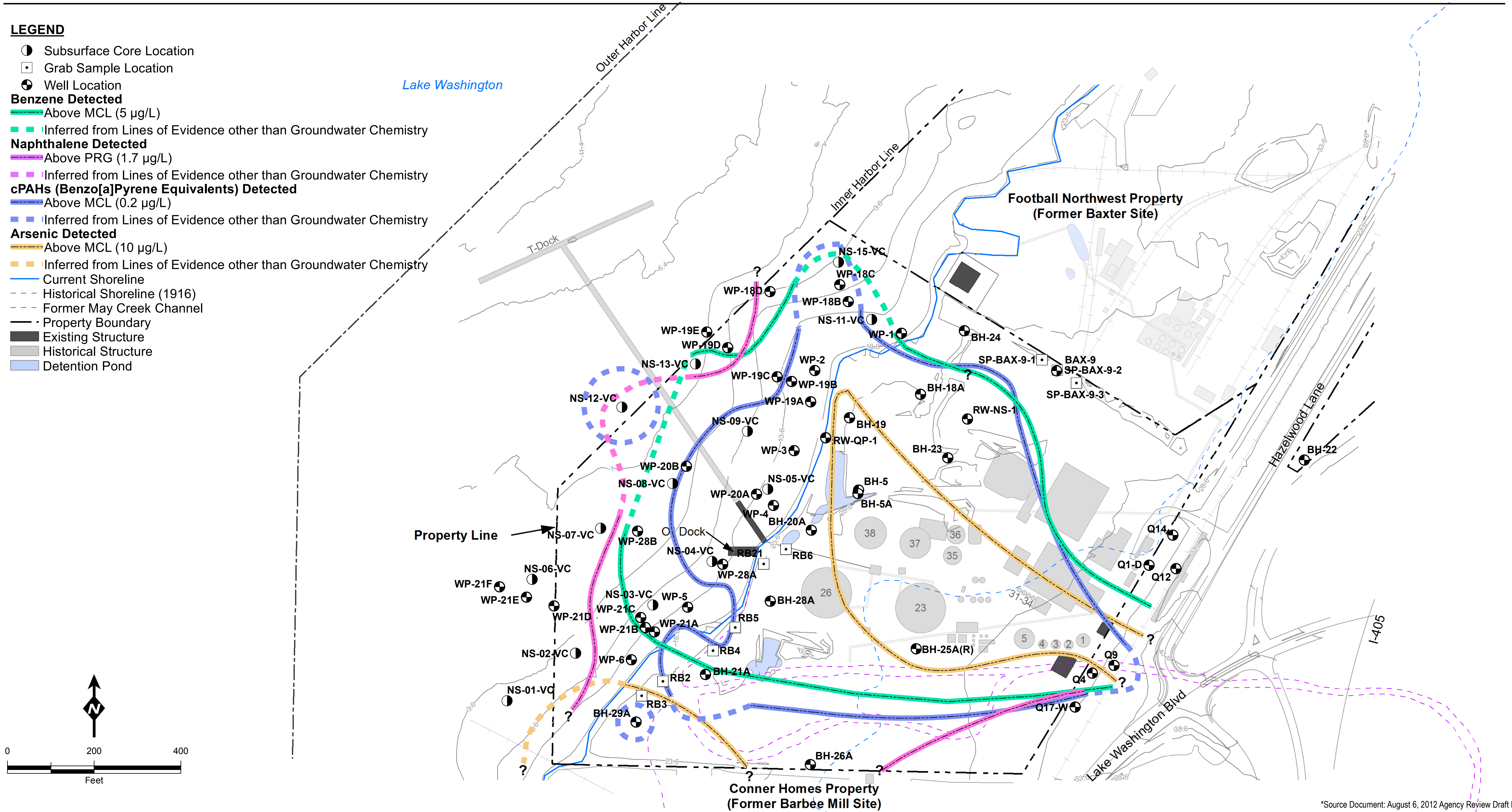


Figure 3-2
Approximate Extent and Thickness of DNAPL
Proposed Plan for the Quendall Terminals
Superfund Site Operable Unit 2
Renton, Washington

EPA



Notes:
1. Contour Intervals are 5 ft, NAVD 88.
2. See Figures 5.2-1, 5.2-8, 5.2-14, and 5.2-16 of the RI Report for basis of approximate extents (Anchor QEA and Aspect 2012). Naphthalene extent has been adjusted from the RI Report based on its lower PRG for the FS (lower PRG based on cancer risk of 10^{-5}). Estimated extents do not consider dispersion.

Figure 3-3
Approximate Extent of Groundwater Contamination in the Shallow Aquifer
Proposed Plan for the Quendall Terminals Superfund Site Operable Unit 2
Renton, Washington

EPA

LEGEND

Detected Organic Carbon Normalized cPAH (B[a]P Equivalent) Concentration in mg/kg-OC

- <6.2
- ≥6.2 - 17.5
- ≥17.5

Historical Organic Carbon Normalized cPAH (B[a]P Equivalent) Concentration in mg/kg-OC

- <6.2
- ≥6.2 - 17.5
- ≥17.5

- Approximate Extent of Detected cPAH Concentrations Exceeding the Background Threshold Value (BTV)
- Inferred from Historical Data
- Current Shoreline
- Historical Shoreline (1916)
- Former May Creek Channel
- Property Boundary
- Existing Structure
- Historical Structure
- Detention Pond
- Sand Placement Grid
- Dry Dock Concrete

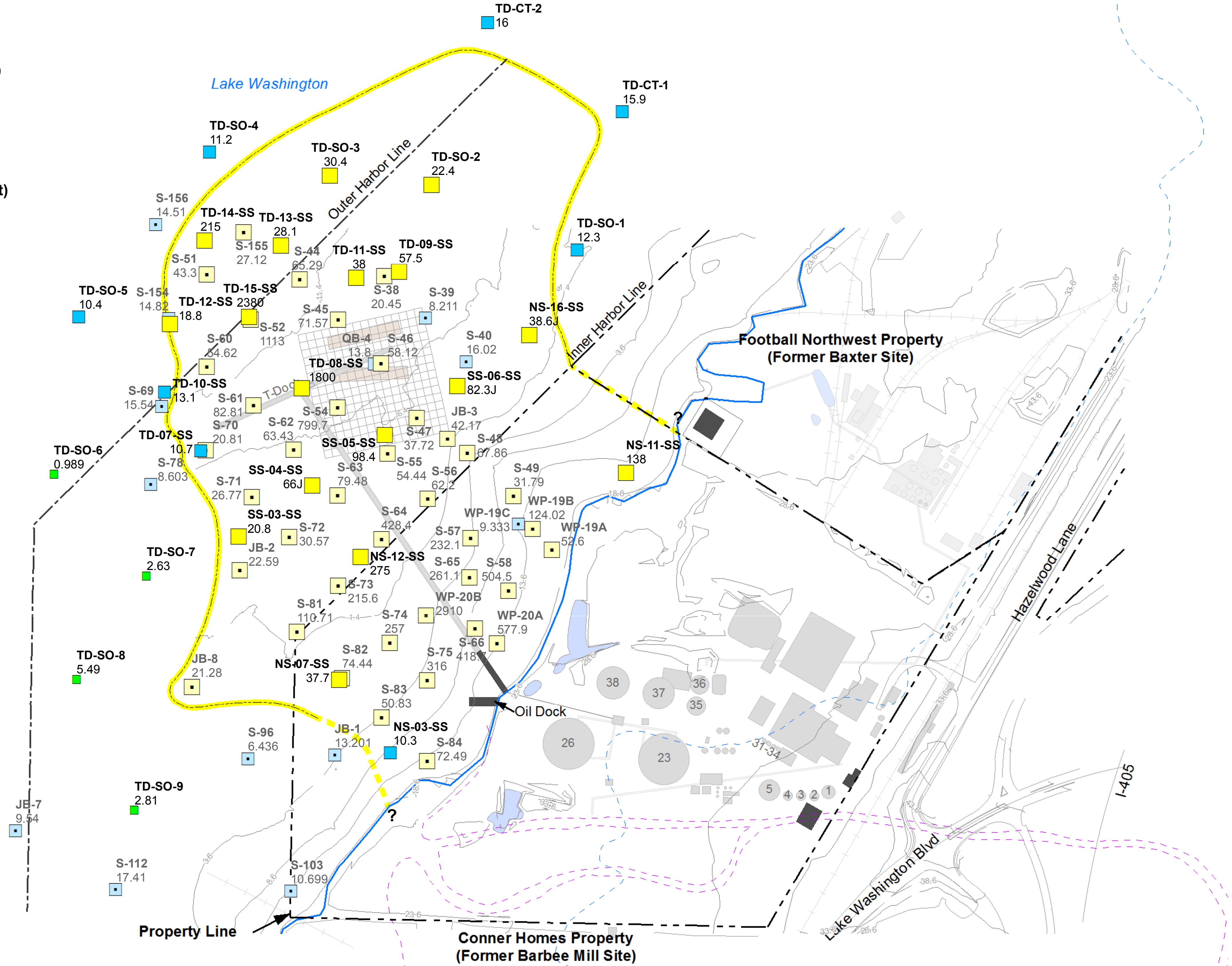
Basis of Screening Level Intervals

6.2 90% Upper Confidence Limit

17.5 Background Threshold Value (BTV)

Notes:

1. Contour intervals are 5 ft, NAVD 88.
2. U = Non-Detect
3. J = Estimated Value
4. The organic carbon normalized PRG screening level for cPAHs in surface bulk sediment of 6.2 milligrams per kilogram (mg/kg)-OC is the 90 percent upper confidence limit on the mean site-specific background samples collected during the 2009 RI field investigation and documented in the RI Report (Anchor QEA and Aspect 2012).
5. The historical stations shown on this figure were sampled by Retec (in 1996 and 1997) and Anchor (in 2002 and 2003).

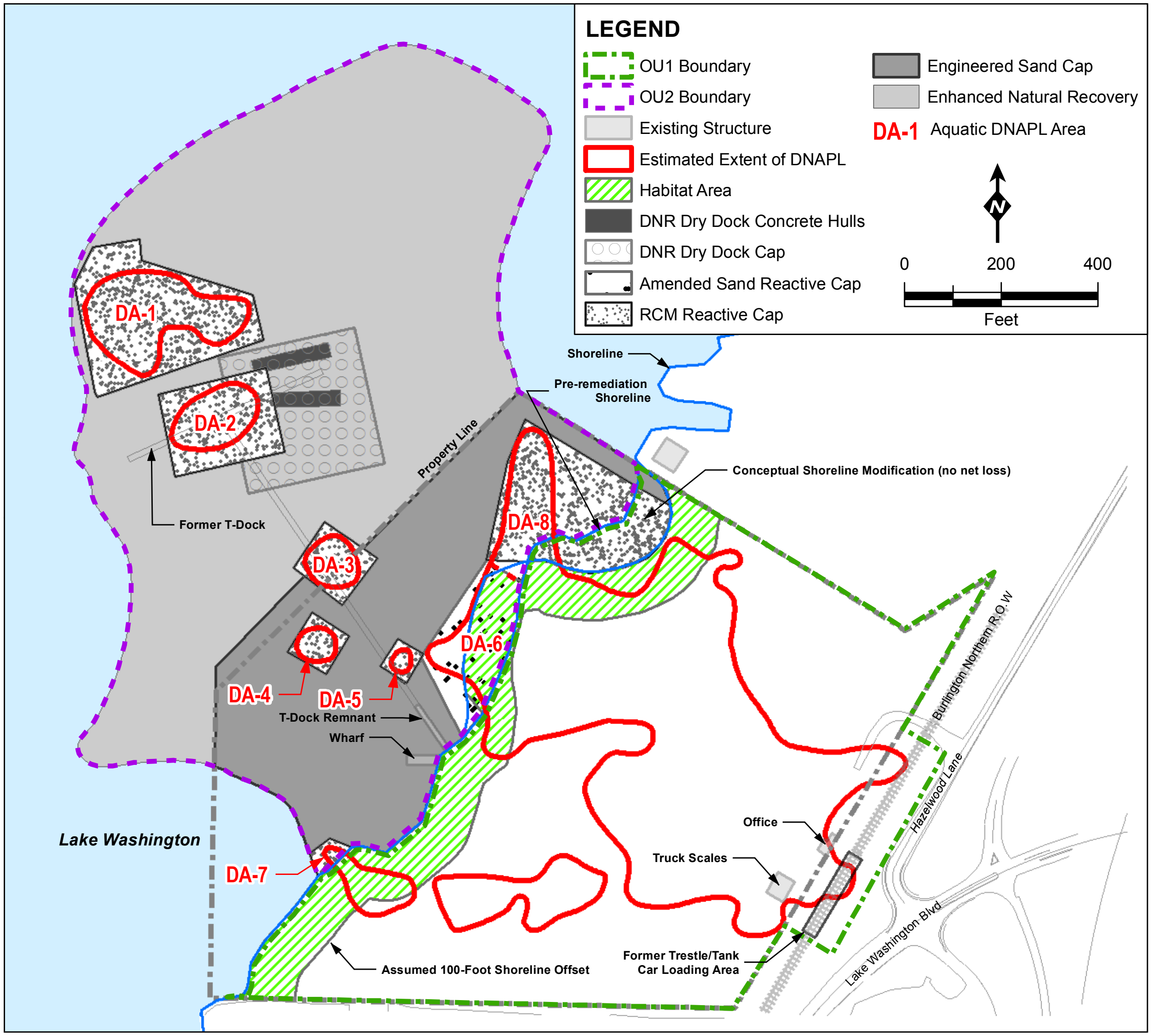


0 200 400

Feet

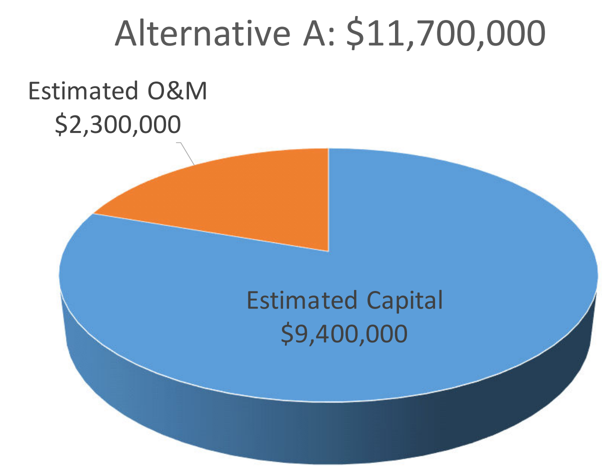
Figure 3-4
Surface Bulk Sediment Organic Carbon Normalized cPAH (Benzo[a]pyrene Equivalent) Concentrations
Proposed Plan for the Quendall Terminals Superfund Site Operable Unit 2
Renton, Washington

EPA



DNAPL Technology	% DNAPL Addressed by Technology (by vol.)
Capping	95%
Dredging	5%

Acronyms:
DA = dredge area
DNAPL = dense nonaqueous phase liquid
DNR = Washington State Department of Natural Resources
ENR = enhanced natural recovery
O&M = operations and maintenance
RCM = reactive core mat



Implementation Sequence

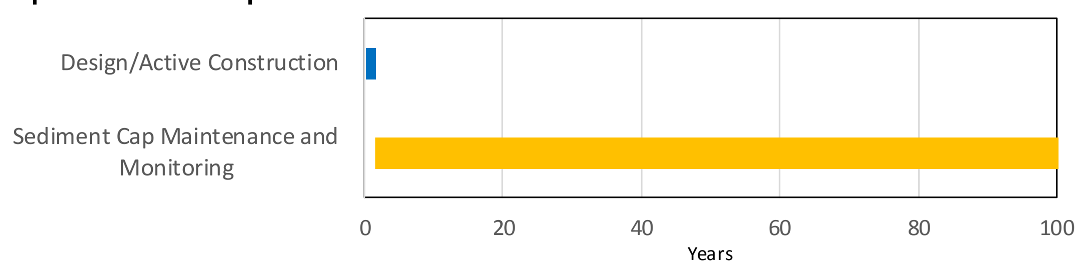
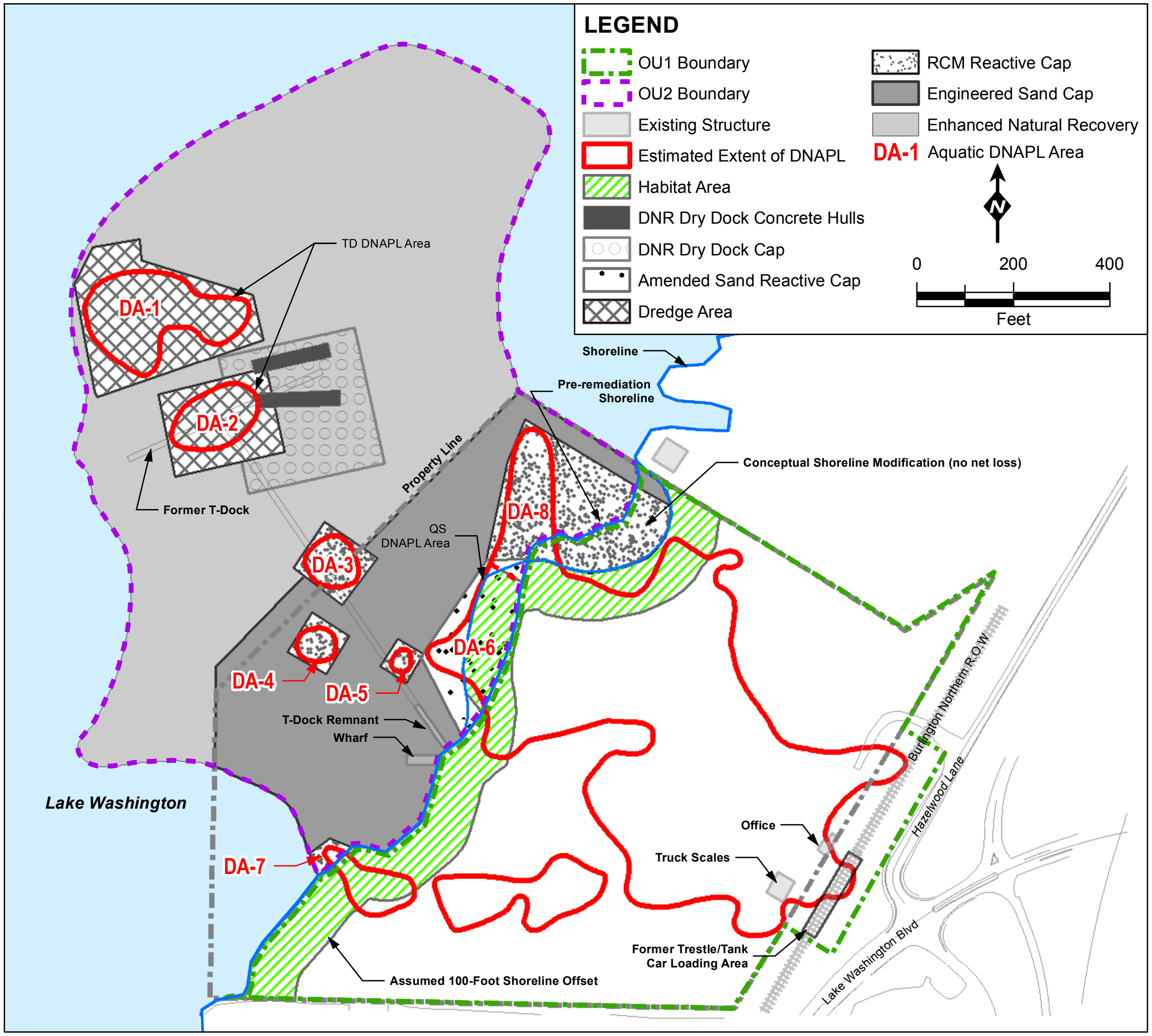


Figure 7-1
Alternative A – Amended Sand Cap, RCM Cap, Engineered Sand Cap, and ENR
Proposed Plan for the Quendall Terminals Superfund Site Operable Unit 2
Renton, Washington

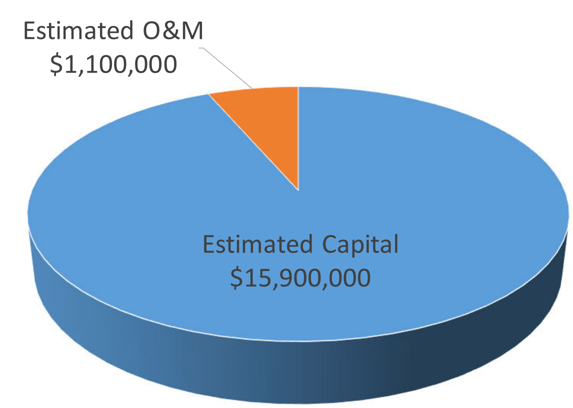
\\SEAFPP01\PROJ\USENVIRONMENTALPROTE\682283QUENDALL\DELIVERABLESBYTASK\TASK12_FS\2016-12_FINAL_FS\GISFILES\QUENDALL_FS_FIGURE_FILES\MAPFILES\2019\OU2_PP\FIGURE_7-1_ALTERNATIVEA_OU2.MXD GGEE 7/31/2019 3:28:19 PM

EPA



DNAPL Technology	% DNAPL Addressed by Technology (by vol.)
Capping	74%
Dredging	26%

Acronyms:
DA = dredge area
DNAPL = dense nonaqueous phase liquid
DNR = Washington State Department of Natural Resources
ENR = enhanced natural recovery
O&M = operations and maintenance
RCM = reactive core mat
TD = T-Dock
QP-S = Quendall Pond Sediment



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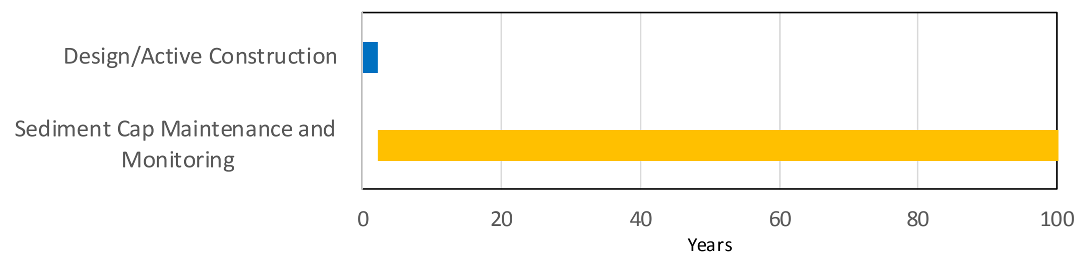
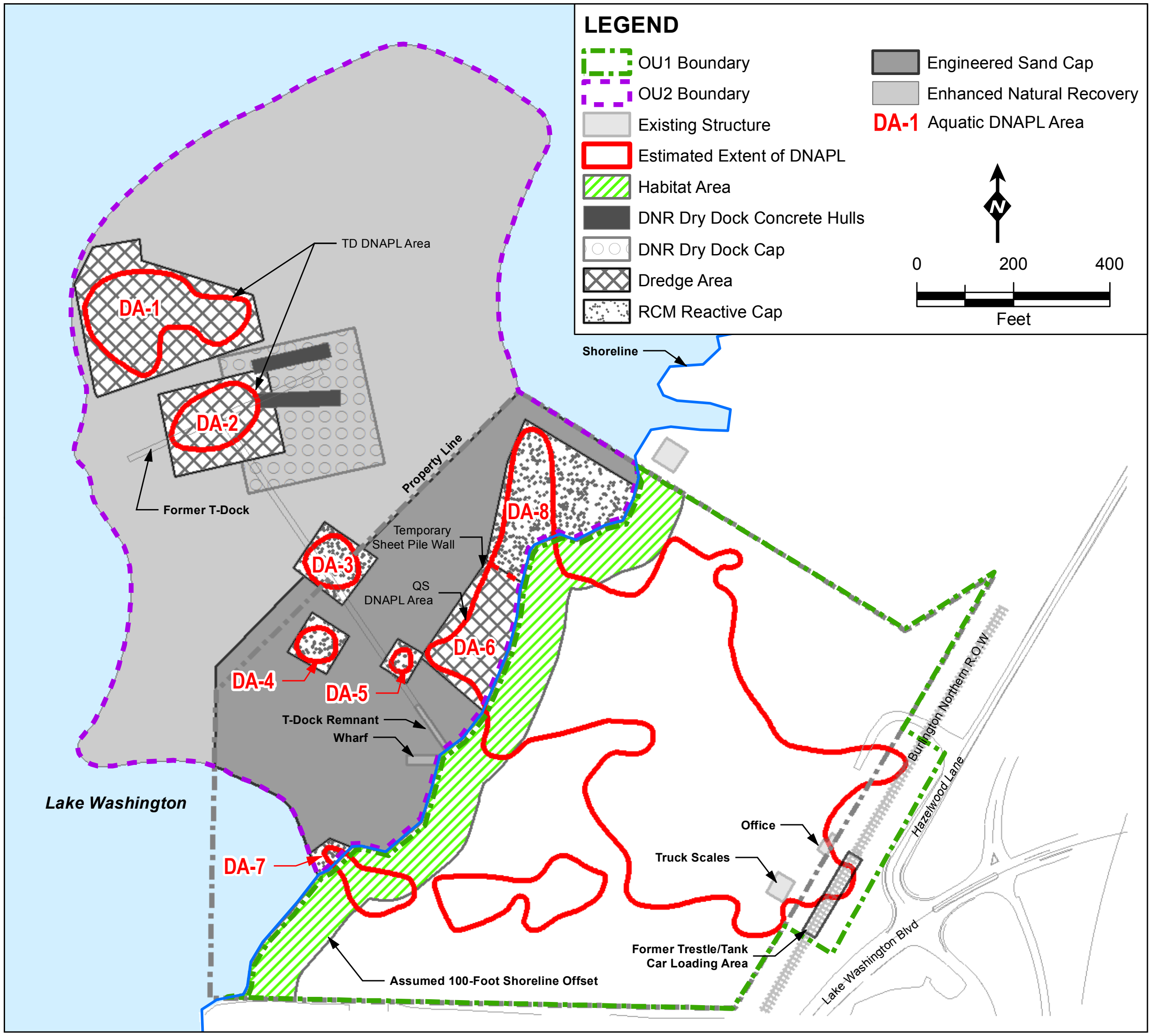


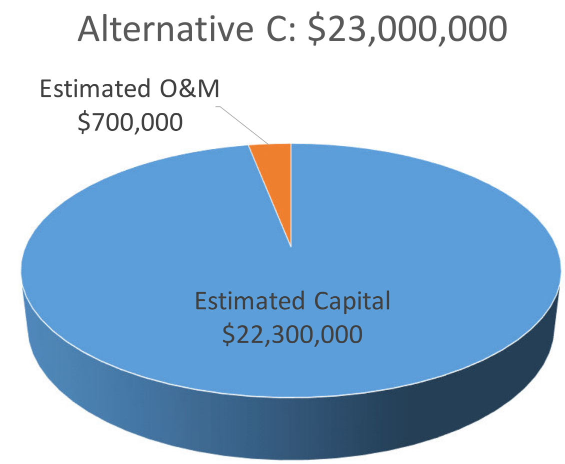
Figure 7-2
Alternative B – Targeted DNAPL Removal (TD DNAPL Area), Amended Sand Cap, RCM Cap, Engineered Sand Cap, and ENR
Proposed Plan for the Quendall Terminals Superfund Site Operable Unit 2
Renton, Washington

EPA



DNAPL Technology	% DNAPL Addressed by Technology (by vol.)
Capping	56%
Dredging	44%

Acronyms:
DA = dredge area
DNAPL = dense nonaqueous phase liquid
DNR = Washington State Department of Natural Resources
ENR = enhanced natural recovery
O&M = operations and maintenance
TD = T-Dock
QP-S = Quendall Pond Sediment



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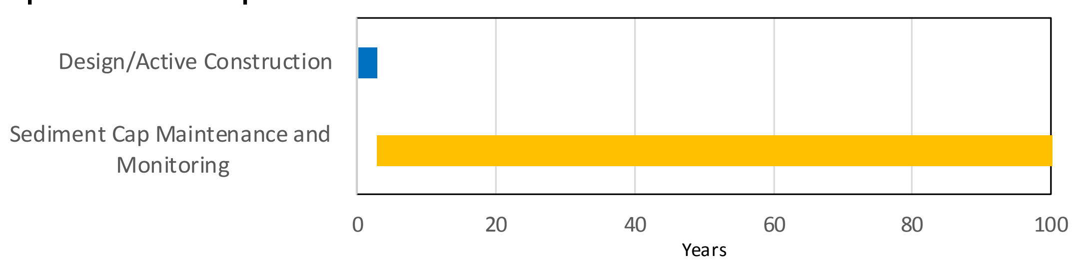
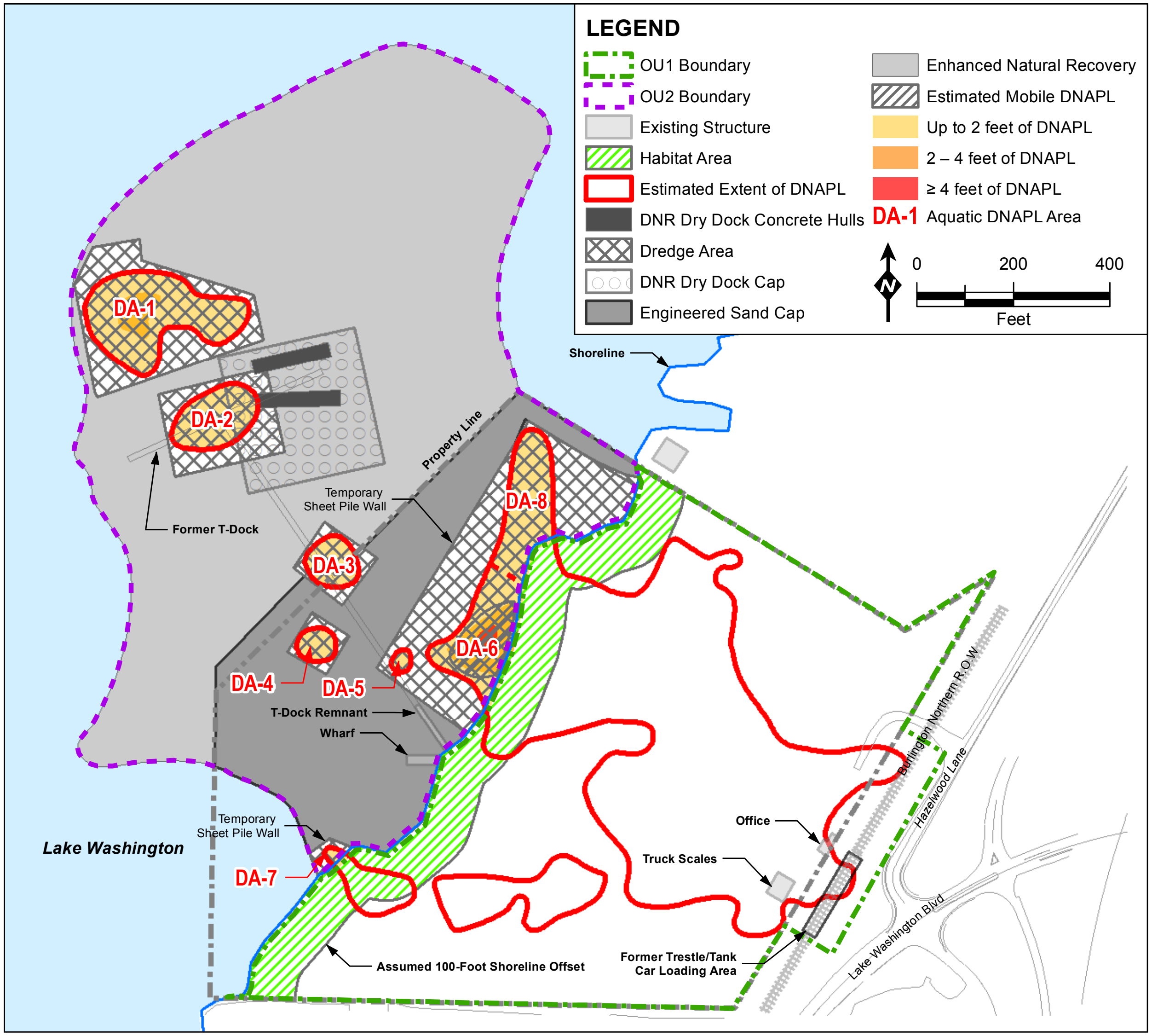


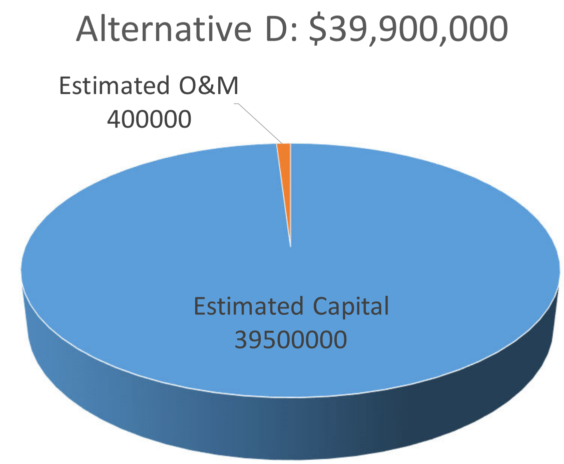
Figure 7-3
Alternative C – Targeted DNAPL Removal (TD and QP-S DNAPL Areas), RCM Cap, Engineered Sand Cap, and ENR
Proposed Plan for the Quendall Terminals Superfund Site Operable Unit 2
Renton, Washington

EPA



DNAPL Technology	% DNAPL Addressed by Technology (by vol.)
Capping	0%
Dredging	100%

Acronyms:
DA = dredge area
DNAPL = dense nonaqueous phase liquid
DNR = Washington State Department of Natural Resources
ENR = enhanced natural recovery
O&M = operations and maintenance



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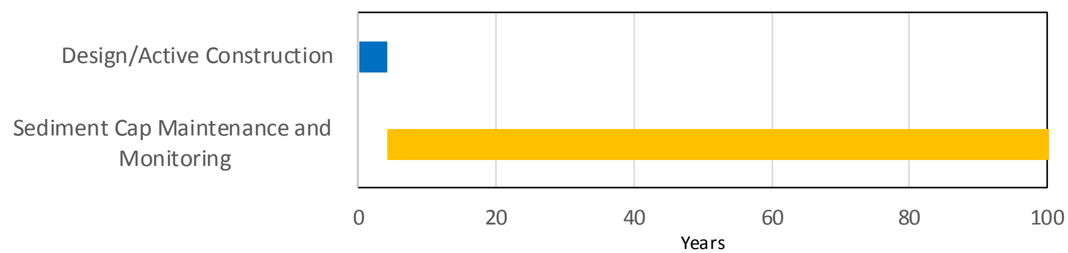
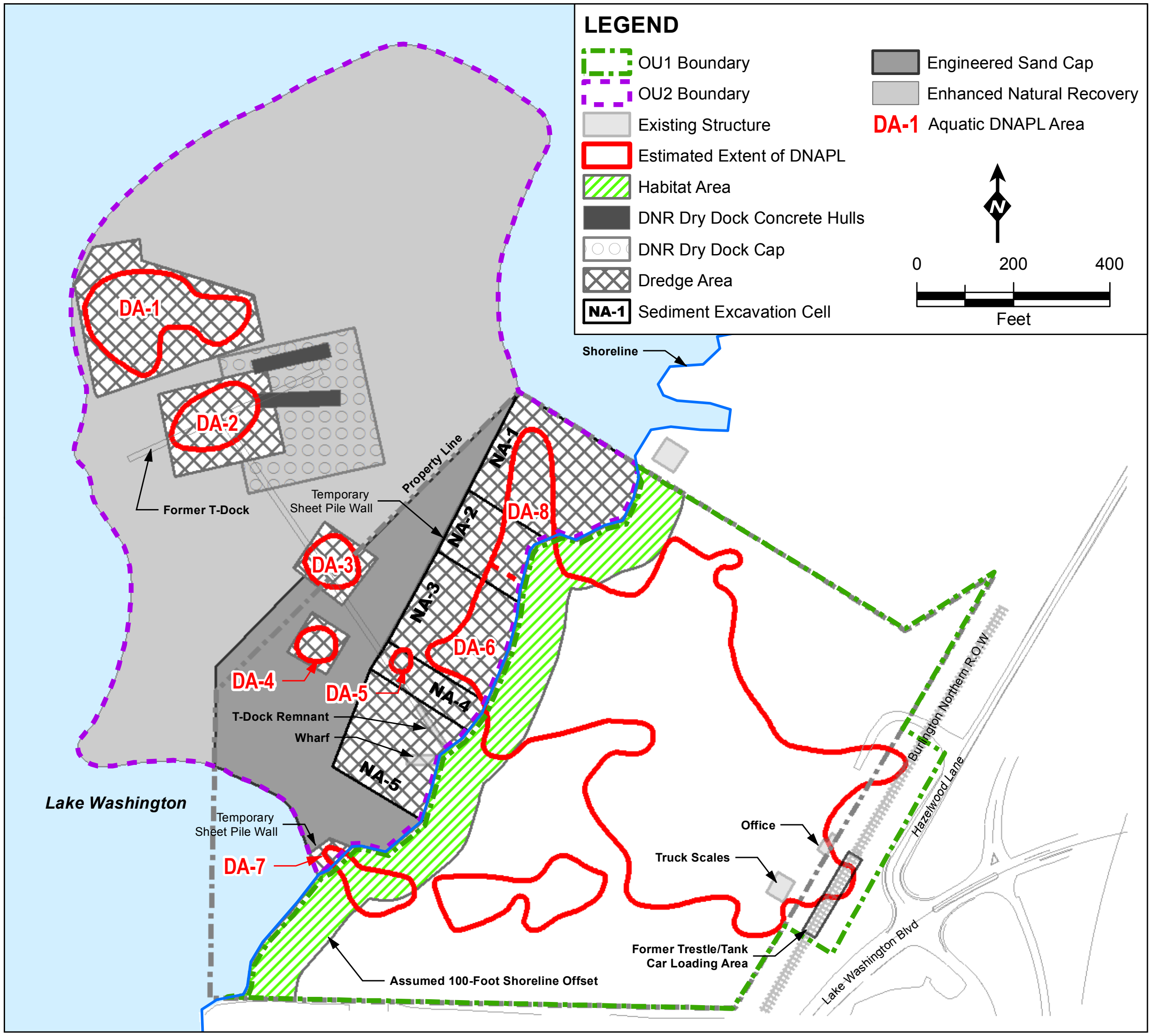
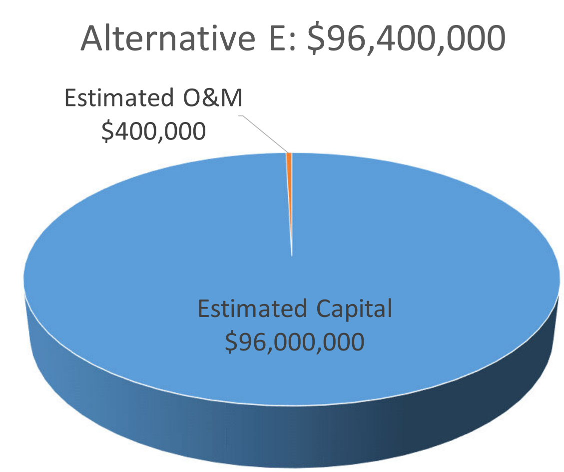


Figure 7-4
Alternative D – DNAPL Removal, Engineered Sand Cap, and ENR
Proposed Plan for the Quendall Terminals Superfund Site Operable Unit 2
Renton, Washington



DNAPL Technology	% DNAPL Addressed by Technology (by vol.)
Capping	0%
Dredging	100%

Acronyms:
DA = dredge area
DNAPL = dense nonaqueous phase liquid
DNR = Washington State Department of Natural Resources
ENR = enhanced natural recovery
O&M = operations and maintenance



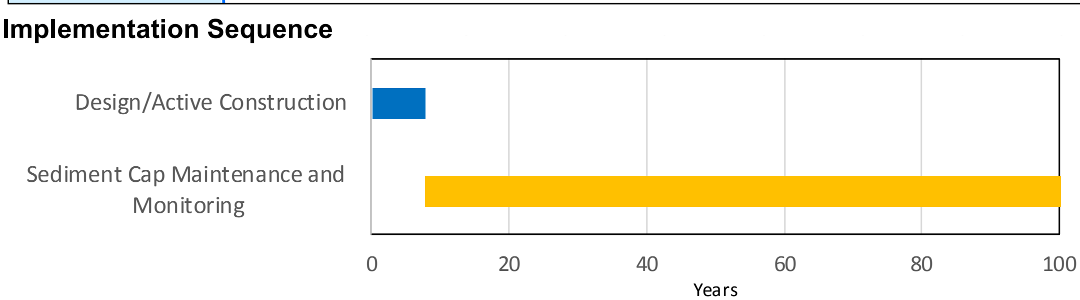
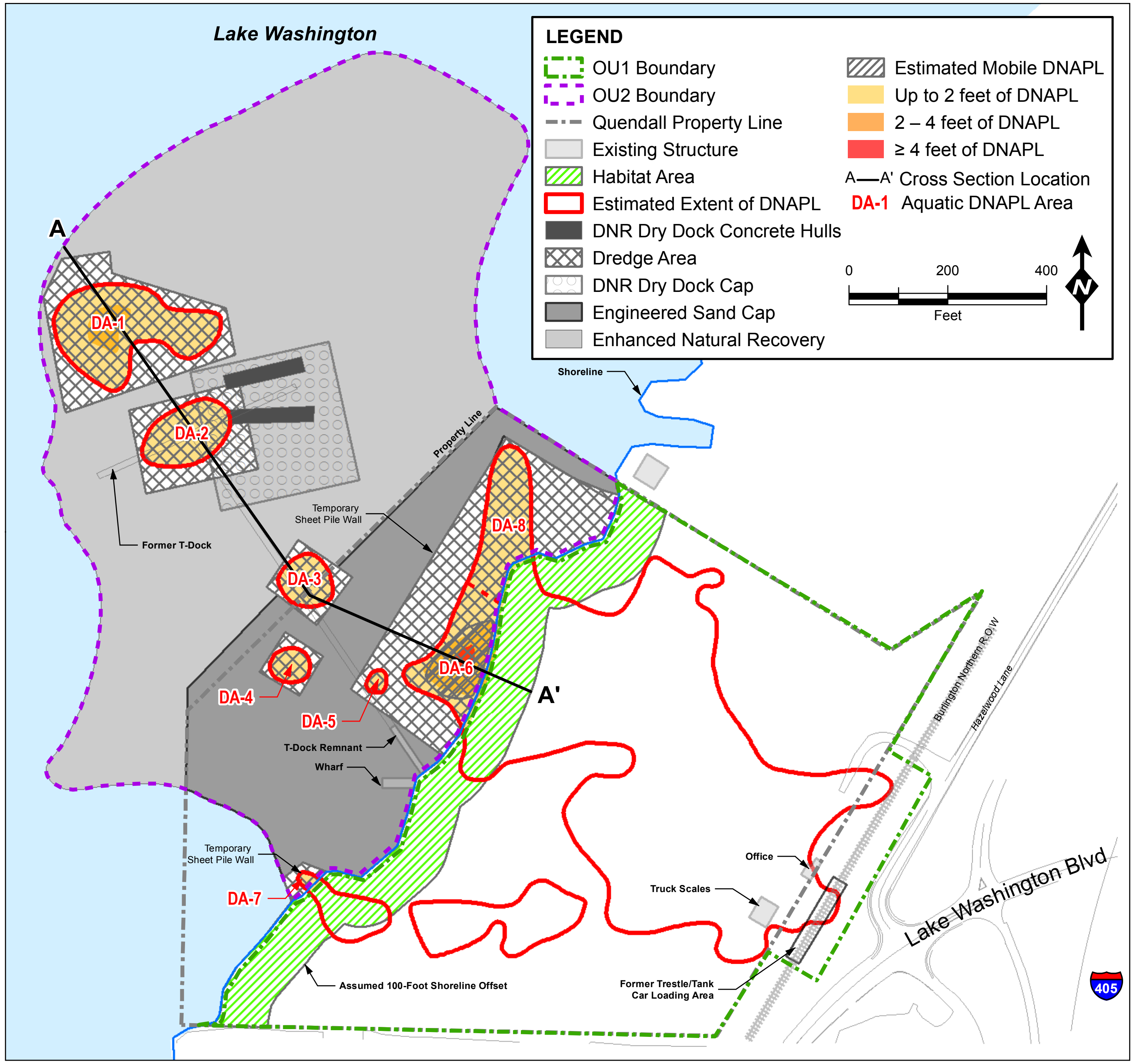
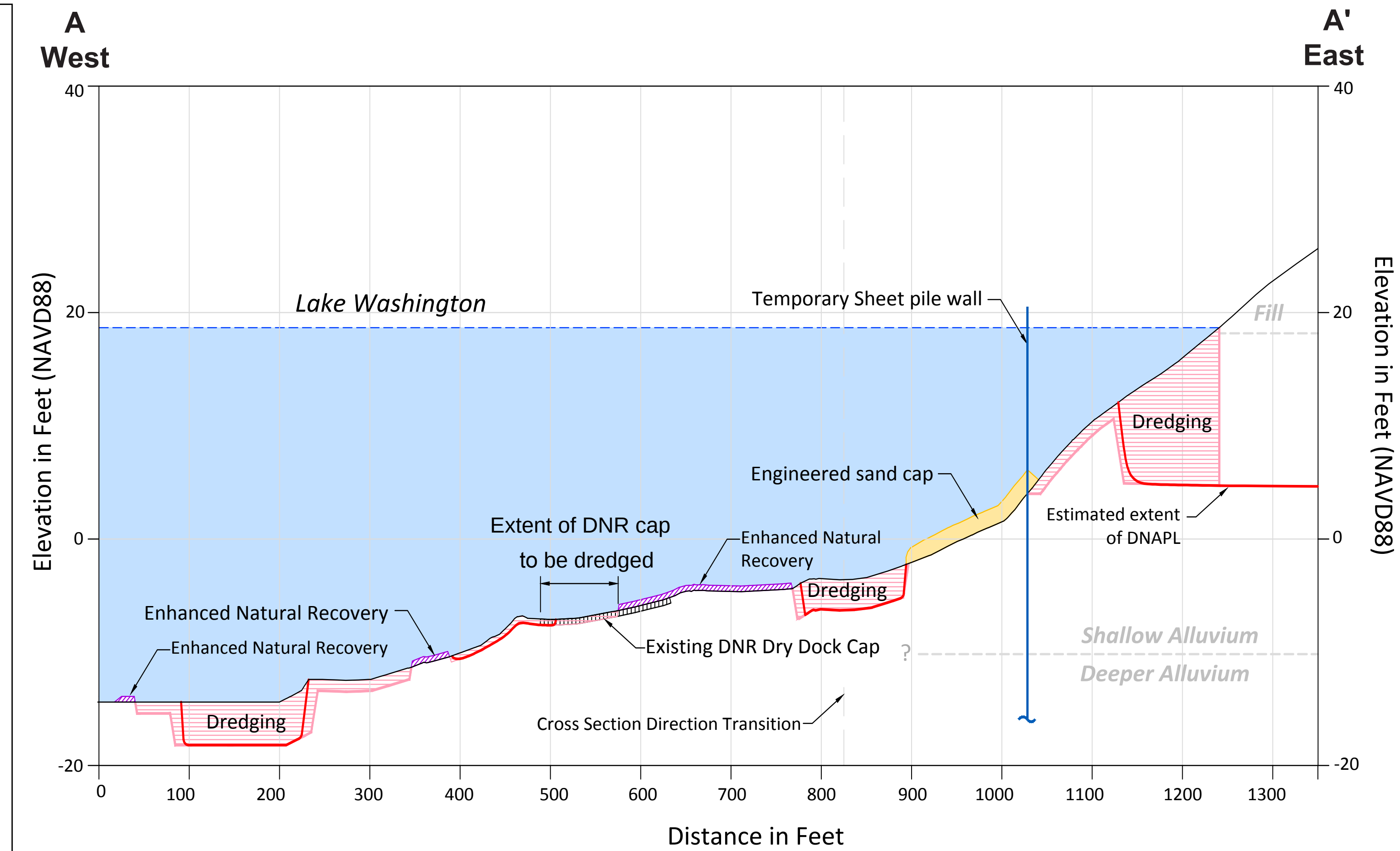
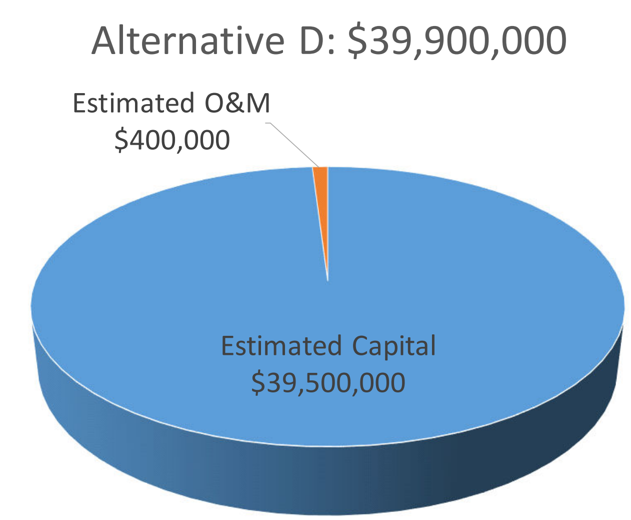


Figure 7-5
Alternative E – DNAPL and Contaminated Sediment Removal, Engineered Sand Cap, and ENR
Proposed Plan for the Quendall Terminals Superfund Site Operable Unit 2
Renton, Washington

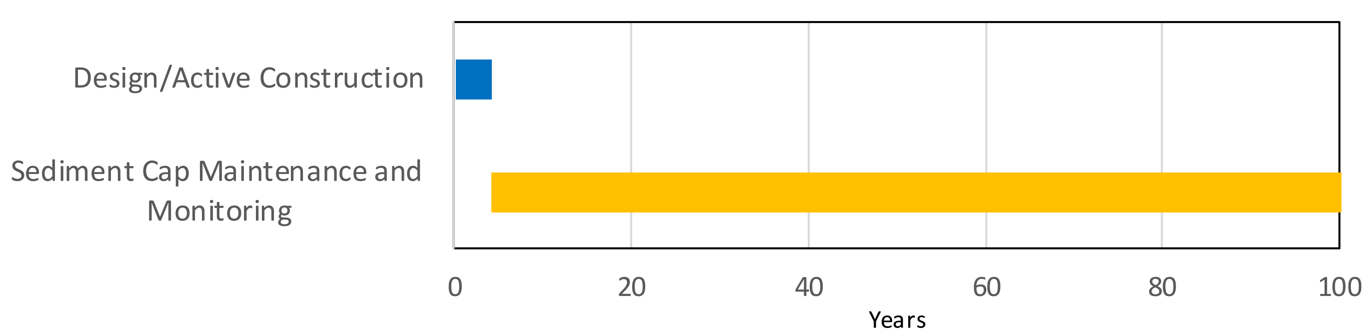






DNAPL Technology	% DNAPL Addressed by Technology (by vol.)
Capping	0%
Dredging	100%

Implementation Sequence



Acronyms:
DA = dredge area
DNAPL = dense nonaqueous phase liquid
DNR = Washington State Department of Natural Resources
ENR = enhanced natural recovery
O&M = operations and maintenance

Figure 9-1
Preferred Alternative D – DNAPL Removal, Engineered Sand Cap, and ENR
Proposed Plan for the Quendall Terminals Superfund Site Operable Unit 2
Renton, Washington