SUPERFUND PROPOSED PLAN

U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION 10

EPA Announces Proposed Plan

The United States Environmental Protection Agency (EPA) is issuing this Proposed Plan as part of its public participation requirements under Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, and Section 300.430(f)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The objective of this Proposed Plan is to present EPA's Preferred Alternative for an interim remedial action for the East Waterway Operable Unit (EW OU) of the Harbor Island Superfund Site (Site) in the City of Seattle, King County, Washington (Figure 1).

EPA's primary objective is to reduce contaminant concentrations in the sediment to levels that are protective of human health and the environment. EPA's long-term vision for the East Waterway is to obtain the lowest contaminant levels possible in sediments to reduce contaminant concentrations in fish tissue so the Washington State Department of Health could minimize reliance on fish consumption advisories. This long-term vision also includes achieving sediment polychlorinated biphenyls (PCBs) concentrations equivalent to the concentrations measured in the non-urban background for Puget Sound (i.e., 2 parts per billion PCBs). Achieving this will rely both on an effective cleanup of the EW OU and robust source control efforts throughout the Green/Duwamish River watershed using a range of federal, state, and local regulatory authorities.

EPA's Preferred Alternative is intended to address unacceptable risks to human health and the environment associated with contaminated sediments in the EW OU. As a result, EPA is proposing an interim remedial action for the EW OU that includes a combination of remedial technologies. Following implementation of the interim remedial action, EPA will evaluate the effectiveness of the

Public Comment Period
April 28 – June 27, 2023

EPA will accept comments on the Proposed Plan during the 60-day public comment period. Comments may be submitted in the following ways:

1. **By Mail:**
   Attn: East Waterway Proposed Plan
   US EPA Region 10, 1200 6th Ave., Suite 155
   Superfund Records Center, MS: 17-C04-1
   Seattle, WA 98101
2. **By email:** EastWaterwayComments@epa.gov
3. **By comment form** on EPA's Harbor Island website: www.epa.gov/superfund/harbor-island
4. **By voicemail**: You may leave oral comments in any language about the Proposed Plan by calling **206-553-6520**.
5. **Attending public meetings and providing oral and/or written comments:**
   - EPA will hold a ***virtual*** **public meeting** in English on **Thursday, May 25, 2023**
   - EPA will also hold an *in-person* public meeting with interpreters in Spanish, Vietnamese, and Khmer on **Saturday, June 3, 2023**

Learn more about the Proposed Plan! Please visit EPA's Harbor Island website (www.epa.gov/superfund/harbor-island) for the most up-to-date information, including:

- ✓ **Supporting materials**, including the full Proposed Plan, Administrative Record, and pre-recorded videos of the presentation on the Proposed Plan in English, Spanish, Khmer, and Vietnamese.
- ✓ **The public meetings** outlined above.
- ✓ **Information on availability sessions** during the comment period where anyone may ask questions.

To receive updates on the East Waterway Proposed Plan by e-mail, please contact Laura Knudsen (knudsen.laura@epa.gov).

cleanup, as well as the separate source control efforts led by Washington state, to inform a final remedy decision for the EW OU which will include establishing cleanup levels.

Historical industrial discharges from marine-related industrial activities, storm drains, and combined sewer overflows have resulted in the contamination of sediments and surface water in the EW OU. Hazardous substances, pollutants, or contaminants are present in sediments at concentrations that pose unacceptable risks to humans through consumption of fish and shellfish, and through direct exposure to sediment when clamming or netfishing. Sediment contamination also poses risks to bottom-dwelling organisms and fish.

This Proposed Plan provides background information on the EW OU and the Superfund cleanup process, describes the cleanup alternatives that were evaluated, and presents EPA's Preferred Alternative for an interim remedial action. The cleanup of the EW OU will address contaminated sediments. This Proposed Plan is primarily based on the Supplemental Remedial Investigation (SRI; Windward and Anchor QEA, 2014) and Feasibility Study (FS; Anchor QEA and Windward, 2019) reports prepared by the Port of Seattle (Port) with assistance from the City of Seattle (City) and King County (County). Together, the Port, City, and County make up the East Waterway Group (EWG). The SRI/FS, which was approved by EPA, is in the Administrative Record along with other pertinent information considered by EPA for selection of the interim remedial action. The SRI/FS provides details regarding all of the alternatives that were evaluated by EPA, including the Preferred Alternative.

Inside this Proposed Plan:

EPA, as the lead agency under the NCP, with support from the Washington State Department of Ecology (Ecology), the Washington State Department of Natural Resources (DNR), the Suquamish Tribe, and the Muckleshoot Indian Tribe, provided oversight of the SRI/FS performed by the EWG.

EPA is seeking comments on this Proposed Plan. Comments can be made on the Preferred Alternative, other alternatives considered, and on the supporting analyses and information which can be found in the Administrative Record. Information on how to provide comments to EPA is presented in the inset, on page 1.

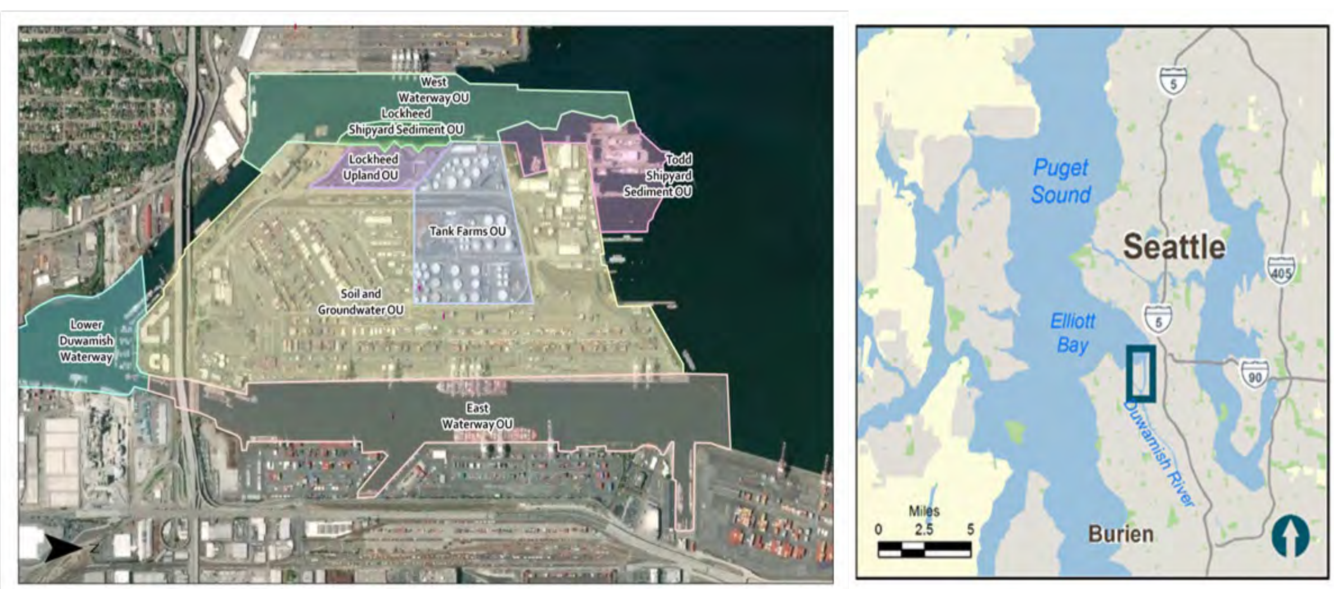


Figure 1. Location of the East Waterway Operable Unit

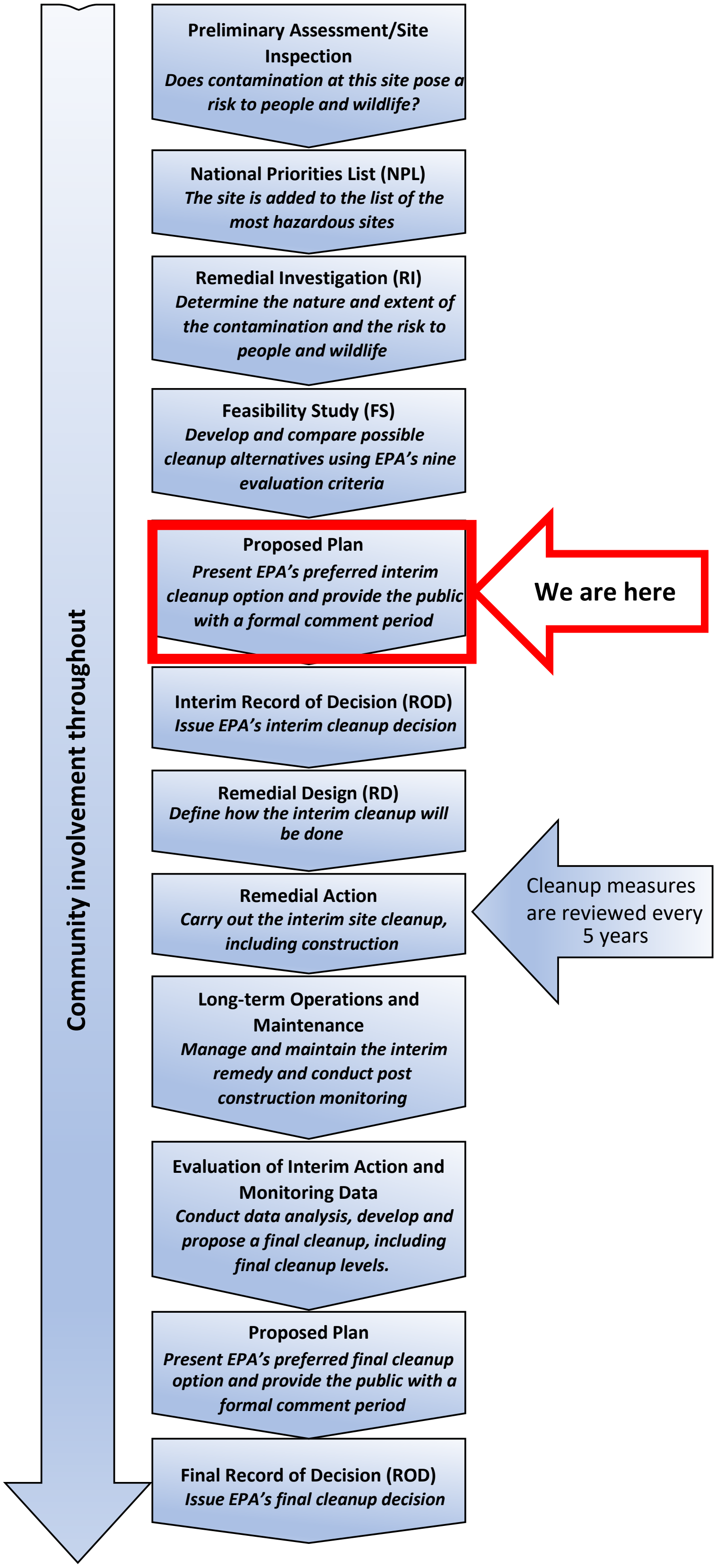


Figure 2. Steps in the Superfund Process

The Superfund Process

The Superfund process is established by CERCLA and the NCP to guide the investigation and cleanup of contaminated sites. The process includes various steps, illustrated in Figure 2, starting with the discovery of a site, and continuing through investigation, remedy selection, remedy implementation, post remedy evaluation, and site completion.

The NCP provides procedures, expectations, substantive requirements, and program management principles for the CERCLA remedial process. In addition, EPA has developed technical guidance and policy on a range of issues to ensure that decisions are based on well-established science and cleanup actions are protective of human health and the environment consistent with CERCLA and the NCP.

The first four steps of the process have been completed for the EW OU.

East Waterway Supplemental Remedial Investigation. The SRI report was completed in 2014. It describes the EW OU, presents a conceptual site model, characterizes the nature and extent of contamination, and provides findings on risks to human health and ecological receptors.

East Waterway Feasibility Study. The FS was completed in 2019. It proposed and screened potential remedial options and evaluated the alternatives using the NCP criteria (see page 38).

This Proposed Plan initiates the next phase of the Superfund process, including public participation in remedy selection. It presents information necessary to inform the public about the nature and extent of contamination, summarizes the potential human health and ecological risks associated with contamination in the EW OU, describes the remedial alternatives under consideration, identifies EPA's Preferred Alternative for cleanup, and requests comments from the public. The key elements of the Preferred Alternative are shown on the next page and on pages 44-46.

In this Proposed Plan, EPA is proposing an interim remedial action to implement a cleanup that will substantially reduce risks to human health and the environment, with sediment cleanup levels being developed at a later time.

The Preferred Alternative is an interim remedial action which does not identify cleanup levels for the contaminants of concern (COCs). Instead, the interim remedial action objective is to remove, cap or treat sediment where contaminant concentrations are greater than Remedial Action Levels. The cleanup levels will then be established in a final Record of Decision (ROD) to be issued by EPA at a future time.

EPA anticipates selecting cleanup levels for COCs based on data collected during and after construction of the interim remedy. This data will include information on the effect of upstream and lateral contamination sources on the EW OU, and the effectiveness of the interim action in reducing sediment contamination. Upstream and non-site-related lateral source control actions are being conducted separately by public and private entities. EPA will involve the public, State, Tribes, and EWG in developing cleanup levels for the EW OU.

The Preferred Alternative:

The Preferred Alternative addresses the entire 157 acres of the EW OU and includes the following elements:

- Approximately 121 acres of active cleanup of contaminated sediments, consisting of:
  - Dredging 99 acres in open water portions of the EW OU (approximately 960,000 cubic yards of sediment would be dredged and disposed in an off-site landfill).
  - Capping 7 acres (may include dredging to accommodate elevation needs).
  - In situ (on-site) treatment in 12 acres under docks and piers using activated carbon or other organic contaminant-sequestering agents.
  - Enhanced natural recovery in 3 acres under the West Seattle Bridge/Spokane Street Bridge corridor where there is limited access for barge-mounted dredges.
- Monitored natural recovery in 36 acres where there will be no dredging or capping.
- Institutional controls to prevent exposure and protect the integrity of the remedy.
- Short-term monitoring will be conducted during and after construction to measure the remedy's progress and effectiveness, and until cleanup levels are achieved. Long-term monitoring will be conducted periodically after cleanup levels are achieved. Cleanup levels will be selected in a future decision document.

Consistent with CERCLA, reviews to assess whether the remedy remains protective will be conducted every five years (Five-Year Reviews).

EPA is seeking comment on the Preferred Alternative presented in this Proposed Plan. After considering public comments, EPA anticipates issuing its decision on the selected remedial alternative in an interim ROD which will provide the rationale for its decision. An interim ROD will also include EPA's responses to comments received during the public comment period.

EPA may modify the Preferred Alternative or select another cleanup alternative for the EW OU after consideration of comments received on this Proposed Plan. Therefore, the public is encouraged to review and comment on any or all alternatives presented in this Proposed Plan.

Site Background

The EW OU forms a portion of the Duwamish River estuary and is located at the river mouth where it joins with Elliott Bay. It was created by filling, dredging, and channeling the area during the construction of Harbor Island.

Over the past 100 years, the EW OU has been substantially modified to support urban and industrial development. Historical activities have included marine terminals, shipyards, bulk fuel terminals, recycling and scrap metal yards, cement manufacturing, small boat marinas, and boat manufacturing and repair. The EW OU remains an active industrial waterway and is used primarily as a container ship terminal. Land use, zoning, and land ownership are consistent with active industrial uses.

The intertidal areas of the EW OU are dominated by hardened shorelines with extensive overwater structures. Localized and upstream sources from both upland and aquatic activities have polluted surface water and sediments. Data from the EW OU investigations demonstrate that surface and subsurface sediment, fish and shellfish, and surface water in the EW OU contain contaminants at concentrations that pose an unacceptable risk to human health and the environment.

Contaminants frequently detected in surface sediments include polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), dioxins/furans, metals, and other organic compounds. See the inset, on page 6, for a description of the COCs. The EW OU is one of ten OUs of the Harbor Island Superfund Site; however, only seven OUs are in the CERCLA process. EPA manages cleanup on each of the seven OUs through separate actions. The EW OU is the last of the seven OUs to have a cleanup decision, and is located immediately downstream of the Lower Duwamish Waterway (LDW) Superfund Site.

Since initial discovery of contamination at the EW OU, several remedial investigations have been completed. Most recently, the EWG, under EPA oversight, completed the SRI and FS. A timeline of activities for the Harbor Island Superfund Site and those activities specific to the EW OU is presented in Table 1. In 1998, the Port, under EPA's oversight, obtained samples from the EW OU as part of sediment characterization for a navigational improvement dredging project along Terminals 18, 30, and 25. Additional sampling and analysis were conducted by the EWG as part of the SRI.

In 2004 and 2005, the Port conducted a non-time-critical removal action under EPA's oversight, removing 273,330 cubic yards (cy) of contaminated sediment from the deep main body of the EW OU and an area bounded on the west by Terminal 18 and on the east by Terminals 25 and 30. A 9-inch-thick layer of clean sand was placed over the dredged surface to provide protection for bottom-dwelling organisms. While there has been some recontamination in these areas, contaminant concentrations in the areas remain lower than prior to the removal action.

Table 1. East Waterway Operable Unit History

Action at East Waterway Operable Unit	Date
Harbor Island Superfund Site listed on the National Priorities List.	1983
Initial remedial investigation of marine sediments around Harbor Island.	1994
Remedial investigation to further characterize the sediment contamination at the Harbor Island Superfund Site.	1995-1996
East Waterway OU designated	1996
Dredge characterization study for EW OU Terminals 18, 25, and 30 completed.	1998
Sediment sampling shows sediment contamination remaining in EW OU after maintenance dredging.	2000 - 2002
Phase 1 removal of 273,330 cubic yards of contaminated sediments from the EW OU.	2004 - 2005
Settlement Agreement reached for the Final EW OU SRI/FS.	2006
Sediment and tissue sampling for EW OU SRI/FS completed.	2009
EW OU SRI completed.	2014
EW OU FS completed.	2019

WHAT ARE THE CONTAMINANTS OF CONCERN?

EPA has identified many hazardous substances, pollutants, and contaminants in the sediment, fish tissue, and water in the EW OU. Of the hazardous substances, pollutants, and contaminants detected in the EW OU, the following pose the greatest risks to human health and the environment.

Polychlorinated biphenyls (PCBs) are man-made chemicals banned from further production in the U.S. in 1979. However, they persist in the environment and can accumulate in fish and shellfish. PCBs are known to affect the immune system and may cause cancer in people. PCBs can also affect learning abilities in children.

Arsenic is a naturally occurring element that is widely distributed in the Earth's crust. It is found in water, air, food, and soil. Arsenic compounds have been widely used as wood preservatives and as pesticides. These uses and other industrial activities can result in much higher concentrations of arsenic in sediment than would be present naturally. Exposure to arsenic can increase the risk of skin, bladder, and other cancers.

Mercury is a naturally occurring metal that can accumulate in the tissues of fish, wildlife, and humans from their diet. Methylmercury can affect people's nervous and reproductive systems, and is particularly harmful during early child development.

Polycyclic aromatic hydrocarbons (PAHs) are formed during the burning of substances such as coal, oil, gas, wood, and garbage. There are more than 100 different PAHs, and they generally occur as complex mixtures. Exposure to certain PAHs (referred to as carcinogenic PAHs, or cPAHs) may increase a person's life-time risk of certain types of cancer. PAHs are toxic to invertebrates and may cause inhibited reproduction, delayed emergence, sediment avoidance and mortality. In fish, PAHs may cause liver abnormalities and impairment of the immune system.

Dioxins and furans are by-products of burning (either in natural or industrial settings), chemical manufacturing, and metal processing. Dioxins are persistent in the environment can accumulate in fish and humans. Specific toxic effects related to dioxins include reproductive effects, effects on fetal/early childhood development, immune system function, and an increased risk of certain types of cancer.

Tributyltin (TBT) was used in paints to prevent and slow the growth of algae and other organisms that attach to the hulls of boats. It is toxic to aquatic life and is a hormone-disrupting chemical that interferes with reproduction in marine organisms, such as snails.

Additional COCs include metals and organic chemicals that are in sediments at concentrations that are considered to have the potential to adversely affect marine organisms that live in the sediments of the EW.

Tribal and Community Involvement

The East Waterway is within the usual and accustomed fishing areas for the Muckleshoot Indian Tribe, the Suquamish Tribe, and the Yakama Nation. Treaty rights retained by these Tribes include the custom and practice to hunt, fish, and gather within their usual and accustomed grounds and stations, which are the basis of the Tribe's source of food and culture. Treaty-reserved resources situated on and off reservation include, but are not limited to, fishery resources situated within each Tribe's usual and accustomed fishing area. These Tribes, as sovereign nations, have directly engaged with EPA on the EW OU investigation and cleanup process. The Tribes have also actively participated in meetings evaluating the course of the cleanup. Coordination with the Tribes will continue throughout the planning, construction, and monitoring of the remedial action.

Recreational users also frequent portions of the EW OU. Recreational uses, such as swimming and kayaking, are possible but are limited due to restricted public access and commercial shipping activity. Recreational fishing is known to occur in the EW OU despite a prominent education campaign informing the public about the Washington State Department of Health (WSDOH) fish consumption advisory warning individuals not to consume contaminated resident fish and shellfish (Figure 3).

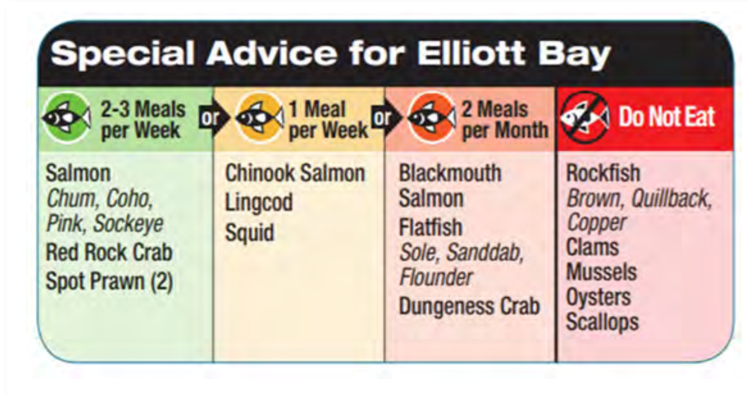


Figure 3. Fish Consumption Advisory for Elliott Bay

EPA, along with Ecology and the EWG have conducted public involvement activities throughout the EW OU investigations. Fact sheets, emails, informational signs, public meetings, and a website that provides the history and current cleanup activities at the Harbor Island Superfund Site have been used to communicate with the community, local businesses, and other stakeholders. The Community Involvement Plan for the EW OU was last updated in 2016, and another updated version was released for public comment in January of 2023.

EPA will accept written comments on this Proposed Plan beginning April 28, 2023 and ending on June 27, 2023. EPA will make its decision on the cleanup only after considering public comments. EPA will respond to comments received during the public comment period in a Responsiveness Summary in the anticipated interim ROD.

Site Characteristics

The EW OU encompasses the entire East Waterway and includes both subtidal and intertidal portions of the waterway.

Physical Characteristics

The EW OU extends 8,250 feet (about 1.5 miles) from Elliott Bay to the southernmost point of Harbor Island, encompassing 157 acres. There is a federally authorized navigation channel extending from the northern tip of Harbor Island to the Spokane Street Bridge. The northern portion of the EW OU is dredged to depths currently needed for deep-draft container ship navigation, while the southern portion of the EW OU near the bridges is maintained to accommodate smaller vessels. Four bridges cross over the EW OU along the Spokane Street corridor, including the West Seattle Bridge and the lower Spokane Street Bridge. The shorelines are dominated by riprap and bulkhead structures, with nearly 60 percent of the shoreline covered by structures such as piers and docks. Outfalls discharge into the EW OU, including storm drains and combined sewer overflows (CSOs).

Current measurements (Figures 4 and 5) within the navigation channel shows depths of -51 feet mean lower low water (MLLW), with the exception of the Nearshore Mound Area near Slip 27. The MLLW is the average height of the lowest daily recorded tide over a 19-year recording period. The navigation channel is currently authorized to be 51 feet deep (-51 feet MLLW) in the northern portion (the Deep Main Body Reach in Figures 4 and 5) and -34 feet MLLW in the southern portion (the Shallow Main Body Reach in Figure 4). At the southern end of the EW OU, bottom depths rise to between -13 and -6 feet MLLW in the Sill Reach and then drop to -25 feet MLLW through the Junction Reach. Under the piers and docks, elevations are between -37 and -50 feet MLLW. Sediments comprising the Sill Reach have not been dredged following the initial construction of East Waterway.

The EW OU is primarily salt water (marine) but receives freshwater flows from the Green/Duwamish River watershed. Salinity is controlled by tidal exchange from Elliott Bay, with a wedge of saltwater flowing southward underneath a layer of fresh water flowing northward from the Green/Duwamish River. The bottom substrates of the EW OU are typically mud, sand, gravel, cobble, or riprap.

Shallow groundwater (approximately 8 to 14 feet below ground surface) in the adjacent Nearshore Areas primarily flows toward the EW OU. The installation of sheet pile walls along much of the EW OU bulkheads has reduced, but not eliminated the mixing of surface water and groundwater. The aquifer extends deeper than the walls, so the overall groundwater flow continues to be towards the EW OU. Contribution from groundwater and seeps to the EW OU is minimal.

The EW OU has been divided into specific construction management areas for the purpose of the CERCLA cleanup process, representing portions of the waterway with similar structural conditions, aquatic use, habitat, or water depth. These areas were then grouped into six areas based on similarity of physical features and potential remedial technologies (Figure 6). The FS evaluated remedial technologies for each of the six areas, identifying the technologies that are most suited for the conditions of the specific area. The open water portion of the EW OU is divided into four areas: Deep Main Body and Berth Areas, Shallow Main Body, Nearshore Areas, and the West Seattle Bridge portion of the Sill Reach. The limited access portions of the waterway are divided into two areas: the Under-Pier Areas and the Low Bridges Portion of the Sill Reach. These six areas are identified on Figure 6 and are defined as follows:

- The Deep Main Body and Berth Areas consist of the northern-end Deep Main Body Reach, the eastern- and western-edge berth areas, and the Junction Reach. These areas include the deeper portions of the EW OU that are maintained to accommodate deep-draft vessels and are therefore subject to periodic erosion due to those vessels. These areas also include shallower portions of the EW OU that are used as berth areas. Remedial actions in these areas must maintain the depths required for marine traffic. The Communication Cable Crossing that traverses the EW OU is a portion of the Deep Main Body Reach where any deepening or remedial action is limited to protect buried cables.
- The Shallow Main Body Reach includes the area at the southern extent of the Federal Navigation Channel, where the maintained navigation elevation becomes shallower. The Former Pier 24 Piling Field, which is characterized by numerous old creosote-treated pilings in poor condition, is included in the Shallow Main Body Reach.
- The Nearshore Areas consist of nearshore sediments and accessible sloped banks in Slip 27 and adjacent to Slip 36 operated by the U.S. Coast Guard (USCG). The higher-elevation Mound Area near Slip 27 is an area of contamination within a hardened substrate that is included in the Nearshore Areas.
- The Under-Pier Areas are defined as those areas located under aprons, docks, and overwater structures (generalized here by the term piers) along the east and west shorelines. There are challenges for addressing contaminated sediment residing underneath and adjacent to these structures due to sediment and structure stability, as well as restricted access due to support pilings.

The Sill Reach is characterized by a naturally occurring shallow area, or sill, at the southern end of the EW OU, with a hardened river bottom. The Sill Reach is divided into two areas as follows:

- The West Seattle Bridge Portion of the Sill Reach is the area underneath the high-deck West Seattle Bridge.
- The Low Bridges Portion of the Sill Reach is the area underneath the low-deck Spokane Street and railroad Bridges. Marine traffic here is limited to small watercraft.

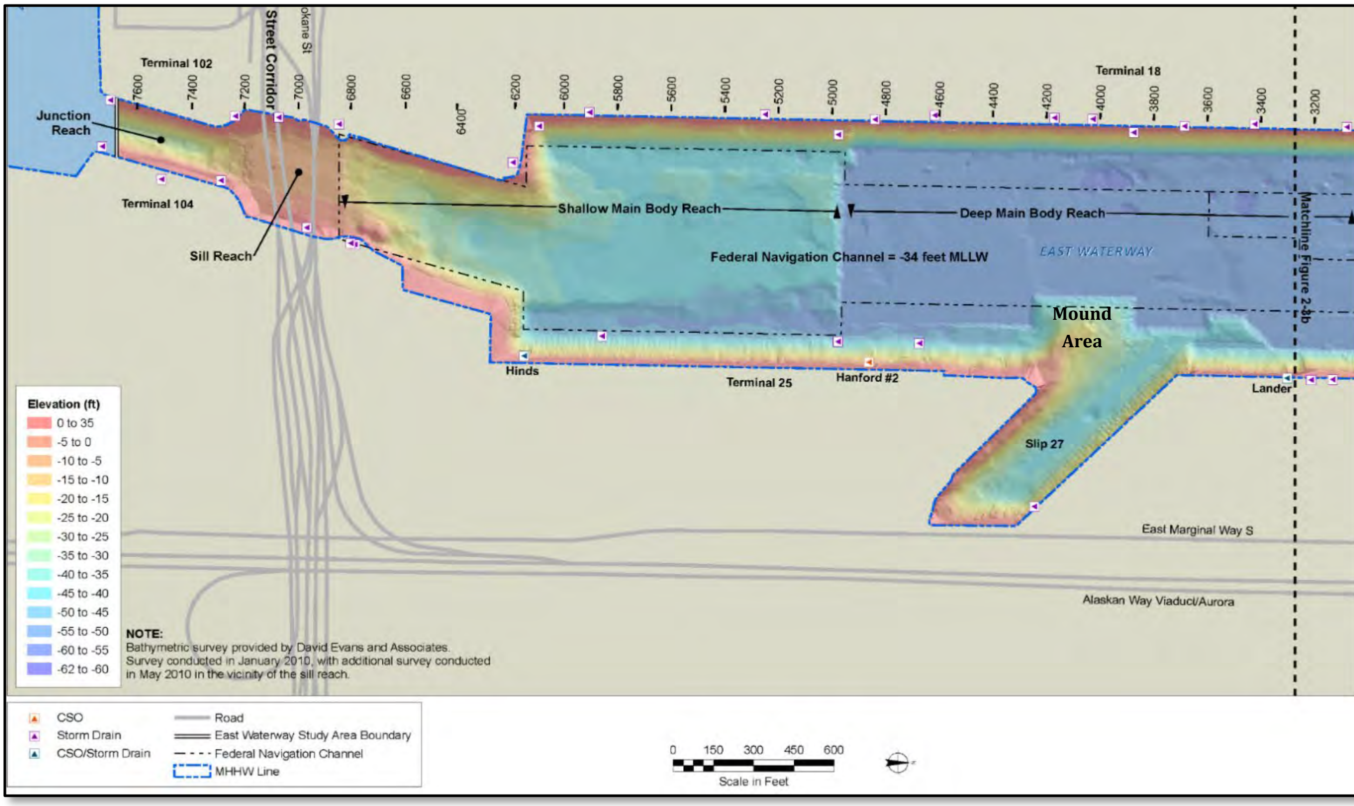


Figure 4. Existing Bathymetry - Southern Portion of East Waterway Operable Unit

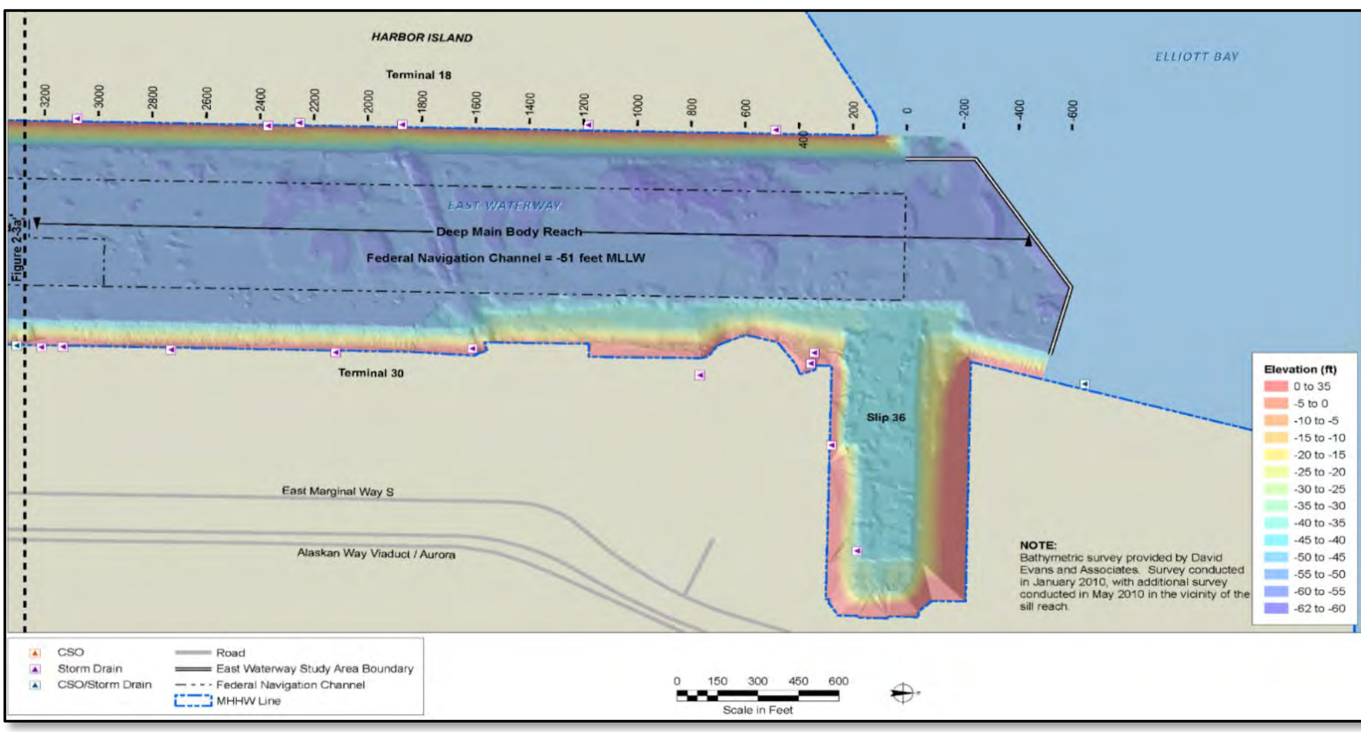


Figure 5. Existing Bathymetry - Northern Portion of East Waterway Operable Unit

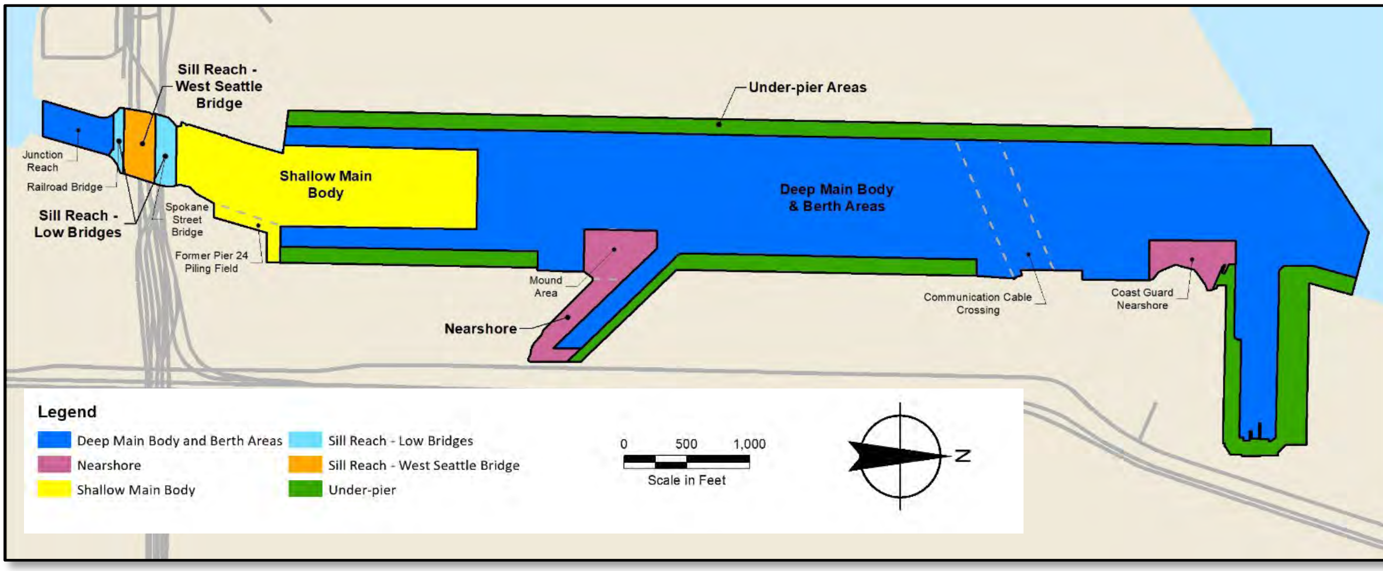


Figure 6. Technology Areas

Note: Open water areas include the Deep Main Body, Shallow Main Body, Nearshore Areas, Junction Reach, and the Sill Reach – West Seattle Bridge. The limited access areas include the Under-Pier Areas and the Sill Reach – Low Bridges.

Conceptual Site Model

A conceptual site model was developed for the EW OU to describe the relationships between the sources of contamination, the affected environmental media (including soil, air, groundwater, sediment and surface water), and the people and wildlife that are potentially exposed to hazardous substances, pollutants, and contaminants. This conceptual site model serves as a basis for assessing the risks from this contamination and for developing cleanup strategies. The following sections summarize the different elements of the conceptual site model.

Sources of Contamination

The primary sources of sediment contamination in the EW OU are associated with historical activities, such as past commercial and industrial uses, and direct discharges from sanitary, stormwater, and industrial waste streams. Ongoing on-site sources are considered to be minor and include contaminated upland sites, spills and leaks, bank erosion, deterioration of treated-wood structures, and urban pollution that enters the EW OU directly through stormwater runoff and CSOs. The contribution from groundwater and seeps is minimal.

EPA is working with the EWG to implement source control to address sources directly discharging to the EW OU. Continued efforts to reduce any ongoing off-site or upstream sources of contaminants entering the EW OU will be necessary to avoid recontamination after cleanup.

The EWG has worked to identify and control potential ongoing lateral sources of contamination to the EW OU. A source control team was established by the EWG to ensure coordination of activities between members and to inform EPA on progress.

The County and City have reduced the frequency and volumes of discharges to EW OU by conducting source tracing and cleanup programs in upland facilities and properties. These include cleaning and maintaining storm drains, tracking actionable sources of pollution to the storm system and CSOs discharging into the EW, as well as reducing the number of discharge points.

The control of upstream sources in the Green/Duwamish River watershed is being led by Ecology. The watershed includes the more heavily industrialized and residential areas of the Duwamish River (including the LDW) and Lower Green River, as well as the more rural, light industrial, and residential areas of the Middle Green River watersheds.

Contamination originating from developed land across the watershed is associated with diffuse sources that are more difficult to identify (such as mobile transportation sources of PAHs and metals) and require a long-term management strategy. The Clean Water Act's National Pollutant Discharge Elimination System permit program for stormwater, coupled with State of Washington chemical-specific actions such as product bans, are key aspects of this long-term management strategy. Ecology is identifying actionable sources in the Green River and is working with municipalities, businesses, and landowners to control known sources. Activities include contaminated site cleanup, removal of underground storage tanks, and stormwater management actions. Ecology is also developing a Pollutant Loading Assessment for the watershed to support future source control actions. These studies, while not developed specifically for the EW OU, are anticipated to reduce the amount of contamination entering the EW.

Upstream source control efforts throughout the Green/Duwamish River watershed will be essential to reduce future contaminant concentrations. Prior to implementing this proposed interim remedial action, EPA will ensure that major sources are sufficiently controlled to minimize the risk of recontamination.

Sediment Transport

Sediment enters the EW OU from the Green/Duwamish River watershed and the LDW Superfund Site (upstream sources) (Figure 7). Lateral sources discharge into the EW OU and can include solids that become sediments in the EW OU. An estimated 32,000 to 54,000 metric tons of sediment enters the EW OU each year. Of that, 40 to 75 percent is estimated to leave the EW OU. Of the total sediment load entering the EW OU, greater than 99 percent is estimated to originate from the Green/Duwamish River watershed upstream of the LDW Superfund Site; less than 1 percent originates from the LDW Superfund Site, including the LDW bed and LDW storm drains and CSOs; less than 0.3 percent originates from storm drains and CSOs within the EW OU, and a negligible amount originates from Elliott Bay. The contaminant concentrations in sediment from each source differ, with lower concentrations from the Green/Duwamish River watershed and higher concentrations from the adjacent LDW Superfund Site and in CSO and stormwater discharges.

The EW OU is generally net depositional (overall more sediment settles out onto the bottom than resuspends off the bottom). Sediment is predicted to accumulate at a rate of approximately 0.5 to 1.5 centimeters (cm) per year. However, the amount of deposition varies greatly throughout the EW OU. Limited or no deposition is predicted to occur in portions of the Shallow Main Body Reach and along the west side of the Deep Main Body Reach. While portions of the Deep Main Body Reach nearest to Elliott Bay are considered net depositional, this area is also influenced by localized mixing or erosion events due to propwash from vessel operations. The Sill and Junction Reaches are not net depositional.

Deposition of sediment from upstream and lateral sources is expected under piers. Sediment in these areas is also likely to be subject to periodic erosion and resuspension due to propwash and vessel thrusters, which can cause relocation and redistribution of contaminated sediments. In some portions of the EW OU, propwash may affect sediment as deep as 5 feet below the sediment surface.

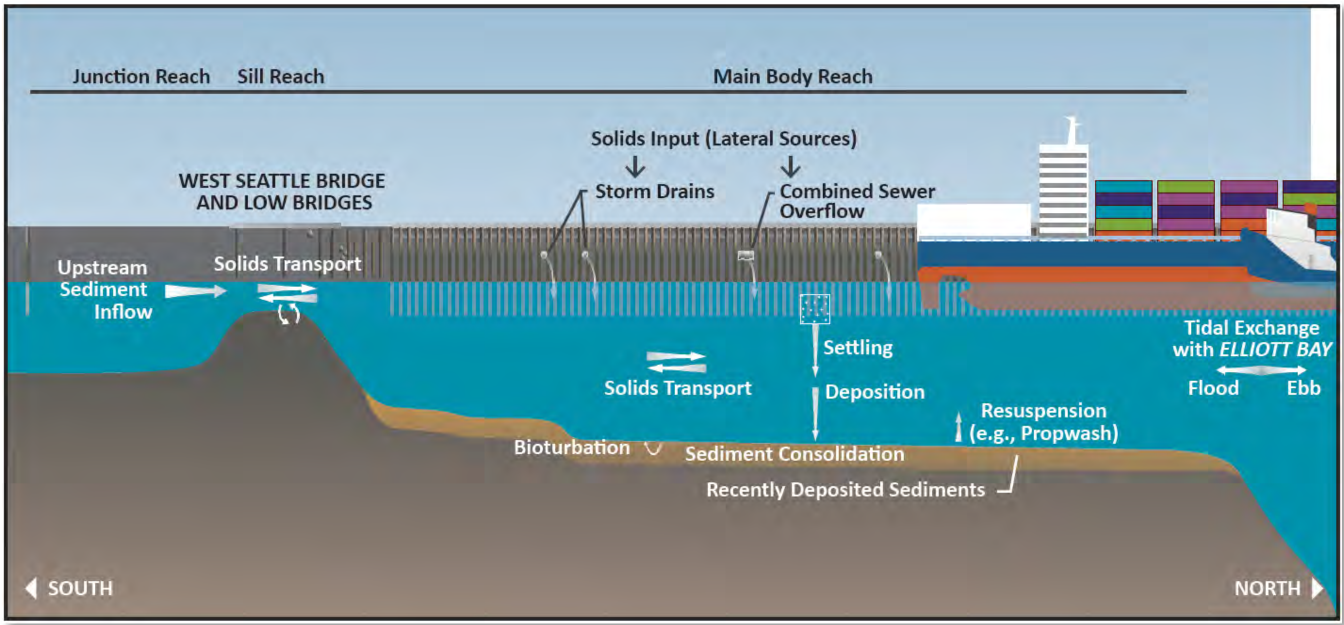


Figure 7. Conceptual Site Model of Sediment Transport

Distribution of Contamination

Historical and ongoing sources of contamination have contaminated EW OU sediment, porewater (the water in sediment), surface water, and the tissue of the animals that live in the EW OU.

Most contamination in the EW OU is associated with the surface sediments (approximately 10 cm in depth), which are the sediments most occupied by benthic communities. PCBs, PAHs, and metals (such as arsenic) are frequently detected in locations throughout the EW OU (Figure 8). Tributyltin (TBT) and dioxins/furans are also found in surface sediment samples but are more limited in distribution. In general, the areas with higher surface sediment contaminant concentrations are in the portions of the EW OU that have not been recently dredged.

The contamination that is most frequently observed at elevated concentrations in subsurface sediment (deeper than 10 cm) are PCBs and mercury. In areas recently dredged, concentrations of this contamination in subsurface sediment are generally lower than those observed in surface sediments. However, in portions of the Shallow Main Body Reach and Deep Main Body Reach that have not been recently dredged, the depth of contamination is 5 to 15 feet, and contaminant concentrations at depth are generally greater than the surface sediment concentrations.

Contaminant concentrations have been measured in fish (English sole, shiner surfperch, brown rockfish, juvenile Chinook salmon) and invertebrates (red rock and Dungeness crabs, clams, mussels, geoduck, shrimp, and marine worms) from the EW OU. Average total PCB and dioxin/furan concentrations are highest in fish and lowest in shellfish. Average PAH concentrations are highest in clams, mussels, and bottom-dwelling invertebrates. Inorganic arsenic concentrations are highest in intertidal clams and other shellfish (geoduck and mussels). TBT concentrations are highest in brown rockfish and bottom-dwelling invertebrates. Table 2 presents the concentrations of COCs that were observed in fish and invertebrates during the SRI.

PCBs, arsenic, and TBT are also present in EW surface water. TBT and volatile organic compounds, such as naphthalene, benzene, and *cis*-1,2-dichloroethene have been detected in porewater.

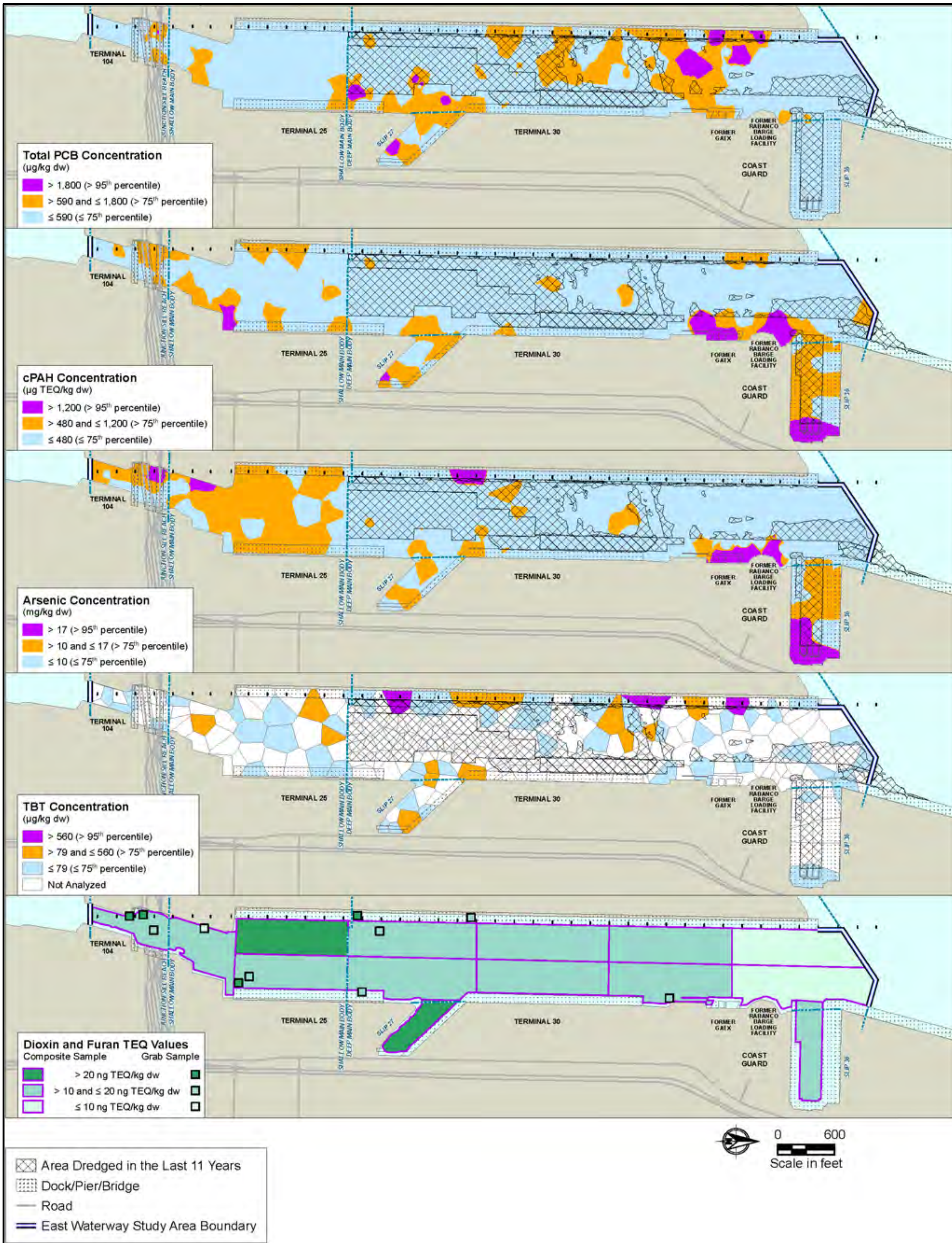


Figure 8. Contaminant Distribution in Surface Sediment

Table 2. Average Contaminant Concentrations in Fish and Invertebrates

	Average Concentration				
	Total PCBs	**Dioxins/ Furans**	**cPAHs**	**Arsenic**	**TBT**
	µg/kg	ng TEQ/kg	µg BaP-eq/kg	mg/kg	µg/kg
Fish					
Rockfish	2,000	26.9	12	0.008	420
Sole	540 – 3,200	14 – 37	0.3 – 11	0.03	14 – 38
Perch	155 – 1,500	14	1	0.021	31 – 67
Invertebrates					
Crab	130 – 590	2 – 12	0.6 – 1.3	0.03 – 0.06	13 – 23
Mussel	26	NA	20	0.078	92
Clam	19 – 66	0.4 – 0.9	1.6 – 16	0.03 – 0.2	10 – 140
Benthic Invertebrates	210	NA	170	NA	390

Notes:

NA: not available
Concentrations are in wet weight
TEQ: Toxic equivalent
mg/kg: milligram per kilogram
µg/kg: microgram per kilogram
ng/kg: nanogram per kilogram
These values originate from data that was presented as average concentrations for various species or collection efforts during the SRI. Where data was available for multiple species or more than one collection effort, the range of average concentrations is presented.

DIFFERENT WAYS TO REPORT CHEMICAL CONCENTRATIONS

Wet weight (ww) is the concentration of a chemical in tissue as measured in a wet (not dried) sample with the moisture included in the weight.

Dry weight (dw) is the concentration of a chemical in sediment based only upon the weight of the sediment particles (dried sediment without water). This is useful when comparing sediment samples that contain different ratios of sediment particles and water.

Organic carbon (OC) is a form of carbon associated with organic matter (such as leaf litter) that is found in sediment. Organic carbon binds certain chemicals influencing bioavailability (the amount of a chemical absorbed into an animal's body) and the potential toxicity. To compare sediment samples that have different amounts of organic carbon, sediment concentrations are normalized to the amount of organic carbon present (labeled as mg/kg OC) .

Toxic equivalents (TEQ) are used to express the concentration dioxins/furans and certain PCBs relative to the toxicity of 2,3,7,8-TCDD. The concentration of each chemical is scaled to the concentration of the reference by multiplying the concentration by the toxic equivalent of each compound. These equivalent concentrations are then summed to give the total 2,3,7,8-TCDD TEQ.

Current and Future Land Uses

The EW OU and adjacent upland areas have served as Seattle's major marine terminal and shipyards since the 1940s. Commercial vessels routinely utilize the EW OU north of the Spokane Street corridor. Most vessel traffic consists of container vessels and assorted tugboats moving into and out of the EW OU. The main waterway is utilized by the Port, the USCG, and to a lesser extent, the U.S. Navy. South of the Sill Reach, recreational and commercial boats may access Harbor Island Marina from the LDW. The low bridges in the Spokane Street corridor physically prohibit passage from the LDW to the EW OU except at low tide by small, shallow-draft boats such as skiffs.

Future use of the EW OU includes shipping via larger vessels. The U.S. Army Corps of Engineers (USACE), through the Seattle Harbor Navigation Improvement Project (SHNIP) (USACE, 2017b), is proposing to deepen the Deep Main Body Reach from the existing depth of -51 feet MLLW to -57 feet MLLW. This is expected to be implemented following cleanup of the EW OU and so will not impede the EW OU cleanup.

The EW OU is also used for recreational activities, including boating and fishing, although these activities are minimal due to limited public access and the amount of commercial shipping activity. Jack Perry Memorial Park and a public fishing pier are located along the north side of the Spokane Street Bridge. The Muckleshoot Indian Tribe and the Suquamish Tribe each have commercial fishing rights for salmon as well as ceremonial and subsistence shellfish harvesting rights (typically occurring in intertidal areas of the Shallow Main Body and Junction Reach). Tribal fishers may also engage in geoduck harvesting in subtidal areas. Both Tribes have had fisheries and harvest opportunities limited by sediment contamination in the EW OU. The landowners and community surrounding the EW OU include marine-related industries, marine-dependent businesses that lease property from the Port, Tribal fishers, and recreational users. There are no residential neighborhoods in the immediate vicinity. The Port is the primary landowner of the upland areas adjacent to the EW OU. Other landowners include the City, County, the U.S. Government, DNR, and Duwamish Properties LLC. DNR owns most of the aquatic bottom lands in the EW OU. The BNSF Railroad also owns nearby property, with right-of-way ownership immediately south of the lower Spokane Street Bridge.

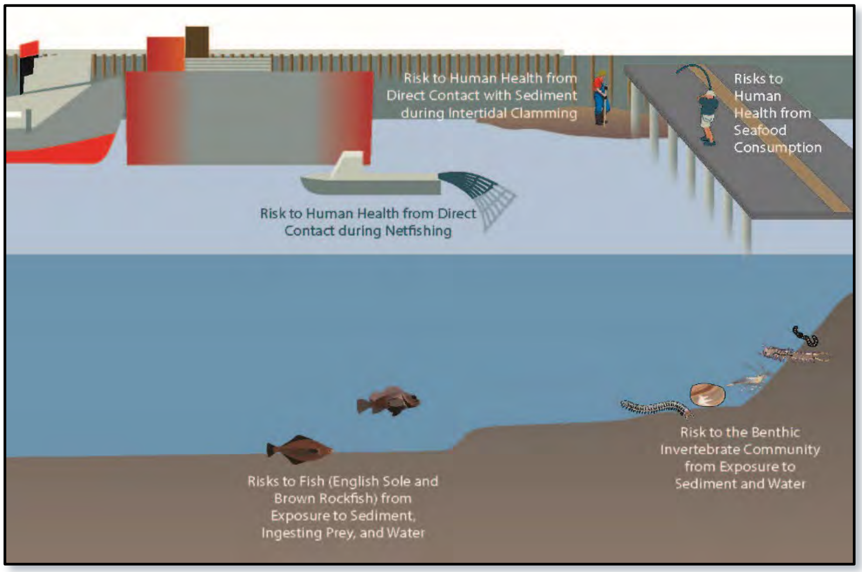
How People and Wildlife May Be Exposed

The ways in which people and wildlife may be exposed to contamination in EW are summarized in Figure 9. In addition to commercial activities, people may be exposed to EW-related contamination during recreational activities, including boating and fishing.

WSDOH has issued advisories against consuming any resident fish or shellfish harvested from the Lower Duwamish River. Tribal members' potential exposure to contamination in the EW OU is primarily through consumption of resident fish and shellfish, and this has been a primary factor shaping the human health risk assessment and in developing risk-based cleanup goals.

Ecological communities in the EW OU include wildlife dwelling in and on the sediment and in the water column, as well as birds and marine mammals at the water's surface. Numerous small benthic (bottom-dwelling) species typical of Puget Sound inhabit the subtidal substrates of the EW OU, including worms, crustaceans, and mollusks (for example, clams). Larger, more motile invertebrates (crabs) and bottom fish (such as sole and rockfish) live in close association with bottom substrates. The EW OU also has a diverse population of pelagic fish that live in the water column, including resident species (for example, shiner surfperch) and migratory species, such as salmon. Because the EW OU connects Puget Sound to the Green/Duwamish River watershed, it is an important migratory pathway for both juvenile and adult salmon. Juvenile salmon primarily feed in suitable nearshore habitats. Aquatic and semi-aquatic wildlife that use the EW include river otter, raccoons, and a variety of marine birds and ducks.

Sixteen aquatic and aquatic-dependent species reported in the vicinity of Elliott Bay area are listed under either the Endangered Species Act or by the Washington Department of Fish and Wildlife as candidate species, threatened species, endangered species, or species of concern. Of these species, Chinook salmon, Coho salmon, steelhead salmon, brown rockfish, bald eagle, western grebe, and Pacific herring are commonly observed in or around the EW OU.



Note: This conceptual site model shows exposure pathways where the risk assessment estimated risks greater than EPA's acceptable risk range.

Figure 9. Conceptual Site Model for Human Health and Ecological Exposure Pathways

Scope of the Remedial Strategy for the Harbor Island Superfund Site and the EW Operable Unit

The EW OU is one of seven operable units of the Harbor Island Superfund Site addressed by EPA, which has been working since 1983 to address the risks posed by the Harbor Island Superfund Site. Final remedies have been selected and, for the most part, have been implemented at six OUs. The EW OU is the last operable unit of the Harbor Island Superfund Site to be addressed. The following are brief summaries of the remedies at the other seven OUs:

OU-01 (Soil and Groundwater OU): The remedy was selected in 1993 and modified in 1994, 1996, and 2001. The selected remedy (soil excavation, capping, and removal of liquid contaminants) was completed in 2012. Institutional controls, a component of the remedy, have been implemented by EPA and the property owners; however, some controls remain to be addressed.

OU-02 (Tank Farms OU): This OU is managed by Ecology under the Washington State Model Toxics Control Act (MTCA) because it was a release of petroleum. Ecology issued Cleanup Action Plans for the three OU-02 facilities in 1999 and 2000. The selected remedies (soil excavation, in situ remediation via air sparging and soil vapor extraction, and institutional controls) are ongoing. Monitoring has indicated the remedy is performing as designed.

OU-03 (Lockheed Upland OU): The remedy was selected in 1994. The selected active remedy (soil excavation, soil capping) was completed in 1995. The remedy included institutional controls, and while most of these controls have been implemented by EPA and the property owners, controls in one area remains to be addressed.

OU-07 (Lockheed Shipyard Sediments OU): The remedy was selected in 1996 and modified in 2002 and 2003. The selected remedy (removal of in- and over-water structures, sediment dredging, and sediment capping) was completed in 2005.

OU-08 (West Waterway Sediments OU): The ROD was signed in 2003, indicating no further CERCLA action was necessary at this OU. Data obtained since that time indicate that additional characterization of the contamination is warranted for this OU.

OU-09 (Todd Shipyards Sediments OU): A ROD was signed in 1996 and modified in 1999 and 2003. The selected remedy (removal of over-water structures, sediment dredging, and sediment capping) was completed in 2007. Following the demolition of over-water structures, additional contaminated material was removed in late 2022, followed by placement of clean habitat material in late 2022 and early 2023.

OU-10 (East Waterway OU): Subject of this Proposed Plan.

The overall strategy for addressing contamination and the associated risks in the EW OU includes controlling sources of contamination to the EW OU and addressing the contaminated media that pose unacceptable risk. Source control for lateral inputs and for sources throughout the watershed is occurring under various federal, state, and local regulatory authorities. The primary objective of this proposed CERCLA action is to aggressively reduce contaminant concentrations in sediment to levels that are protective of human health and the environment.

EPA is proposing an interim remedy that includes a combination of technologies, including dredging, capping, in situ treatment, enhanced natural recovery, monitored natural recovery, and institutional controls to address the entire EW OU. Actively addressing contaminated sediment will reduce contaminant concentrations in other contaminated media. EPA anticipates selecting cleanup levels in a future decision document based on data collected during and after construction of the interim action. The data collected will be used to evaluate the effectiveness of the interim action and of ongoing source control. These data will provide EPA, the public, the State, Tribes, the EWG and other stakeholders information needed to develop cleanup levels.

EPA's long-term vision for the EW OU is to achieve the lowest contaminant levels possible in sediments, with the overarching goal such that there will be an associated reduction of contaminant concentrations in fish to levels that allow WA DOH to minimize fishing advisories. EPA also expects that in the long-term, with effective comprehensive source control throughout the Green/Duwamish River watershed, sediment PCB concentrations equivalent to the concentrations measured in non-urban background for Puget Sound (2 ppb PCBs) can be achieved at the EW OU. Achieving this long-term goal will require aggressive source control using a range of federal, state, and local regulatory authorities on both point sources and non-point sources throughout the Green/Duwamish River watershed.

Summary of Site Risks

Human health and ecological risk assessments were conducted to estimate the risk associated with exposure to contamination based on current and likely future uses of the EW OU. These baseline risk assessments are presented in Appendices A and B of the SRI.

Human Health Risks

The baseline human health risk assessment (BHHRA) (Windward, 2012b) evaluated cancer and non-cancer health hazards associated with exposure to EW OU-related contamination that may occur during recreational, occupational, or cultural activities. The BHHRA considered contamination in sediment, surface water, fish, and shellfish. Following CERCLA guidance, a reasonable maximum exposure (RME) that portrays the highest level of exposure that could reasonably be expected to occur was evaluated. Additionally, a central tendency exposure, considered representative of average exposure, was also evaluated. As required in the NCP, remedial decisions will be based on an RME evaluation. In 2019, an addendum to the BHHRA was included with the EW OU FS that reevaluated cPAH risks based on an updated toxicity assessment for benzo[*a*]pyrene by EPA (Windward, 2019).

Populations were identified that could potentially be exposed to EW OU-related contamination through a variety of activities consistent with both current and future use of the EW. These activities included fishing, gathering shellfish along the shoreline, boating or swimming, and occupational exposures associated with the industrial activities in the EW OU. Given the industrial nature of the EW OU, young children are not expected to engage in recreational activities, such as beach play. Populations with the greatest potential for exposure to contaminated sediments were selected as a representative population for each activity. The routes of exposure included ingestion (oral exposures), inhalation, and dermal contact. The assumptions and populations and routes of exposure that were evaluated were estimated as follows:

> **Current/future Tribal exposures:** Consumption of fish and shellfish by adults and children based on Tribal fish consumption rates for Puget Sound; direct exposure to sediment or water via incidental ingestion or skin contact while engaging in activities such as Tribal net fishing and clamming.
>
> **Current/future ethnic community exposures:** Consumption of fish and shellfish for adults and children as represented by an Asian & Pacific Islander scenario (described below).
>
> **Current/future recreational exposures:** Direct contact with surface waters for swimmers, including skin absorption and incidental ingestion of waters and sediments, and the consumption of fish and shellfish by recreational fishers, assuming one meal per month.
>
> **Current/future occupational exposures:** Direct contact with sediment for habitat restoration workers, including incidental soil ingestion, dermal contact with sediment, and inhalation of dust.

Risks associated with consumption of fish and shellfish by Tribal members were based on data from a fish consumption survey of Tulalip Tribal practices (Toy et al., 1996). However, because the Suquamish Tribe's usual and accustomed fishing area includes the EW OU, the BHHRA also included an assessment of Tribal fish and shellfish consumption risks based on a Suquamish fish consumption survey (the Suquamish Tribe, 2000) for comparative purposes.

Exposure factors for evaluating direct contact during swimming, were based on information collected by King County (King County, 1999). Exposures associated with subsistence fishing by ethnic groups were based on fish consumption rates for Asian & Pacific Islander community in King County (EPA, 1999) and the Lower Duwamish Waterway Fishers Study (Windward, 2016) which included an evaluation of local communities that fish from the Spokane Street Bridge. There are no recreational fish consumption survey data of sufficient quality to assess risks to recreational anglers. Risks for this group were evaluated assuming consumption of one meal per month, to allow individuals to estimate risks based on their individual consumption rates. Actual risk results depend on the number of meals per month. Included in this evaluation were resident fish and shellfish that spend most of their life in the EW OU, including sole, perch, rockfish, crabs, clams, geoduck, and mussels. While migratory fish such as salmon are an important food source, they were not considered to be an important contaminant pathway because they spend very little of their lifespan in the EW, and salmon do not acquire a significant amount of contamination from the EW OU (Windward, 2007).

WHAT IS HUMAN HEALTH RISK AND HOW IS IT CALCULATED?

A CERCLA baseline human health risk assessment (BHHRA) is an analysis of the potential adverse health effects caused by the hazardous substances released from a site in the absence of any actions to control or mitigate under current and future land uses. A four-step process is used for assessing site-related human health risks.

1. **Hazard Identification:** The first step is the identification of contaminants based on toxicity, fate and transport in the environment, and chemical concentration, mobility, persistence, and bioaccumulation.
2. **Exposure Assessment:** This step involves identifying the different exposure pathways through which people might be exposed to site-related contaminants. Examples include consumption of contaminated fish or shellfish or dermal contact with, or incidental ingestion of, contaminated sediment (Figure 9). For each pathway, factors needed to compute the dose of a chemical to which individuals may be exposed are estimated (exposure concentrations, rates at which humans come into contact with contaminated media [such as sediment ingestion rates], and the frequency and duration of that exposure). Using this information, contaminant doses are calculated for each receptor group (adult or child) and exposure pathway.
3. **Toxicity Assessment:** In this step, the types of adverse health effects associated with chemical exposures and the relationship between magnitude of exposure (dose) and severity of adverse effects (response) are determined. Potential health effects are chemical-specific and may include the risk of developing cancer over a lifetime or other non-cancer health hazards. Some contaminants may cause both cancer and non-cancer health hazards.
4. **Risk Characterization:** This step combines output from the exposure and toxicity assessments to provide a quantitative assessment of site risks for each COC. Exposures are evaluated based on the potential risk of developing cancer and the potential for non-cancer health hazards. Only risks associated with exposures from the site are considered; those risks are termed excess risk and do not include other health risks to which people may be exposed.

Cancer risks are expressed as the probability of an individual developing cancer over their lifetime. For example, a 10^{-4} cancer risk means a 1 in 10,000 excess cancer risk or 1 additional cancer in a population of 10,000 people as a result of exposure to site contaminants. Superfund generally considers remedial action warranted when risks are greater than the acceptable risk range of 1 in 10,000 to 1 in 1,000,000 (1×10^{-4} to 1×10^{-6}).

Non-cancer health effects are evaluated using a hazard quotient (HQ) approach, calculated as the exposure concentration relative to a reference dose representing an exposure unlikely to cause adverse health effects. An HQ less than 1 indicates that adverse health effects are unlikely. In general, the more the HQ is greater than 1, the greater the level of concern. However, the HQ is not a statistical probability, nor does the level of concern increase linearly. EPA also examines the hazards posed by groups of chemicals with the same non-cancer toxic endpoint using the hazard index, or HI. The HI is computed by summing the HQs of all chemicals with the same toxic endpoint. The significance of HI values is evaluated in a manner identical to that of HQ values.

Contaminants that exceed a 1×10^{-6} cancer risk or have HQ or HIs exceeding 1 are typically those that will require remedial action and are referred to as COCs in the Proposed Plan.

Risk Estimates

Cumulative risks for each receptor group and exposure pathway were compared to the EPA acceptable risk range of 1 in 10,000 (1×10^{-4}) to 1 in 1,000,000 (1×10^{-6}) for cancer risks and a hazard index (HI) of 1 for non-cancer hazard. The cumulative risk is derived by summing the cancer risks posed by all carcinogens found at a site. In general, total risks resulting from the consumption of fish or shellfish were orders of magnitude higher than risks resulting from direct contact with sediment or surface water.

Risks to subsistence Tribal fishers represented the highest risks for both the seafood consumption pathway and the direct contact pathway. The cancer and non-cancer risks for both the adult and child scenarios exceeded the acceptable risk range.

Risks associated with direct contact for recreational users and occupational exposures were less than EPA's acceptable risk range. The estimated cancer and non-cancer risk levels from consumption of fish and shellfish are primarily due to total PCBs, arsenic, cPAHs, and dioxins/furans; cancer risks for direct contact are primarily due to arsenic (Table 3).

Table 3. Human Health Risk Estimates for Selected Exposure Scenarios

Pathway and Population [a]	Contaminant of Concern				
	Total PCBs	Arsenic	cPAHs	Dioxins Furans	Total
Consumption of Fish and Shellfish					
Adult Tribal RME					
Cancer Risk based on Tulalip data	1×10^{-3}	2×10^{-4}	1×10^{-5}	1×10^{-4}	1×10^{-3}
Non-cancer HQ	27	0.4	--	1	--
Child Tribal RME Based on Tulalip Data					
Cancer Risk	2×10^{-4}	4×10^{-5}	1×10^{-5}	2×10^{-5}	3×10^{-4}
Non-cancer HQ	58	0.9	--	2	--
Asian Pacific ng/kg Islander RME					
Cancer Risk	4×10^{-4}	8×10^{-5}	7×10^{-6}	4×10^{-5}	5×10^{-4}
Non-cancer HQ	24	0.4	--	0.9	--
One Meal per Month[d]					
Cancer Risk	4×10^{-4}	1×10^{-5}	1×10^{-6}	2×10^{-5}	4×10^{-4}
Non-cancer HQ	21	0.08	--	0.4	--
Direct Contact [b,c]					
Tribal Netfishing RME Cancer Risk	6×10^{-7}	3×10^{-6}	3×10^{-7}	6×10^{-7}	5×10^{-6}
Tribal Clamming RME Cancer Risk	3×10^{-6}	1×10^{-5}	2×10^{-6}	1×10^{-6}	2×10^{-5}

Notes:

a. Risks from exposure to surface water were all less than 1×10^{-6}.
b. Risks to habitat workers through direct contact were less than 1×10^{-6}.
c. All direct contact hazard quotients were less than 1.
d. Assumes one meal per month, reported value is the highest level of risk for either bottom fish, clams, crab, rockfish or perch. Actual risks depend on the number of meals per month.

Ecological Risks

The Baseline Ecological Risk Assessment (BERA, Windward, 2012a) evaluated the potential for adverse effects to ecological receptors from exposure to contaminants at the EW OU. The BERA evaluates risks to wildlife that are representative of the communities living in the EW. The BERA quantified risk to different potentially exposed ecological receptors as hazard quotients (HQs), the ratio of contaminant concentration to a given toxicological benchmark. If an HQ is calculated to be equal to or less than 1, then no adverse effects are expected as a result of exposure. If the HQ is greater than 1, adverse effects are possible. The following representative receptors and exposure pathways were evaluated in the BERA.

Benthic Invertebrates: This group includes invertebrates that live in or on the sediment, including clams and worms that are food for larger predators. Exposure pathways included direct contact with sediment and surface water, ingestion of biota and sediment, and direct contact with porewater. Risk to these receptors was evaluated by comparing chemical concentrations in surface sediment (0-10 cm sediment depth) to regionally developed effects-based threshold response values. Exceedances of threshold response values were confirmed by conducting toxicity tests of EW OU sediments.

Benthic risks from TBT were assessed using tissue concentrations associated with adverse effects from scientific literature. Sediment thresholds were then derived using a sediment-tissue relationship developed from site-specific information for the EW OU.

Crabs: Risks to crabs were evaluated by comparing tissue concentrations of crabs collected from the EW OU to literature-based screening levels.

Fish: Potential risk was evaluated for resident fish that live and feed in close association with sediment, as well as juvenile Chinook salmon. Exposure pathways included direct contact with sediment and surface water, ingestion of contaminated prey, incidental ingestion of contaminated sediment, and direct contact with contaminated porewater. Risks to fish were evaluated by comparing tissue concentrations in fish collected from the waterway to literature-based effects levels and modeling potential exposure of fish to chemicals in food items and prey.

Birds and Mammals: Osprey, pigeon guillemot, river otter, and harbor seals represented larger wildlife potentially exposed to contamination in the EW OU. Exposure pathways evaluated included ingestion of contaminated prey and incidental ingestion of sediment. These were evaluated by modeling the potential exposure of those receptors to chemicals ingested in food items and prey, which were then compared to literature-based effects thresholds.

WHAT IS ECOLOGICAL RISK AND HOW IS IT CALCULATED?

A CERCLA Baseline Ecological Risk Assessment (BERA) is an analysis of the potential adverse effects to biota caused by hazardous substance releases from a site in the absence of any actions to control or mitigate these under current and future land and resource uses. The process used for assessing site-related ecological risks includes:

1. **Problem Formulation:** In this step, the contaminants of potential ecological concern at the site are identified in a manner similar to the BHHRA.
2. **Exposure Assessment:** In this step, a quantitative evaluation is made of what plants and animals are exposed to and to what degree they are exposed.
3. **Ecological Effects Assessment:** In this step, literature reviews, field studies or toxicity tests are conducted to describe the relationship between chemical contaminant concentrations in sediment (toxicity reference values) or in tissue (critical tissue levels) and their effects on ecological receptors, on a media-, receptor- and chemical-specific basis.
4. **Risk Characterization:** In this step, the results of the previous steps are used to estimate the risk posed to ecological receptors. Individual risk estimates for a given receptor for each chemical are calculated as a hazard quotient (HQ), which is the ratio of contaminant concentration to a given toxicological benchmark. In general, the more the HQ is greater 1, the greater the level of concern. However, the HQ is not a statistical probability, nor does the level of concern increase linearly

The risk to ecological receptors is then described, including the overall degree of confidence in the risk estimates, summarizing uncertainties, citing evidence supporting the risk estimates and interpreting the adversity of ecological effects.

The following presents the primary conclusions of the BERA:

- 29 chemicals or groups of chemicals were identified as COCs for the benthic community, with HQ values greater than 1). Approximately 62 percent of the waterway was predicted to pose adverse effects to the benthic community based on sediment chemistry and confirmatory toxicity tests.
- Surface sediment also contained concentrations of TBT greater than a site-specific concentration determined to pose adverse effects on benthic organisms.
- Cadmium, copper, and zinc were identified as COCs for crabs based on tissue residues.
- Risks to fish are generally low, although risks to English sole and brown rockfish are associated with total PCBs concentrations
- Concentrations of contaminants did not pose unacceptable risk to bird or mammal receptors.

The results of the ecological risk assessment are summarized in Table 4.

Table 4. Summary of Baseline Ecological Risk Assessment Results

Receptor Group	Media	HQ	Contaminants of Concern	Primary COCs
Benthic invertebrate community	Sediment	<1 – 355	29 COCs	TBT
	Tissue	3.3	TBT	TBT
Crab	Tissue	1.1 – 1.5	Cadmium, copper, zinc	None
Fish	Dietary Dose	1.0 – 2.5	Cadmium, copper, vanadium	None
	Tissue	1.6 – 12	Total PCBs, TBT	Total PCBs
Birds	Dietary Dose	<1	None	None
Mammals	Dietary Dose	<1	None	None

Note: The contaminants that posed the greatest risk to ecological receptors include: mercury, high molecular weight polycyclic aromatic hydrocarbons (HPAHs), low molecular weight polycyclic aromatic hydrocarbons (LPAHs), and total PCBs.

Basis for Taking Action

The Preferred Alternative identified in this Proposed Plan, or one or more of the other active measures considered in this Proposed Plan, is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances, pollutants, and contaminants. This determination is based on the following:

- The cumulative cancer risks associated with human consumption of resident fish and shellfish pose unacceptable cancer risk and non-cancer hazards.
- The cumulative cancer risks associated with the direct contact with sediments during netfishing and clamming pose unacceptable cancer risk.
- COCs in sediment are present at concentrations that pose unacceptable risks to benthic organisms, crab, and resident fish.

Remedial Action Objectives

In accordance with the NCP, EPA develops 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 are developed to address unacceptable risks associated with each COC, exposure pathway, exposure route, and receptor. Consistent with the final RAOs 1-4 below, EPA's long-term objective is to reduce sediment concentrations to be protective of both human health and wildlife. EPA's long-term vision is that sediment PCB concentrations would be reduced as much as possible (to the non-urban background for Puget Sound of 2 ppb for PCBs) through aggressive in-water CERCLA cleanup in conjunction with comprehensive source control work under other authorities. What can be ultimately achieved with any CERCLA cleanup at the EW OU is, in large part, dependent on source-control actions implemented by the State and public entities. Therefore, EPA is proposing that this action be an interim remedy. Implementing this action now and remediating the contaminated sediment will immediately reduce risks through reduction of contaminant concentrations. This proposed interim action will support and be consistent with a final ROD, and consistent with CERCLA and the NCP. Post-construction monitoring of the proposed interim action as well as continued monitoring of upstream loading will provide data to better predict what a final remedy can achieve in the long-term.

Consistent with the intent of this Proposed Plan for an interim ROD which will require cleanup of all sediments greater than the Remedial Action Levels, an additional RAO has been developed for the interim action:

> **RAO to be achieved by this Interim Action:** Reduce through active remediation concentrations of COCs in sediment greater than Remedial Action Levels**.**

The FS was based on the RAOs developed for the anticipated final cleanup of the EW OU. These objectives, presented below, represent the long-term objectives for the EW OU cleanup. These were the basis for development of the remedial alternatives. Although they are long-term objectives and not the objectives of this interim action, they are still relevant because the interim action will be consistent with the final action and its long-term objectives.

Anticipated Final RAO 1: Reduce to protective levels risks associated with the consumption of contaminated resident EW OU fish and shellfish by adults and children with the highest potential exposure. PCBs, arsenic, cPAHs, and dioxin/furans are the primary COCs that contribute to the estimated unacceptable cancer risk and non-cancer hazard from the consumption of resident contaminated fish and shellfish.

Anticipated Final RAO 2: Reduce to protective levels risks from direct contact (skin contact and incidental ingestion) by adults and children to contaminated sediments during netfishing and clamming. Arsenic is the primary COC that is anticipated to present unacceptable cancer risks from netfishing and clamming.

Anticipated Final RAO 3: Reduce to protective levels risks to benthic invertebrates from exposure to contaminated sediments.

Anticipated Final RAO 4: Reduce to protective levels risks to crabs and fish from exposure to contaminated sediment, surface water, and prey.

Preliminary Remediation Goals

Preliminary remediation goals (PRGs) generally represent the long-term contaminant concentrations needed to be achieved by the remedial alternatives to meet the narrative goals stated in the RAOs. They are used during the initial development, analysis, and selection of cleanup alternatives. New or different requirements may be identified that may be used to modify the PRGs before they are established as cleanup levels in the final ROD. Although, the FS developed alternatives based on long-term PRGs, concerns regarding the effectiveness of source control actions, has led EPA to propose this action as interim and identify the Remedial Action Levels as the goals for this interim action. Monitoring during and after completion of the interim action will provide information to develop and select cleanup levels to achieve RAOs with consideration of the concentration of contaminants in upstream sediments and equilibrium conditions of the Site.

Applicable or Relevant and Appropriate Requirements

CERCLA and the NCP[1] require remedial actions at CERCLA sites to meet applicable, or relevant and appropriate requirements (ARARs), including federal environmental laws and promulgated state environmental or facility siting laws that are more stringent than federal laws, unless such ARARs are waived by EPA. Federal or state advisories, criteria, and guidance that are not ARARs may still be factored into remedial actions and are called to be considered or TBCs.

Only the requirements that are pertinent to the scope and purpose of the interim remedial action will be considered ARARs. Because this is projected to be an interim action decision, review of this Site and of this interim remedy will be ongoing as EPA continues to develop the final remedial decision and cleanup levels for the EW OU. ARARs for the final remedial action, including those that pertain to the selected cleanup levels, will be addressed by EPA in the final ROD.

[1]Section 121(d)(2) of CERCLA, 42 U.S.C § 9621(d)(2); 40 C.F.R. §§ 300.430(f)(1)(i)(A) &(ii)(B)

Risk-Based Preliminary Remediation Goals

Risk-based PRGs are calculated to be protective of human health and ecological risk as follows:

- Concentrations protective of human health for direct and indirect exposures representing an excess cancer risk of 1 x 10^{-6} and a non-cancer HQ of 1 (RAOs 1 and 2).
- Risk-based sediment concentrations for protection of benthic invertebrates (RAO 3).
- Risk-based concentrations protective if ecological receptors for either direct contact with sediment or exposure via food-chain transfer and consumption of contaminated prey (RAO 4).
- Background concentrations when greater than the risk-based PRGs.

EPA will develop cleanup levels for the EW OU following the completion of the interim action based on data collected during and after remedy construction that evaluates the effectiveness of remedial action and ongoing source control efforts.

Summary of Remedial Alternatives

This section presents the remedial alternatives considered to address the risks at the EW OU and meet the RAO for the interim action and the anticipated long-term RAOs. These alternatives were developed following the requirements established in CERCLA and the NCP.

Remedial Action Levels

Remedial Action Levels (RALs) are contaminant concentrations used to delineate areas and sediment depths that require active cleanup. The relative effect of remediating those areas exceeding RAL concentrations is evaluated as part of the analysis of alternatives. RALs are not cleanup levels but are the performance standards for this interim action. RALs were developed for each COC posing unacceptable human health risk (total PCBs, arsenic, and dioxins/furans) and those contaminants posing unacceptable ecological risk. The alternatives considered two RALs for PCBs: 192 µg/kg (12 mg/kg-OC), and 120 µg/kg (7.5 mg/kg-OC). The method by which specific RALs were developed is further explained in the Section 6.1 of the FS.

Table 5. Remedial Action Levels

Contaminant	RAL	Units
Total PCBs[a]	12 or 7.5	mg/kg OC[b]
Arsenic	57	mg/kg dw
Dioxins/furans	25	ng TEQ/kg dw
Tributyltin	7.5	mg/kg OC
1,4-Dichlorobenzene	3.1	mg/kg OC
Butyl benzyl phthalate	4.9	mg/kg OC
Acenaphthene	16	mg/kg OC
Fluoranthene	160	mg/kg OC
Fluorene	23	mg/kg OC
Mercury	0.41	mg/kg dw
Phenanthrene	100	mg/kg OC

Notes:

a. Alternatives were developed using two PCB RALs.
b. Based on the average EW OU organic carbon content of 1.6 percent, 12 mg/kg OC is equivalent to 192 µg/kg dw, and 7.5 mg/kg OC is equivalent to 120 µg/kg dw.

Common Elements of the Alternatives

As required by CERCLA, a No Action Alternative is included for comparative purposes. The No Action Alternative would include only monitoring to evaluate changes in COC concentrations over time.

All other alternatives include some type of active remediation and are comprised of common elements including the remedial technologies, waste disposal options, methods for managing dredge residuals, institutional controls, and monitoring requirements. The differences between alternatives are defined by where each technology is applied.

Remedial Technologies Applied to Alternatives

With the exception of the No Action Alternative, each alternative includes one or more of the following remedial technologies that may be applied to one or more area (see Figure 6).

Monitored natural recovery (MNR): MNR relies on natural processes to reduce ecological and human health risks while monitoring natural recovery over time to determine remedy success. Within the EW OU, the primary natural recovery processes are sedimentation and mixing with incoming cleaner sediment.

Enhanced natural recovery (ENR): ENR refers to the placement of a thin layer of clean sand (or other suitable habitat material) on top of contaminated sediments. Over time, this cleaner surface material mixes with the underlying contaminated sediment to reduce contaminant concentrations more quickly than would occur with MNR. ENR may be used in conjunction with sediment dredging to maintain appropriate water depths for navigation. The alternatives include two types of ENR defined by location and thickness:

ENR-sill – ENR placed in the Sill Reach consists of a 9-inch layer of clean sand.

ENR-nav – ENR placed within the Deep Main Body and Berth Areas consists of an 18-inch layer of clean sand. A thicker layer of ENR is required due to propwash scour. Some ENR-nav areas would require partial dredging to accommodate navigational depths.

Removal of contaminated sediments: All action alternatives include the removal of contaminated sediment due to the need to maintain the current and future use of EW OU as a navigable waterway. In the FS, the following assumptions were considered for purposes of cost estimates and feasibility evaluation:

Mechanical dredging to remove contaminated sediment is assumed for open water areas, using either articulated fixed-arm or cable-operated dredges situated on a barge or from the shore.

Diver-assisted hydraulic dredging to remove contaminated sediment is assumed in Under-pier Areas.

The footprint and depth of dredging is determined by the RAL in open water areas. In nearshore habitat areas, dredged areas would be backfilled to existing contours to maintain elevations suitable for habitat. Dredging is limited by existing underground utilities in the Communication Cable Crossing of the Deep Main Body and Berth Areas. Contaminated sediment removal would be conducted to the extent practicable, and the area backfilled to protect the existing utilities.

Engineered Capping: Engineered caps contain contaminated sediments by placing layers of sand, gravel, or rock to isolate and prevent migration of contamination. Capping may be used in conjunction with dredging to maintain appropriate water depths for navigation or habitat. Cap composition and thickness will be determined during design and will consider maintaining habitat.

In situ treatment: In situ treatment is the placement of a layer of activated carbon (or other sequestering agent) on top of the contaminated sediment. The activated carbon mixes with the underlying contaminated material through bioturbation and propwash to reduce contaminant bioavailability of the surface sediments. In some cases, it may not be possible to treat all contaminated sediments in limited access areas due to obstructions or areas where access is limited. The impact of these untreated sediments will be evaluated during post-construction monitoring and may require additional treatment or other containment strategies if needed to assure that sediment concentrations are less than the RALs and ultimately that the final cleanup levels are attained.

Residuals Management Cover (RMC): Dredge residuals refers to material released during dredging, and redepositing on the dredged surface. This may be mitigated with the placement of a residuals management cover (RMC), consisting of approximately nine inches of clean sand that would be applied as soon as possible following the completion of dredging. The final thickness would be determined based on concentrations measured during post-remediation sampling. The RMC would be placed in all open water dredged areas and locations adjacent to dredged areas where residuals may have settled, providing a cleaner surface material that would mix with the underlying contaminated sediment to reduce contaminant concentrations.

Sediment Disposal

Dredged material not suitable for open water disposal would be transported to a permitted off-site upland disposal facility, most likely by barge and rail. Data collected during the SRI/FS indicate that the dredged material is likely to be non-hazardous under the Resource Conservation and Recovery Act (RCRA) and can be disposed at a facility that accepts non-hazardous waste. Dredged material determined to meet the definition of a hazardous waste will be disposed of at an appropriately permitted off-site facility. Some clean material may need to be dredged as part of the cleanup; for example, to maintain slope stability at the edges of the dredge area. Clean sediments that pass the Dredged Materials Management Program criteria for the State of Washington may be disposed at an open water disposal site.

Institutional Controls

Institutional controls are advisories, limitations, or restrictions put in place to protect human health and the environment by reducing exposure to contamination left in place, to ensure remedy protectiveness, and to protect the long-term integrity of the engineered components of the remedy. Below are potential institutional control mechanisms that may be used at the EW OU.

Fish advisories and educational outreach: Advisories and educational outreach programs that have been implemented for fish consumption at multiple CERCLA sites in the watershed would be implemented in the EW OU to inform the public of the risks associated with the consumption of contaminated fish and shellfish. The ongoing fish and shellfish consumption advisories addressing resident species in the East Waterway would be continued in coordination with WSDOH. Risk related to residual PCBs following cleanup, as well as those associated with PCBs throughout the watershed, will be evaluated and may continue to be addressed through WSDOH fish advisories. Educational outreach programs similar to those implemented in the LDW will be established for the EW OU and may include informational meetings, development and distribution of informational materials such as brochures and maps, and installation and maintenance of advisory signs at known fishing locations.

Waterway use restrictions and regulated navigation areas: Where engineered caps would be utilized to contain contamination in navigable areas, waterway use restrictions may be implemented to ensure the long-term integrity of the cap. These measures may include restrictions on boat anchoring and keel dragging, vessel groundings in shallow areas, the use of spuds to stabilize vessels, structure and utility maintenance, and future maintenance dredging and/or deepening. Notifications such as signs and buoys may also be used to notify and warn the public. These restrictions would be implemented in coordination with the USCG.

Land use restrictions: Land use restrictions would be implemented in areas of in situ treatment or capping to ensure the applied treatment material or cap is not disturbed.

Monitoring

Monitoring is an integral component of all the alternatives to ensure that the selected remedy is constructed to design specifications, achieves the performance standards to evaluate short and long-term effectiveness of the interim action, and in this case to develop cleanup levels that are achievable and protective. Media monitored for these purposes will include sediment, sediment porewater, surface water, stormwater, and fish and shellfish tissue.

The program will include monitoring the known and potential sources of contamination to better understand the hydrodynamics of the Green/Duwamish Watershed to inform final cleanup level development for the EW OU. The data from this monitoring program, along with other pertinent information, will be used to assess the short and long- term effects of these sources on the sediment in the EW OU and determine what can be achieved at the EW OU.

ARARs

Section 121(d)[2] of CERCLA requires that, with respect to hazardous substances, pollutants or contaminants that will remain onsite, remedial actions achieve a level or standard of control for such hazardous substances, pollutants or contaminants that attains ARARs which are comprised of federal environmental law or more stringent and promulgated state environmental or facility siting law. CERCLA further provides that a remedy that does not attain an ARAR can be selected if the remedy assures protection of human health and the environment and meets one of six waiver criteria described in CERCLA Section 121(d)(4)[3]. At this time, EPA has no information to justify waiving any of the identified potential ARARs for the Site. Potential ARARs include certain provisions of the Resource Conservation and Recovery Act (RCRA),) the Washington Model Toxics Control Act (MTCA), the Washington Sediment Management Standards (SMS), Washington Water Quality Standards, Ambient Water Quality Criteria under the Clean Water Act (CWA), and dredge and fill requirements of the CWA. Endangered Species Act (ESA) requirements may affect remedy implementation to protect Chinook salmon migrating through the EW OU during in-water construction. Generally, in-water construction is considered to be restricted to a period between July 16 to February 15 (about 150 working days; USACE, 2017a). Additional reductions in construction windows to a period between October 1 and February 15 may be required to accommodate Tribal treaty fishing rights. The construction duration estimated for each alternative was based on the shorter construction window (100 days); however, coordination with the National Marine Fisheries Service and the Tribes may allow for a longer construction window.

Remedial Alternatives

The FS evaluated 10 alternatives (Appendix L of the FS) to actively address those areas with sediment concentrations greater than the RALs, varying the following three components.

Alternative Component 1: Open water areas. Open water areas do not have access limitations, yet these areas typically have increased potential for disturbance from marine vessel traffic (see Figure 6 and Table 9). The remedial technologies considered for areas above the RAL in the open water areas are as follows:

Option 1 Removal, capping, and ENR in the navigation and Sill Reach.

Option 2 Removal, capping, and ENR in the Sill Reach.

Option 3 Removal and capping.

[2,3] 42 U.S.C. § 9621(d)

Alternative Component 2: Limited access areas. The remedial technologies under bridges and piers are restricted by the limited access (see Figure 6). The remedial technologies considered for areas where concentrations are greater than the RALs in the limited access areas are summarized below:

Option A MNR in Under-pier Areas. MNR and ENR in the Sill Reach.

Option B In situ treatment in Under-pier Areas. ENR in the Sill Reach.

Option C+ Diver-assisted hydraulic dredging at Under-pier Areas with PCBs or mercury concentrations greater than the RALs, followed by in situ treatment for other Under-pier Areas. ENR in the Sill Reach.

Option E Diver-assisted hydraulic dredging followed by in situ treatment in all Under-pier Areas. ENR in the Sill Reach.

Alternative Component 3: RAL for Total PCBs. The remedial footprint was developed using all RALs. For total PCBs, two RALs were considered during alternatives evaluation:

12 mg/kg OC (192 μg/kg dry weight)

7.5 mg/kg OC (120 μg/kg dry weight)

The technology components that comprise each alternative are summarized in Table 6. The areal extent of construction is 121 acres (representing 77 percent of the EW) when using the PCB RAL of 12 mg/kg OC and is 132 acres (representing 84 percent of the EW) when using the PCB RAL of 7.5 mg/kg OC. Beyond the areal extent, differences among the alternatives are due to the technologies that are used to address different portions of the EW.

Consistent with EPA guidance (EPA, 2000), a present value analysis was performed for the anticipated expenditures over the life of each alternative to enable a comparison of total project costs. This was done by using discount rates developed annually by the Office of Management and Budget (OMB). Typically, remedial action costs are discounted by 7 percent to account for economic growth. However, the federal government has a different cost of capital than the private sector (the federal government cannot invest money in the same way). The EW OU project has been primarily funded by public entities, including the County, City, and Port, and the project is unlikely to be transferred to private entities. The cost of capital for these local government entities was considered to be similar to that of the federal government, and a discount rate of zero percent was used in the FS for the present value analysis. Costs based on a discount rate of 7 percent were also calculated for each alternative for comparative purposes and are presented in the comparative analysis. Operations and maintenance (O&M) costs for all alternatives were estimated assuming a duration of 20 years.

The areas associated with each technology for each alternative are shown in Figure 10. The costs shown are the net present value.

Table 6. Remedial Alternatives

<table>
<tr><th rowspan="2">Alternative</th><th colspan="5">Technologies for Open Water Areas[1,2]</th><th colspan="3">Technologies for Limited Access Areas[1]</th><th rowspan="2">PCBs RAL (mg/kg OC)</th></tr>
<tr><th>Option</th><th>Deep Main Body and Berth Areas</th><th>Shallow Main Body</th><th>Nearshore</th><th>Sill Reach – West Seattle Bridge</th><th>Option</th><th>Under-pier</th><th>Sill Reach – Low Bridges</th></tr>
<tr><td>No Action</td><td>-</td><td colspan="4">None</td><td>-</td><td colspan="2">None</td><td>None</td></tr>
<tr><td>1A(12)</td><td rowspan="3">1</td><td rowspan="3">Dredging and ENR-nav</td><td rowspan="3">Dredging and Capping</td><td rowspan="3">Dredging and Capping</td><td rowspan="3">ENR-sill</td><td>A</td><td>MNR</td><td>ENR-sill and MNR</td><td rowspan="7">12</td></tr>
<tr><td>1B(12)</td><td>B</td><td>In situ treatment</td><td>ENR-sill</td></tr>
<tr><td>1C+(12)</td><td>C+</td><td>Diver-assisted dredging in areas with elevated PCBs or mercury. Then, in situ treatment everywhere.</td><td>ENR-sill</td></tr>
<tr><td>2B(12)</td><td rowspan="2">2</td><td rowspan="2">Dredging</td><td rowspan="2">Dredging and Capping</td><td rowspan="2">Dredging and Capping</td><td rowspan="2">ENR-sill</td><td>B</td><td>In situ treatment</td><td>ENR-sill</td></tr>
<tr><td>2C+(12)</td><td>C+</td><td>Diver-assisted dredging in areas with elevated PCBs or mercury. Then, in situ treatment everywhere.</td><td>ENR-sill</td></tr>
<tr><td>3B(12)</td><td rowspan="2">3</td><td rowspan="2">Dredging</td><td rowspan="2">Dredging</td><td rowspan="2">Dredging and Capping</td><td rowspan="2">Dredging</td><td>B</td><td>In situ treatment</td><td>ENR-sill</td></tr>
<tr><td>3C+(12)</td><td rowspan="2">C+</td><td rowspan="2">Diver-assisted dredging in areas with elevated PCBs or mercury. Then, in situ treatment everywhere.</td><td rowspan="2">ENR-sill</td></tr>
<tr><td>2C+(7.5)</td><td>2</td><td>Dredging</td><td>Dredging and Capping</td><td>Dredging and Capping</td><td>ENR-sill</td><td rowspan="2">7.5</td></tr>
<tr><td>3E(7.5)</td><td>3</td><td>Dredging</td><td>Dredging</td><td>Dredging and Capping</td><td>Dredging</td><td>E</td><td>Diver-assisted dredging followed by in situ treatment.</td><td>ENR-sill</td></tr>
</table>

Notes:

1. Technology areas are shown in Figure 6.
2. Technologies address areas where concentrations are greater than the RAL; MNR is considered in all areas where concentrations are less than the RAL

No Action Alternative

CERCLA requires that a No Action Alternative be considered as a baseline for comparison with other alternatives. Estimated costs for the No Action Alternative were based on conducting a review of EW conditions at 5-year intervals and monitoring sediment, water, and fish. These costs are included in the summary below.

Capital Costs:	$0
O&M Costs:	$950,000
Net Present Value (0%):	$950,000
Net Present Value (7%):	$650,000
Construction Timeframe:	N/A

Alternative 1A (PCB RAL 12 mg/kg)

Alternative 1A(12) employs a combination of dredging sediment, capping, and ENR in open water areas, and ENR and MNR in limited access areas, as shown on Figure 11. This alternative addresses 121 acres by removing approximately 810,000 cy of contaminated sediment by dredging and placing of 290,000 cy of new clean material for capping, ENR, MNR, and a RMC layer. The total acres assigned each technology is shown on Figure 10.

Capital Costs:	$254,000,000
O&M Costs:	$1,910,000
Net Present Value (0%):	$256,000,000
Net Present Value (7%):	$192,000,000
Construction Timeframe:	9 years

Alternative 1B (PCB RAL 12 mg/kg)

Alternative 1B(12) includes the same action for the open water areas as described in Alternative 1A(12). However, it includes in situ treatment of sediment in the Under-pier Areas, instead of MNR, as shown on Figure 11. This alternative addresses 121 acres by dredging approximately 810,000 cy of contaminated sediment and placing 290,000 cy of new clean material for capping, ENR, and in situ treatment and placing a RMC layer. The total acres assigned each technology is shown on Figure 10.

Capital Costs:	$261,000,000
O&M Costs:	$2,960,000
Net Present Value (0%):	$264,000,000
Net Present Value (7%):	$199,000,000
Construction Timeframe:	9 years

Alternative 1C+ (PCB RAL 12 mg/kg)

Alternative 1C+(12) includes all the work described in Alternative 1B(12) for open water but utilizes diver-assisted dredging in some Under-pier Areas. This alternative addresses 121 acres employing a combination of dredging, capping, and ENR in open water areas as shown on Figure 11. Alternative 1C+(12) removes 820,000 cy of contaminated sediment by mechanical dredging and places 290,000 cy of new clean material for capping, ENR, and in situ treatment, and placing a RMC layer. The total area assigned each technology is shown on Figure 10.

Capital Costs:	$274,000,000
O&M Costs:	$2,960,000
Net Present Value (0%):	$277,000,000
Net Present Value (7%):	$209,000,000
Construction Timeframe:	9 years

Alternative 2B (PCB RAL 12 mg/kg)

Alternative 2B(12) employs a combination of dredging, capping, and limited ENR in the open water areas, and ENR and in situ treatment in the limited access areas, shown on Figure 12. This alternative addresses 121 acres by dredging approximately 900,000 cy of contaminated sediment and placing 280,000 cy of new clean material for capping, ENR, and in situ treatment, and placing a RMC layer. The total area assigned each technology is shown on Figure 10.

Capital Costs:	$281,000,000
O&M Costs:	$2,900,000
Net Present Value (0%):	$284,000,000
Net Present Value (7%):	$210,000,000
Construction Timeframe:	10 years

Alternative 2C+ (PCB RAL 12 mg/kg)

Alternative 2C+(12) employs a combination of dredging, capping, and limited ENR in the open water areas, and ENR, diver-assisted dredging, and in situ treatment in the limited access areas as shown on Figure 12. This alternative addresses 121 acres by removing 910,000 cy of contaminated sediment through mechanical dredging and place 280,000 cy of new clean material for capping, ENR, and in situ treatment, and placing a RMC layer. The total acres assigned each technology is shown on Figure 10.

Capital Costs:	$294,000,000
O&M Costs:	$2,900,000
Net Present Value (0%):	$297,000,000
Net Present Value (7%):	$220,000,000
Construction Timeframe:	10 years

Alternative 3B (PCB RAL 12 mg/kg)

Alternative 3B(12) includes dredging for nearly all open water areas, with the exception of two nearshore locations near the Mound Area and Coast Guard nearshore that would be capped due to the technical infeasibility of dredging in these areas. Contaminated sediment in nearshore areas of the Sill Reach and former Terminal 25 would be removed and backfilled with clean material to the pre-dredge elevation as shown on Figure 12. This alternative addresses 121 acres by dredging approximately 960,000 cy of contaminated sediment, placing 270,000 cy of new clean material for capping, ENR, and in situ treatment, and placing a RMC layer. The total acres assigned each technology is shown on Figure 10.

Capital Costs:	$295,000,000
O&M Costs:	$2,870,000
Net Present Value (0%):	$298,000,000
Net Present Value (7%):	$220,000,000
Construction Timeframe:	10 years

Alternative 3C+ (PCB RAL=12 mg/kg)

Alternative 3C+(12) employs a combination of dredging and capping in the open water areas; ENR, diver-assisted dredging, and in situ treatment in the limited access areas, as shown in Figure 13. This alternative addresses 121 acres by dredging 960,000 cy of contaminated sediment and placing 270,000 cy of new clean material for capping, ENR, and in situ treatment, and placing a RMC layer. The total acres assigned each technology is shown on Figure 10.

Capital Costs:	$307,000,000
O&M Costs:	$2,870,000
Net Present Value (0%):	$310,000,000
Net Present Value (7%):	$230,000,000
Construction Timeframe:	10 years

Alternative 2C+ (PCB RAL= 7.5 mg/kg)

Alternative 2C+(7.5) employs a combination of dredging, capping, limited use of ENR in the open water areas; ENR, diver-assisted dredging, and in situ treatment in limited access areas, as shown on Figure 13. This alternative addresses 132 acres by dredging 1,010,000 cy of contaminated and placing 290,000 cy of new clean material for capping, ENR, and in situ treatment, and placing a RMC layer. The total acres assigned each technology is shown on Figure 10.

Capital Costs:	$323,000,000
O&M Costs:	$2,880,000
Net Present Value (0%):	$326,000,000
Net Present Value (7%):	$235,000,000
Construction Timeframe:	11 years

Alternative 3E (PCB RAL=7.5 mg/kg)

Alternative 3E(7.5) is the most removal-focused alternative, with removal in the open water and all of the Under-pier Areas. This alternative employs a combination of removal and capping in the open water areas; ENR and diver-assisted dredging (prior to in situ treatment) in all limited access areas, as shown on Figure 13. This alternative addresses 132 acres by dredging 1,080,000 cy of contaminated sediment and placing 270,000 cy of new clean material for capping and ENR, and placing a RMC. The total acres assigned each technology is summarized on Figure 10.

Capital Costs:	$408,000,000
O&M Costs:	$2,850,000
Net Present Value (0%):	$411,000,000
Net Present Value (7%):	$285,000,000
Construction Timeframe:	13 years

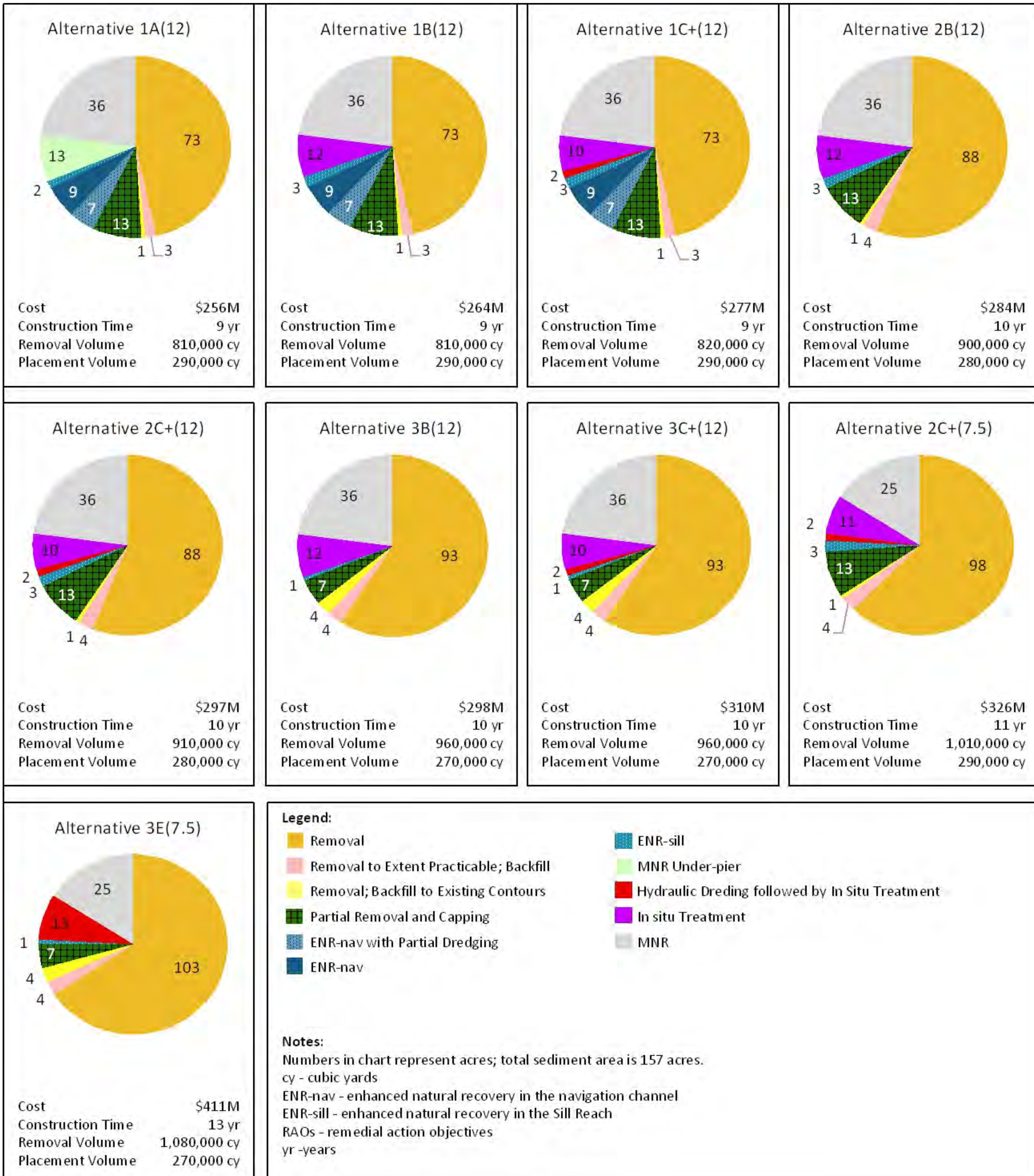


Figure 10. Areas, Volumes, and Costs for all Action Alternatives

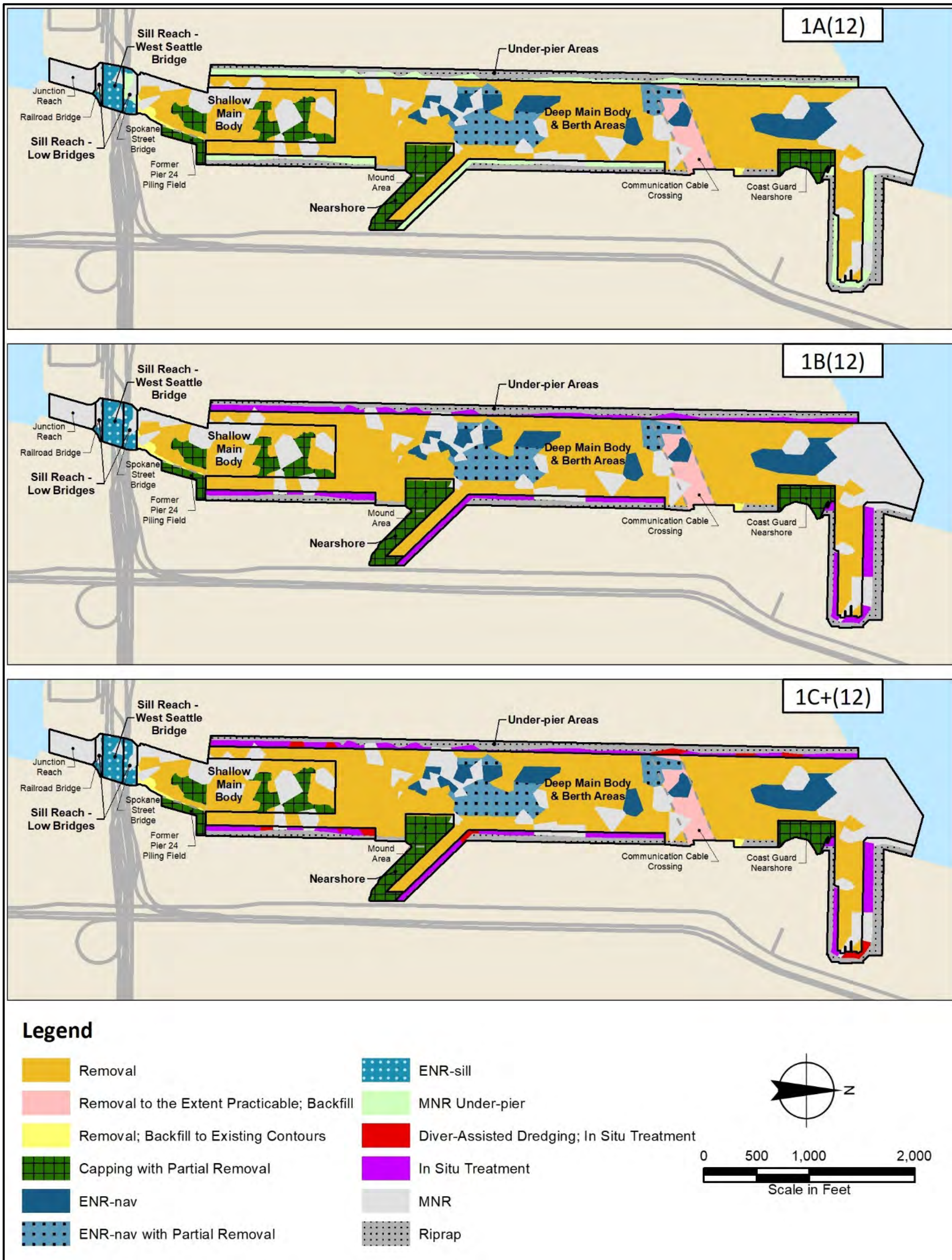


Figure 11. Map of Alternatives 1A(12), 1B(12), and 1C+(12)

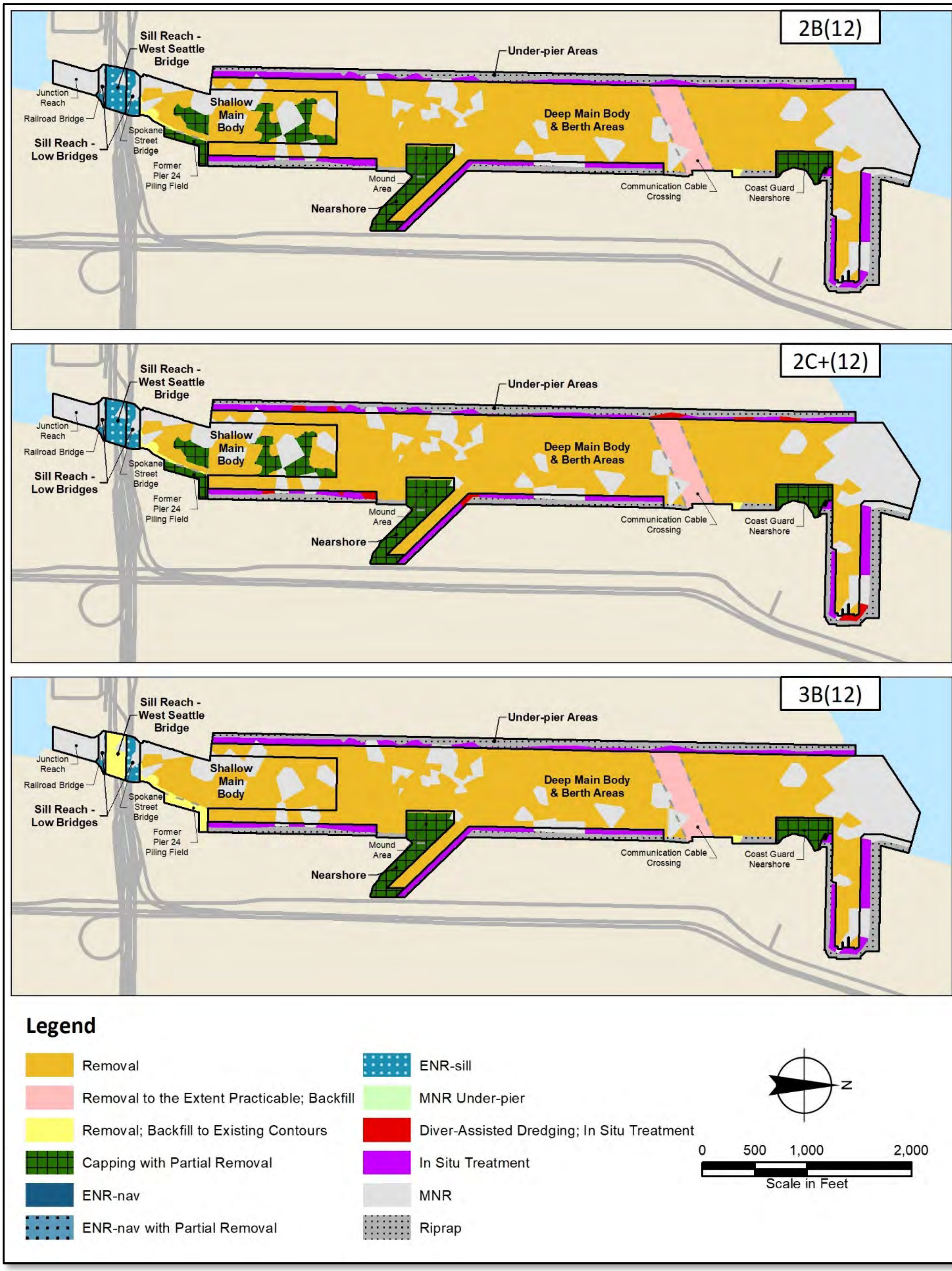


Figure 12. Map of Alternatives 2B(12), 2C+(12), and 3B(12)

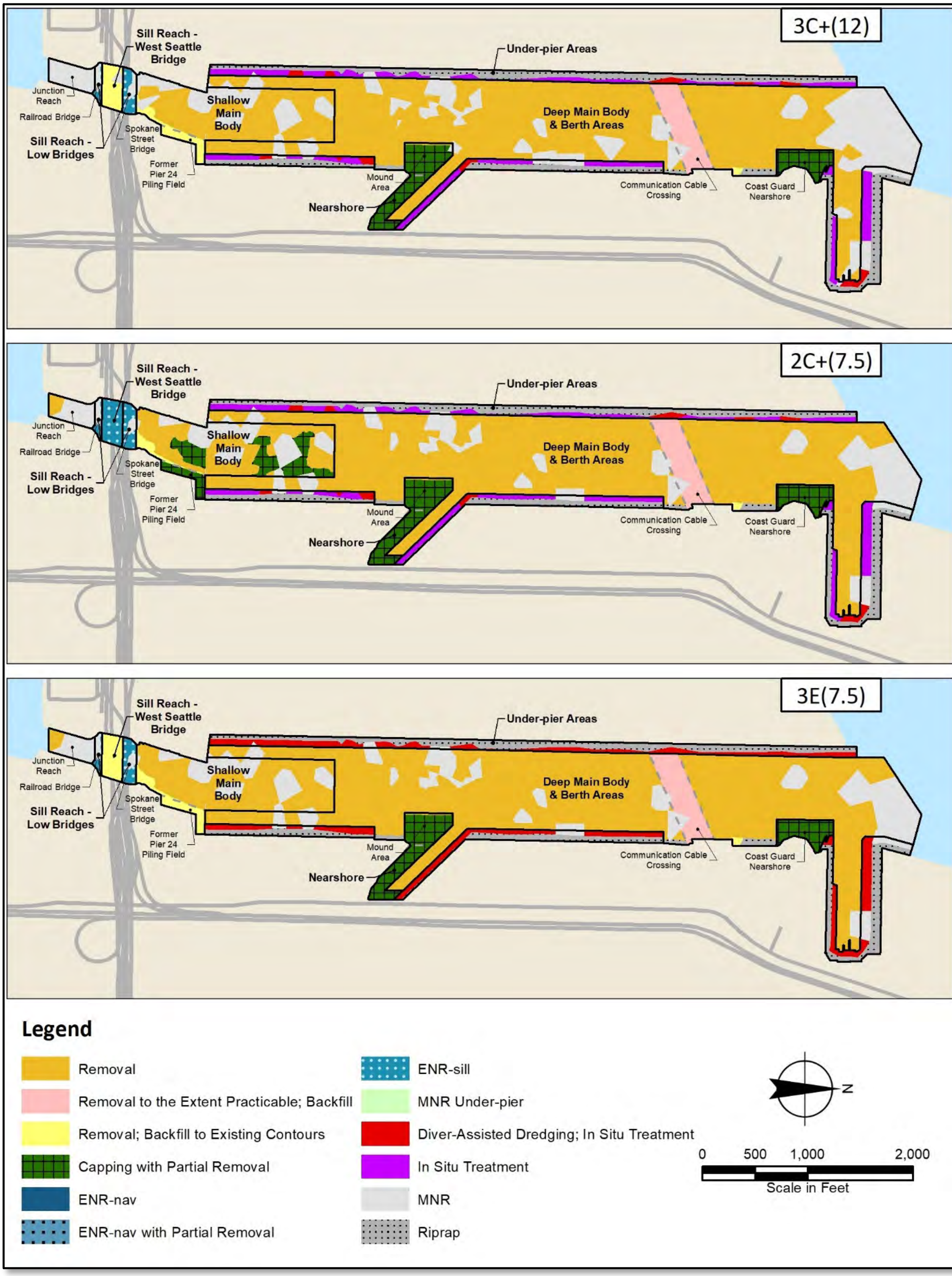


Figure 13. Map of Alternatives 3C+(12), 2C+(7.5), and 3E(7.5)

THE NINE SUPERFUND EVALUATION CRITERIA (40 C.F.R. § 300.430(e)(9)(iii))

The first two criteria are ***threshold criteria*** that must be met by each alternative.

1. **Overall Protection of Human Health and the Environment** evaluates whether an alternative adequately protects human health and the environment by eliminating, reducing, or controlling unacceptable risks posed by exposures to hazardous substances, pollutants, or contaminants.
2. **Compliance with ARARs** evaluates whether the alternative meets federal and state environmental statutes, regulations, and other requirements that pertain to the site, or whether a waiver of any such requirements is justified.

The next five criteria are the ***balancing criteria*** upon which the analysis in this Proposed Plan is based.

3. **Long-Term Effectiveness and Permanence** considers the ability of an alternative to maintain protection of human health and the environment over time.
4. **Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment** evaluates an alternative's use of treatment or recycling to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.
5. **Short-Term Effectiveness** considers the length of time needed to achieve protection and the risks or impacts the alternative poses to workers, the community, and the environment during implementation of the remedial action.
6. **Implementability** considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.
7. **Cost** includes estimated capital and annual operations and maintenance costs, as well as net present value of these costs. Net present value cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.

The final two criteria are referred to as ***modifying criteria***, which will be evaluated following comments received during the public comment period and addressed in making the final remedy decision in the ROD.

8. **State/Tribal Acceptance** considers state and affected Tribes agree with EPA's analyses and recommendations, as described in the RI/FS and Proposed Plan.
9. **Community Acceptance** considers whether the local community agrees with EPA's analyses and Preferred Alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

Comparative Analysis of Alternatives

Superfund regulations require that alternatives be evaluated using nine criteria (described in the inset above). Using these criteria, the alternatives are evaluated independently, then compared to identify the relative advantages and disadvantages of each.

Threshold criteria must be achieved for an alternative to be considered under CERCLA. The Preferred Alternative is then selected based on the weight of evidence of the five balancing criteria. Two modifying criteria (state and Tribal acceptance, and community acceptance) will be evaluated based on comments received on the Proposed Plan during the public comment period.

The FS considered both the threshold criteria and balancing criteria in evaluating each of the alternatives. The following section summarizes the results of the comparative analysis. Additional details can be found in Section 10 of the FS.

Overall Protection of Human Health and the Environment

A requirement of CERCLA is that the selected remedial action be protective of human health and the environment. An alternative is protective if it reduces current and potential future risks associated with each exposure pathway at a site to acceptable levels. The No Action Alternative would not be protective of human health and the environment. Contaminants in the EW OU surface sediments, surface water, and biota would continue to pose unacceptable risks to human health and the environment for the foreseeable future. Natural recovery alone is unlikely to achieve levels that are protective and meet the long-term RAOs in a reasonable timeframe.

The remaining alternatives achieve the Interim RAO and are expected to result in declining contaminant concentrations in sediment following construction of the interim action through natural processes.

Except for the No Action Alternative, each of the alternatives achieve a similar level of overall protection of human health and the environment by relying primarily on removing contaminated sediment from the EW OU. Remaining risks are addressed through a combination of capping, ENR, MNR, and institutional controls. Differences between these alternatives are the potential application of ENR or capping in open water areas, and the use of in-situ treatment or diver-assisted hydraulic dredging in the limited access areas. The remedial footprint is identical for seven of the nine alternatives. Two of the remedial alternatives (2C and 3E) apply a lower RAL for PCBs (7.5 mg/kg OC), resulting in a slightly larger remedial footprint.

Compliance with ARARs

ARARs are discussed in Sections 6.2.1 and 7.3 of the FS.

The No Action Alternative is not expected to comply with ARARs, and therefore the No Action Alternative does not meet either threshold criteria, and therefore is not discussed further. All other alternatives comply with ARARs as they relate to the interim action.

Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of an alternative to maintain reliable protection of human health and the environment over time. Key considerations for evaluating this criteria are long-term risks and magnitude of the residual risk, and the adequacy and reliability of controls for containing untreated waste left in place at depth or treatment residuals over time.

Magnitude of Residual Risk

Residual risk is the same for all the alternatives, as each alternative is expected to ultimately achieve the same sediment concentrations through natural processes.

Adequacy and Reliability of Controls

The adequacy and reliability of controls is a measure of the effectiveness of the controls needed to manage residual risks from contaminated sediment remaining following remediation. The magnitude and importance of those controls is driven primarily by the potential for exposure to contaminants left in place.

The alternatives differ in the long-term reliability of the methods used to contain contamination left in place. Alternative 1A(12) relies on MNR, particularly under docks and piers. Surface sediment contamination would remain in place untreated, resulting in ongoing exposures and risk for an extended period of time. Exposure to contamination is predicted to be lower for all other alternatives, primarily due to the contaminated sediment removal and the application of the RMC layer in open water areas and treatment or removal in the limited access areas.

The amount of subsurface contamination that is removed also provides an indication of the long-term permanence of the alternatives. Bottom disturbances, such as propwash from vessel traffic, can expose and redistribute contaminated subsurface sediments. The potential for exposing contaminated subsurface sediments is lowest for alternatives that include complete removal and capping.

In the under-pier areas, in-situ treatment would be less protective than dredging or capping because it leaves contaminants in place. In-situ treatment is expected to reduce bioavailability by 70 to 90 percent. ENR reduces risk from contaminated sediments by placing a 9- to 18-inch layer of sand/gravel over the sediment surface, lowering surface sediment concentrations. This cleaner material provides a protective layer that is mixed into the underlying sediment over time, but subsurface contaminants can be exposed through disturbance and mixing of the ENR layer.

Based on the amount of subsurface contamination left in place and the potential for that contamination to be exposed or redistributed, it is anticipated that those alternatives with the most extensive removal of contaminated sediments would provide the best long-term effectiveness. While the application of in-situ treatment/ENR/MNR are important considerations, the under-pier areas proposed for these treatments are relatively small compared to the areas proposed for dredging and capping.

The application of a RMC layer is included in each alternative as a means of controlling dredged residuals and is similar for each alternative. Further discussion of residuals management is presented in Section 10 of the FS.

The extent of cap monitoring and maintenance is directly related to the areal extent where contamination is left in place. Alternatives that remove more of the contaminated sediments require less long-term monitoring. Alternatives with more capping require more monitoring than those that rely on a greater amount of dredging. Alternatives that rely more on MNR, ENR, and in-situ treatment require more monitoring to ensure that sediment concentrations continue to decline.

Institutional controls will be required for all alternatives to maintain the integrity of all capped areas and in-situ treatment areas. Fish consumption advisories to protect human health are already in place.

Summary

Long-term effectiveness and permanence were evaluated for each alternative based on long-term risk reduction and magnitude of the risk remaining and the adequacy and reliability of controls. This evaluation considers areas where contamination is permanently removed as well as areas that will require technology-specific monitoring and maintenance.

Alternative 3E(7.5) removes the greatest amount of contaminated sediment and would require the fewest long-term controls. Alternatives 2B(12), 2C+(12), 3B(12), 3C+(12), 2C+(7.5) each rely on either extensive contaminated sediment removal or other permanent actions that would require minimal maintenance and monitoring. Alternatives 1B(12) and 1C+(12) leave more contaminated sediment in place and would require more maintenance and monitoring to maintain long-term protectiveness. Alternative 1A(12) would leave the greatest amount of contaminated sediment in place, resulting in greater reliance on MNR and less reliance on engineered controls.

Reduction in Toxicity, Mobility, or Volume through Treatment

Alternative 1A(12) does not include any treatment. All other action alternatives include in situ treatment using activated carbon or other sequestering agents as a remedial technology in the under-pier areas of the EW OU.

Short-Term Effectiveness

Short-term effectiveness evaluates the impacts of each alternative on human health and the environment during the construction phase of the interim remedial action. This criterion includes the following metrics:

- Community and worker protection during construction.
- Environmental impacts from construction, including those associated with dredge releases, transportation, air emissions, and carbon footprint during implementation.
- The time to construct the interim remedy.

Community and Worker Protection

Risks to workers from activities at the construction site, as well as exposure to EW OU-related contaminants, are generally low and are managed through established health and safety requirements for work at hazardous waste sites and best management practices. Nevertheless, the potential for worker injuries increases with a longer construction period. Consumption of shellfish and resident fish during and following construction represents a short-term risk to the community. Concentrations of COCs in resident fish are expected to remain constant or may increase during construction due to contaminated sediment resuspension but are expected to decline once construction activities cease.

Disruptions and inconveniences to the public and commercial community, such as increased traffic and temporary waterway restrictions, can be expected during construction. These include the impacts of trucks, trains, and barges needed to transport materials to and from the EW OU.

Short-term risks to workers and the community are generally proportional to the duration of construction activities, volume of material handled, and transportation requirements.

Diver-assisted hydraulic dredging is a specialized worker category included in Alternatives 1C+(12), 2C+(12), 3C+(12), 2C+(7.5), and 3E(7.5). This activity has more risk for workers than any of the other construction activities, with risks increasing with greater duration and amount of this activity. Alternative 3E(7.5) poses the highest risk to worker safety because of the amount of hazardous diver-assisted hydraulic dredging included (13 acres).

The relative impacts of trucks, trains, and barges needed to transport sediment were based on the total hauled miles, which included transporting sediment to off-site disposal facilities as well as transporting construction materials (sand, gravel, armor stone, and activated carbon) to the EW OU. Transportation impacts will be managed with traffic control plans developed during remedial design. Based on the volume of material removed and imported for caps and cover, duration of construction and transportation miles, Alternatives 1A(12), 1B(12), and 1C+(12) are predicted to have the lowest short-term community impacts. Alternatives 2B(12), 2C+(12), 3B(12), and 3C+(12) would have greater impacts, and Alternatives 2C+(7.5) and 3E(7.5) would have the greatest impacts.

Environmental Impacts

Environmental impacts considered in evaluating the alternatives included noise, air emissions, landfill capacity utilization, depletion of natural resources, ecological impacts, and energy consumption. As with impacts to the community, alternatives with longer durations and higher volumes of sediment to transport have greater environmental impacts. Remedial design will evaluate ways to lower environmental impacts when alternatives exist, following regional and national green remediation guidance (EPA, 2009).

Time to Achieve RAOs

The time to achieve RAOs is an evaluation of the time required from the start of construction until performance expectations are met. As cleanup goals will be established in a final ROD, this analysis evaluated the time to achieve the RAO for the Interim Action, which is equivalent to the time required to complete the construction of each alternative.

Summary

Relative rankings for short-term effectiveness were based on community/worker protection and environmental impacts, as indicated by construction duration, volume removed, and time to achieve the interim RAO.

Alternatives 1B(12), 1C+(12), 2B(12), and 3B(12) have the fewest impacts to workers, the community, and the environment, with construction durations of 9 to 10 years, no diver-assisted hydraulic dredging, and low to moderate volumes of sediment removal. These alternatives achieve the interim RAO at the end of construction.

Alternatives 2C+(12) and 3C+(12) are expected to have greater short-term risks to workers, the community, and the environment than Alternatives 1B(12), 1C+(12), 2B(12), and 3B(12), with construction durations of 10 years and removal of 910,000 to 960,000 cy of sediment, and 2 years of diver-assisted hydraulic dredging.

Alternative 1A(12) is considered to have greater short-term risks to workers, the community, and the environment than Alternatives 2C+(12) and 3C+(12) because the time to achieve long-term performance goals is longer due to greater reliance on MNR. Alternative 2C+(7.5) also has greater construction impacts compared to the other action alternatives (11 years of construction; 2 years of diver-assisted dredging).

Alternative 3E(7.5) has the greatest short-term risks to workers, the community, and the environment. This alternative includes extensive diver-assisted dredging, the largest volume of dredged sediment, and the longest construction timeframe (13 years).

Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Technical feasibility encompasses the complexity and uncertainties associated with implementation of the alternative; the reliability of the technologies; the availability of materials, services, and equipment necessary for construction; and monitoring requirements. Administrative feasibility includes the activities required for coordination with other parties and agencies (such as obtaining permits for any off-site activities, access, or rights-of-way for construction).

All alternatives employ similar technologies in open water areas, including dredging, capping, and ENR. The construction activities required for the implementation of all open water technologies would be technically feasible and have been implemented at many Superfund sites around the country to address contaminated sediments. Materials, services, and equipment necessary for construction are readily available. Disposal facilities are also readily available and have adequate capacity for the volumes of contaminated material being removed.

The degree of technical challenges associated with the limited access areas vary more widely. MNR, as part of Alternative 1A(12), poses few technical challenges, with the lowest potential for difficulties, delays, and impacts to EW tenants and users. In situ treatment and diver-assisted hydraulic dredging in under-pier areas pose greater technical challenges than MNR. In-situ treatment, included in all alternatives except 1A(12), requires the selection of effective treatment material that depends on site-specific chemical and physical factors. Placement of in-situ treatment material in under-pier areas would be performed by conveyors, which is more complex than placement in open water areas.

Diver-assisted hydraulic dredging, included in all C+ and E alternatives, is a more difficult remedial technology to implement. Divers will be operating the dredge on steep slopes composed of large riprap. There are a number of factors that make the work more hazardous from a worker health and safety perspective, including divers working below overwater structures while anchoring sediment is removed, working in low visibility as a result of shade from the pier, working in deeper water, and working in sediments suspended due to dredging activities. Debris such as cables, large wood, and broken pilings will also make dredging more difficult and potentially physically more dangerous for workers implementing the interim remedy. Finally, hydraulic dredging generates large quantities of slurry (sediment and water mixture) that must be appropriately handled and treated as needed prior to disposal. The handling of this slurry requires large upland areas for storage, dewatering, and treatment.

Administrative feasibility factors for the EW OU include in-water construction windows, coordination with the maintenance and deepening of navigational depths, and coordination with ongoing vessel activities. In-water construction is not anticipated to occur year-round in order to protect juvenile salmonids migrating through the EW OU. This affects all the alternatives requiring in-water work proportional to the estimated length of the construction timeframe for each alternative. Coordination with DNR will be needed for all alternatives that include capping on State-owned aquatic land.

Construction activities associated with each alternative vary with respect to the compatibility with potential future dredging to maintain navigation depths in the waterway. Alternatives 1A(12), 1B(12), 1C+(12), 2B(12), 2C+(12), and 2C+(7.5) include capping in the southern Shallow Main Body Reach area, where the cap would be placed at elevations shallower than the current authorized elevation. Such cap placements may interfere with future efforts to increase navigation depths in the Shallow Main Body Reach.

The compatibility with future channel deepening from the Seattle Harbor Navigation Improvement Project (SHNIP) and amount of coordination required vary among the alternatives. Alternatives 1A(12), 1B(12), and 1C+(12) include areas of ENR and partial removal with ENR. ENR is assumed to require placement of a sand layer with a thickness of 18 inches. Given the currently authorized depth of -51 MLLW for the EW, it is likely that the future SHNIP will result in interference with ENR for these alternatives. The remaining Alternatives 2B(12), 2C+(12), 3B(12), 3C+(12), 2C+(7.5), and 3E(7.5) include full removal of contaminated sediment within the navigation channel boundaries. Therefore, these alternatives are unlikely to conflict with future SHNIP construction activities.

Alternatives 1A(12), 1B(12), 2B(12), and 3B(12) are considered to be the most implementable, balancing both technical and administrative implementability. Alternatives 1C+(12), 2C+(12), 3C+(12), 2C+(7.5), and 3E(7.5) were considered to be less implementable.

Cost

The estimated costs for the alternatives are based on the best available information related to volumes, concentrations and current market unit costs. Using a 7 percent discount rate Alternative 1A(12) is the least expensive at $256 million, followed by alternatives 1B(12) 1C+(12), 2B(12), 2C+(12), and 3B(12), 3 C+(12), 2C+(7.5) in increasing order, with alternative 3E(7.5) being the most costly at $411 million.

State and Tribal Acceptance

EPA has consulted with the State and affected Tribes and will further consider their input in the form of comments on the Preferred Alternative presented in this Proposed Plan.

Community Acceptance

EPA will consider community comments on EPA's Preferred Alternative presented in this Proposed Plan. Community acceptance of the preferred alternative will be addressed in the Responsiveness Summary in the interim ROD.

Preferred Alternative

After consideration of the remedial alternatives presented in the FS, EPA proposes a modified version of Alternative 3B(12) as the Preferred Alternative for this interim remedy. It follows the technology assignments of this alternative, except the open water area under the West Seattle Bridge. In this area, EPA is proposing ENR rather than dredging of contaminated sediment and backfill due to the technical limitations of mechanical dredging near the low clearance bridges. The locations for each remedial technology for the Preferred Alternative are shown on Figure 14, and total acres to which each technology is assigned are summarized on Figure 15.

The Preferred Alternative is being proposed as an interim remedy and will result in substantial near- and long-term reductions of COC concentrations in sediment, with resulting reductions in risk to human health and the environment. EPA has determined that an interim remedy will initiate the reduction of risks and allow time to evaluate the performance of the implemented interim action and the effectiveness of source control actions to select cleanup levels for the EW OU. Because all alternatives rely on RALs to assign various remedial technologies within the EW OU to actively remediate contaminated sediments, and then rely on MNR to achieve further reductions in contaminant concentrations, ultimately the contaminant concentrations in the EW OU sediments will equilibrate to the concentrations in the incoming sediments.

The key elements of the Preferred Alternative are:

- Open water: Option 3 Modified.
- Deep Main Body and Berth Areas: sediment removal.
- Shallow Main Body Reach: sediment removal, or sediment removal and backfill.
- Nearshore: Capping.
- Sill Reach – West Seattle Bridge: ENR.
- Limited Access: Option B.
- Under-Pier Areas: In situ treatment.
- Sill Reach – Low Bridges: ENR.
- PCB RAL: 12 mg/kg OC. A list of RALs for the other COCs for the Preferred Alternative is shown in Table 5.

The Preferred Alternative actively remediates 121 acres of the EW and includes the following:

- Dredging 99 acres of contaminated sediment in the open water portions of the EW. This includes 93 acres of dredging without backfill, 2 acres of dredging with backfill to existing contours, and up to 4 acres of dredging and backfilling in the Communication Cable Crossing.
- Capping 7 acres in the Nearshore Areas, which may require some dredging to accommodate navigation and habitat elevation requirements.

- Placement of approximately 3 acres of a 9-inch ENR layer in the Sill Reach under the Spokane Street, West Seattle, and Railroad Bridges. Access in this area is limited by low-clearance bridges that restrict access by mounted dredges.
- Placement of in situ treatment for contaminated sediments on over 12 acres of limited access in under-pier areas.
- Monitored natural recovery in 36 acres of the EW OU, where contaminant concentrations are below the RALs.
- The estimated time for construction is 10 years, assuming a 4.5-month construction window each year.

Sediment Disposal: An estimated 940,000 cy of contaminated sediment will be removed from the EW OU. This material will be transported, likely via barge and rail, to a permitted upland off-site disposal facility that accepts non-hazardous waste. Any hazardous waste encountered during dredging would be sent to a facility that is permitted to accept hazardous waste.

Residuals Management Cover: A RMC will be placed as soon as possible following completion of dredging activities for each dredging season and in areas adjacent to dredged areas where residuals may have settled. The RMC will consist of clean sand and is expected to be between 4 to 12 inches thick, with the final thickness to be determined based on post-remediation sediment bed elevation and sampling.

Institutional Controls: These controls include waterway use restrictions, and land use restrictions to protect caps and areas where in situ treatment is applied. Fish consumption advisories are already in place. EPA will work with the local governments to review data that will inform these advisories in the future.

Monitoring: Monitoring will be conducted during construction to ensure that the remedy is built according to specifications, such as determining that materials are dredged to the specified depth, verifying that sediment contaminant concentrations exceeding the RAL are removed, and ensuring the RMC is placed to the specified thickness and elevation. During construction activities, COC concentrations will also be monitored in the water column to ensure that best management practices for controlling resuspension of contaminated sediment during dredging are effective.

Data will be collected in the EW OU to assess the effectiveness of in-situ treatment, as well as in the Green/Duwamish watershed to inform development of final cleanup levels for the EW OU. Additionally, fish tissue will be monitored to identify trends in fish tissue levels over time and inform existing fish consumption advisories in the future.

Cost: The total estimated capital cost to construct the Preferred Alternative is $290 million ($214 million in net present value at the start of construction). This estimate is based on Alternative 3B(12), with some cost reduction associated with the change in technology in the Sill Reach – West Seattle Bridge.

Since the preferred alternative will leave contamination in place above levels that allow for unlimited use and unrestricted exposure, five-year reviews would be conducted as required by CERCLA.

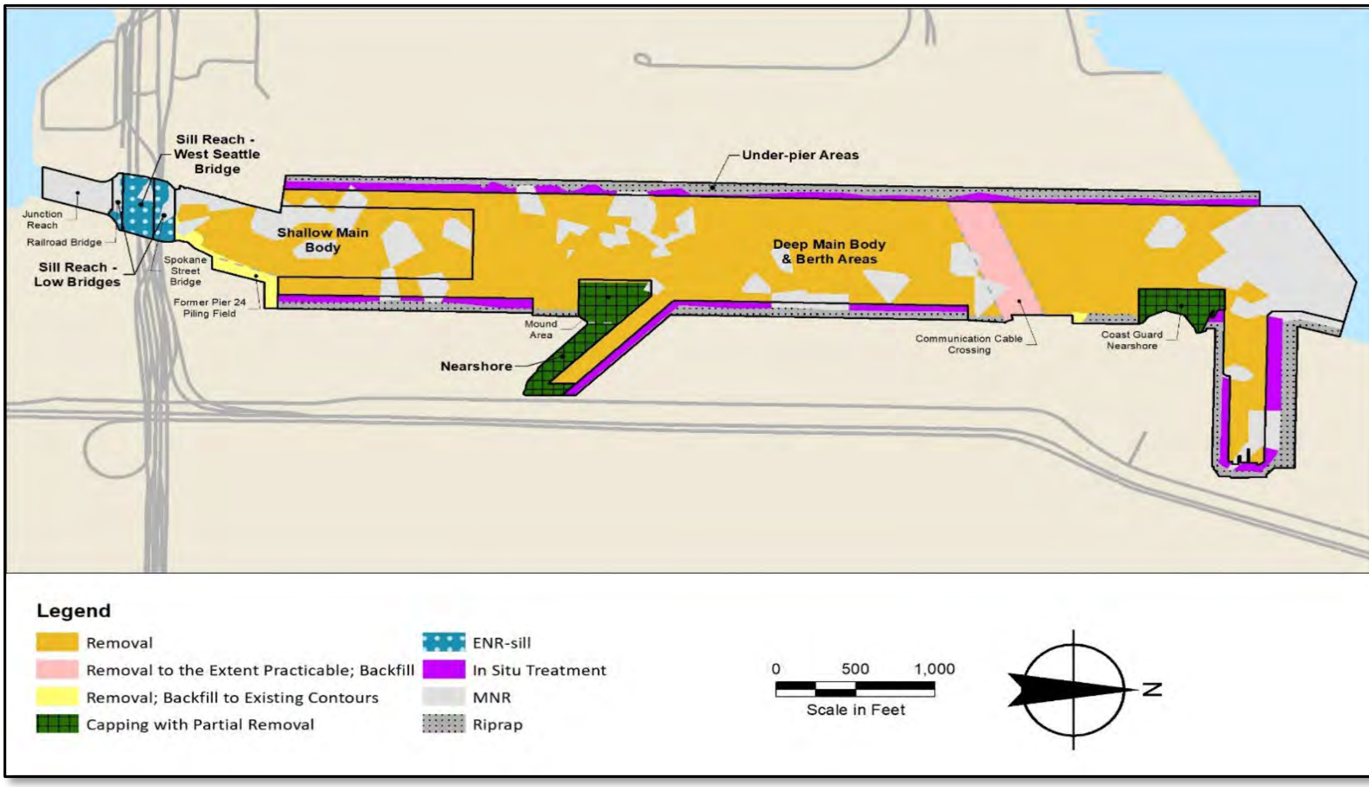


Figure 14. Preferred Alternative

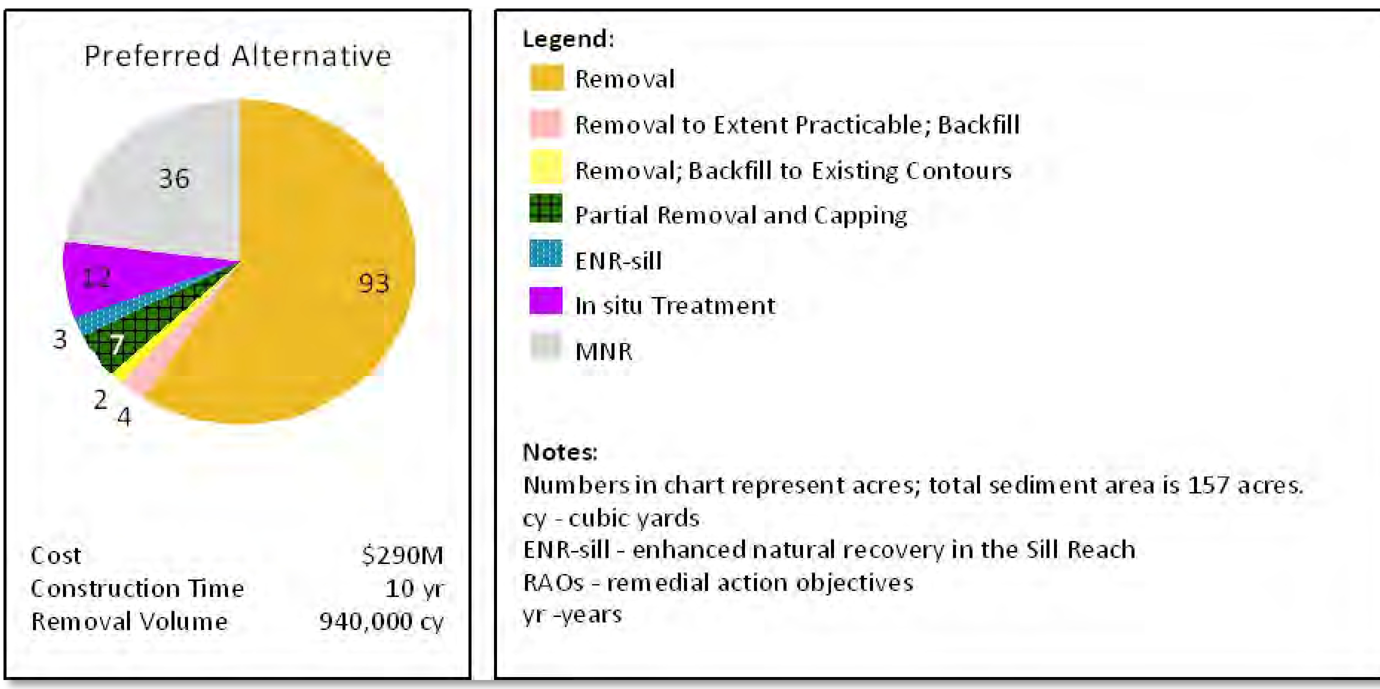


Figure 15. Area, Volume, and Cost Summary for the Preferred Alternative

Rationale for Selecting the Preferred Alternative

The Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs among the balancing criteria and will be consistent with the expected final remedy. It will reduce sediment contaminant concentrations contributing to human health and ecological risks, it will provide for long-term reliability by actively remediating 121 acres of contaminated sediment, and is implementable, cost-effective, and consistent with current and future uses of the EW OU.

The Preferred Alternative will achieve substantial risk reduction primarily through dredging, capping, and treating the most contaminated sediments. Additional reductions in risk will be achieved after implementation of this interim remedy through MNR. Cleanup levels will be selected in a final ROD after evaluating data collected during and afer remedy construction to evaluate remedy performance, source control, and the trends in contaminant concentrations.

Based on the information currently available and discussed above, the Preferred Alternative provides the best balance of tradeoffs compared to the other alternatives. In addition to implementation of the Preferred Alternative, to achieve EPA's long-term vision of achieving the lowest sediment contaminant levels possible in the EW OU, Ecology's upstream source control efforts throughout the Green/Duwamish River watershed will be essential.

EPA encourages the public to continue to engage on this Site throughout the Superfund cleanup process. It is important that the public understands the work that is being done and has an opportunity to provide meaningful input on cleanup decisions. EPA believes the best remedies are developed and implemented with the support of a well-informed community, and Superfund law requires that the public has an opportunity to read and comment on EPA's Proposed Plan for cleanup.

EPA has been working closely with the public since the Harbor Island Superfund Site was added to the National Priorities List in 1983, and has worked with affected communities, tribes, and local government to provide information that is as easy to read and clear as possible. With the issuing of this Proposed Plan, EPA has also prepared a summary of contaminants of concern (see the inset on page 6) and a list of acronyms (starting on page 50) to assist the public with navigating the Proposed Plan and other technical documents. This Proposed Plan will be available to the public online and at public meetings.

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Acronyms and Abbreviations

ARAR	applicable or relevant and appropriate requirements
AWQC	Ambient Water Quality Criteria
BERA	baseline ecological risk assessment
BHHRA	baseline human health risk assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	contaminant of concern
cPAHs	carcinogenic polycyclic aromatic hydrocarbons
cy	cubic yard
DNR	Washington State Department of Natural Resources
dw	dry weight
Ecology	Washington State Department of Ecology
ENR	enhanced natural recovery
EPA	U.S. Environmental Protection Agency
EW	East Waterway
EWG	East Waterway Group
FS	Feasibility Study
HI	hazard index
HQ	hazard quotient
kg	kilogram
LDW	Lower Duwamish Waterway
mg	milligram
MLLW	mean lower low water
MNR	monitored natural recovery
MTCA	Washington State Model Toxics Control Act
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
OC	organic carbon
O&M	operations & maintenance
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PRG	preliminary remediation goal
RAL	remedial action level
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
RMC	residuals management cover
RME	reasonable maximum exposure
ROD	Record of Decision
SCO	Sediment Cleanup Objective
SHNIP	Seattle Harbor Navigation Improvement Project
SMS	Washington State Sediment Management Standards
SRI	Supplemental Remedial Investigation
TBT	tributyltin
TTC	target tissue concentration

TEQ	toxic equivalent
µg	microgram
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
WQS	water quality standards
ww	wet weight