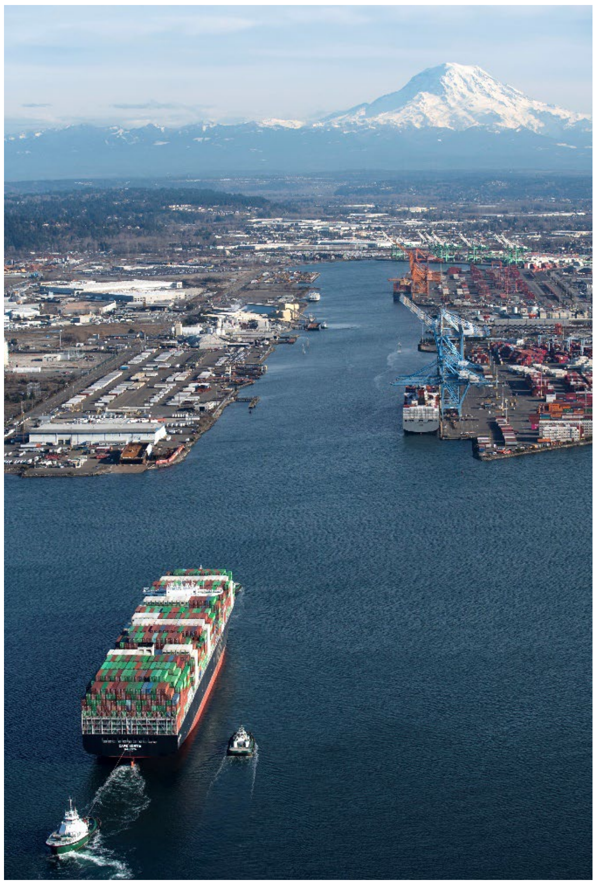
TACOMA HARBOR, WA
FEASIBILITY STUDY
PIERCE COUNTY, WASHINGTON

FINAL INTEGRATED FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT



April 2022

UPDATED June 2022

US Army Corps
of Engineers®
Seattle District

Port of
Tacoma

Front cover photograph courtesy of the Port of Tacoma

ERRATA SHEET
General Investigation Study
Integrated Feasibility Report and Environmental Assessment (IFR/EA)
Tacoma Harbor, Washington
3 June 2022

The intent of this errata sheet is to document revisions to the Final IFR/EA resulting from additional coordination with the Puyallup Tribe that occurred following Northwestern Division (NWD) approval of the Final IFR/EA on 3 May 2022. Additional information for the main report Executive Summary regarding the Puyallup Tribe's perspective is described below. Additional coordination correspondence has been added to Appendix D – Compliance Documentation. The revisions do not affect the selection of the recommended plan or other considerations contemplated by the IFR/EA. Each revision is described below.

Executive Summary

- Add to cover page "Updated June 2022".
- Add the following text to Executive Summary:

Add the following text below the Executive Summary table titled "Estimated Disposal Volumes for the Recommended Plan":

> "The Recommended Plan (NED Plan with Beneficial Reuse Proposal) will also result in only 562,000 cubic yards of suitable material being placed in Commencement Bay compared with full placement of an estimated 2,412,000 cubic yards suitable for open-water disposal under the NED Plan with Base Plan for Disposal thereby preserving capacity at the Commencement Bay open-water disposal site for other uses in the future. If in the pre-construction engineering and design (PED) phase the Saltchuk site is found to not be feasible, the project would revert to the base plan of full placement of an estimated 2,412,000 cubic yards at the Commencement Bay open-water disposal site. The Corps prepared a draft Monitoring and Adaptive Management Plan during feasibility (Appendix C, Supplemental Information) to evaluate the ecological effectiveness of beneficial use of suitable dredged material placement at the Saltchuk site during and post-construction. The Monitoring and Adaptive Management Plan will be updated based on additional design analysis conducted during PED.
>
> Further refinement of the beneficial reuse design at Saltchuk will be developed during the PED phase. The Corps will collaboratively engage with NMFS, other Federal and state agencies, and the Puyallup Tribe in finalizing any potential Saltchuk design (Section 6.2 ESA) including sediment suitability, placement locations and depths and monitoring. A full

sediment characterization that will occur during PED will provide additional information about material suitability for Saltchuk, and the Puyallup Tribe will be offered the opportunity to review and comment on this sampling design. The Corps will also engage the Tribe regarding criteria for placement of sediments at the Saltchuk site. Further coordination with natural resource agencies and tribes during PED will further inform the material's suitability for beneficial use."

Appendix D – Compliance Documents

- Add to cover page "Updated June 2022".
- Add to Table of Contents, under "1. Correspondence Addresses"

  "c. Communication with Puyallup Tribe of Indians and Port of Tacoma regarding disposal of dredged material at the Saltchuk Site (May-June 2022)

  i. Email correspondence/Puyallup Tribe of Indians – Disposal of Blair Waterway dredge spoils (11 May 2022)

  ii. Email correspondence/Port of Tacoma – Blair Waterway Deepening Project – Port of Tacoma Message (20 May 2022)

  iii. Email correspondence/Puyallup Tribe of Indians – Disposal of Blair Waterway dredge spoils (20 May 2022)

  iv. Email correspondence/Puyallup Tribe of Indians – Technical Meeting Tacoma Harbor GI Study (25 May 2022)

  v. Email correspondence/USACE – Beneficial Use at Saltchuk (3 June 2022)'

- Add to Appendix D in location described above the three emails received from Puyallup Tribe of Indians 11 May 2022, 20 May 2022, and 25 May 2022 describing the tribe's concerns with use of "dredge spoils" from Blair Waterway at the Saltchuk site, the 20 May 2022 Port of Tacoma email, and the 3 June 2022 email response from USACE to the Puyallup Tribe.

Executive Summary

Report Description

This integrated feasibility report and environmental assessment (IFR/EA) presents the results of a U.S. Army Corps of Engineers (Corps) deep draft navigation feasibility study undertaken to identify and evaluate alternatives to improve the navigation system's efficiency in Tacoma Harbor, Washington. This study is authorized by Section 209 of the Rivers and Harbors Act of 1962, as amended (Public Law 87-874). The Corps is undertaking this study in partnership with the Port of Tacoma (Port) as the non-Federal sponsor. This IFR/EA documents the plan formulation process to identify a Recommended Plan for navigation improvement, with environmental, engineering, and cost details of the Recommended Plan, which would allow additional design and construction to proceed following approval of this IFR/EA.

The existing authorized Federal navigation project at Tacoma Harbor consists of Foss Waterway, Blair Waterway, Hylebos Waterway, and two training structures at the Puyallup River's mouth. The project is in Puget Sound's Commencement Bay at Tacoma, Washington. While Tacoma Harbor includes multiple navigation features, this feasibility study focuses on the Blair Waterway and non-Federal Sitcum Waterway. The Port initially identified these two waterways as the areas of critical importance for navigation improvements. The Corps identified alternatives at both waterways during initial plan formulation; however, the Corps removed Sitcum Waterway from the study scope based on subsequent evaluation (Chapter 3).

Purpose and Need

The purpose of the proposed Federal action is to achieve transportation cost savings (increased economic efficiencies) at Tacoma Harbor. The currently authorized depth does not meet the draft requirements of today's fleet of larger container ships. Tide restrictions, light loading, or other operational inefficiencies created by inadequate channel dimensions result in economic inefficiencies that translate into costs for the national economy. As a result, channel deepening can reduce transportation costs by allowing larger vessels to sail at deeper drafts with more cargo per trip. When larger vessels load more cargo, carriers require fewer overall port calls. This reduction in total trips leads to transportation cost savings, a national economic development (NED) benefit.

Alternatives Evaluation

The Corps identified several structural and non-structural measures to improve the navigation system's efficiency during the plan formulation process. The following measures were carried forward for alternatives formulation and analysis: channel deepening and associated widening, turning basin expansion, and improvement of the existing training structures. The Corps combined measures into three action alternatives. For these action alternatives, the Corps evaluated depths from the authorized -51 feet Mean Lower Low Water (MLLW) down to -58 MLLW. The final array of alternatives carried through detailed analysis are the following:

- Alternative 1 – No Action
- Alternative 2 – Blair Waterway Deepening to -58 MLLW (from Station [STA] –5+00.00 to STA 137+24.11)

- Alternative 2a – Blair Waterway Deepening through Husky Terminal (STA –5+00.00 to STA 41+85.18) to -58 MLLW
- Alternative 2b – Blair Waterway Deepening to -57 MLLW (STA –5+00.00 to STA 137+24.11)

Alternative 2a is a reduced length version of Alternative 2. Alternative 2b is a shallower version of Alternative 2 at -57 MLLW.

Recommended Plan

The Recommended Plan, also called the Agency Preferred Alternative, is the alternative that the Corps has concluded would fulfill its statutory mission and responsibilities, considering economic, environmental, technical, and other factors. For this study, the Recommended Plan is also the national economic development (NED) Plan. The NED Plan is defined as the alternative that reasonably maximizes net NED benefits while remaining consistent with the Federal objective of protecting the environment. In this feasibility study, the NED Plan is Alternative 2b, which consists of deepening the entire Blair Waterway to -57 MLLW with associated channel widening for design vessel navigation (each action alternative assumes up to two additional feet of allowable overdepth).

The NED Plan requires dredging approximately 2,803,000 cubic yards (CY) of material from the Blair Waterway. The Base Plan for disposal of this material is defined as the least cost disposal plan consistent with sound engineering practice and all Federal environmental standards. In this study, the Base Plan for disposal is at the Commencement Bay Dredged Material Management Program (DMMP) open-water, non-dispersive site for the estimated volume of suitable material (approximately 2,412,000 CY); with the remaining dredged material (approximately 392,000 CY) that is unsuitable for open-water disposal removed and placed at an appropriate upland disposal site. Costs for upland disposal of contaminated sediments at a permitted waste disposal facility would be a non-federal expense.

After determining the NED Plan for navigation improvement and the Base Plan for dredged material disposal, the Corps assessed the appropriateness of four beneficial use disposal options beyond the Base Plan for disposal. The Port identified the Saltchuk site northeast of the Blair Waterway as a potential location for the beneficial use of dredged material for environmental benefits. The Corps evaluated the effects and costs of multiple placement scenarios at the Saltchuk site using an existing nearshore habitat model and selected a Beneficial Use Plan for disposal. The Beneficial Use Plan involves the placement of 1,850,000 CY of dredged material at the Saltchuk site. This placement would restore up to approximately 64 acres of nearshore intertidal, and subtidal substrate conditions for fish and wildlife species at the Saltchuk site, including Endangered Species Act listed species. The site would realize the benefits of approximately 14.5 average annual habitat units (AAHUs) and create up to approximately 38 lower shore zone acres. The average annual equivalent (AAEQ) cost of the Beneficial Use Plan is $23,000 per AAHU or an AAEQ cost of $5,200 per acre. The Corps determined that the incremental cost of the Beneficial Use Plan above the Base Plan cost is reasonable in relation to the environmental benefits to be achieved. Disposal volumes of the Base Plan and the Beneficial Use Plan appear in the table below.

Estimated Disposal Volumes for the Recommended Plan.

Disposal Plan	Commencement Bay	Saltchuk Beneficial Use	Upland disposal
NED Plan with Base Plan for Disposal	2,412,000 CY	-	392,000 CY
Recommended Plan (NED Plan with Beneficial Use Plan)	562,000 CY	1,850,000 CY	392,000 CY

The estimated project first cost of the Recommended Plan is $295,328,000 including beneficial use of dredged material. Operation and maintenance (O&M) dredging is estimated at a rate of 30,000 CY, or a cost of $4,755,000, every 25 years, with O&M, dredged material to be characterized prior to each event. O&M material disposal is assumed to be suitable for the Commencement Bay open-water disposal site. The Recommended Plan includes incremental costs of $9,572,000 for the Beneficial Use Plan at the Saltchuk site leading to a benefit of 14.5 AAHUs.

Recommended Plan Cost and Benefit Summary (October 2021 Price Level, FY22 Discount Rate @ 2.25%)

Tacoma Harbor, Washington Recommended Plan Average Annual Equivalent (AAEQ) Benefits and Costs October 2021 price level, 50-year Period of Analysis, 2.25% Discount Rate	
Project Investment Costs	
General Navigation Features - Dredging[1]	$285,479,000
Lands, Easements, Rights-of-Way, and Relocations	$307,000
Beneficial Use of Dredged Material	$9,542,000
Project First Costs - GNF	**$295,328,000**
LSF, Berth Deepening Costs	$112,101,000
Interest During Construction	$13,255,000
Total Investment Cost	**$420,684,000**
AAEQ Investment Cost	$14,115,000
AAEQ Increased Maintenance Dredging	$144,000
Total AAEQ Investment Cost	**$14,259,000**
AAEQ Benefits	$152,715,000
Net AAEQ Benefits	$138,456,000
Benefit-Cost Ratio	**10.7**
Beneficial Use Plan	
Total Incremental Investment Cost	$9,542,000
Incremental AAEQ Costs	$334,000[3]
Ecosystem Restoration Benefits (AAHU)[2]	14.5

1 Includes Preconstruction, Engineering & Design, and Construction Management
2 Average Annual Habitat Units
3 Includes $428,000 for interest during construction of the beneficial use plan only @ 2.25% over 4 years

No compensatory mitigation is proposed for the Recommended Plan as no loss of wetlands, no significant adverse effects to protected species and no significant impacts to commercially important species or protected marine mammals are anticipated to occur based on the analyses in this document. The Corps has coordinated with natural resource agencies and tribes on their concerns, conclusions, and recommendations regarding project impacts; coordination will continue through design and implementation. In addition to monitoring requirements in the Blair Waterway and at Saltchuk to avoid and minimize effects to listed species, the Corps committed to several avoidance and minimization measures to ensure that adverse impacts are less than significant. The Corps will review the need for supplemental environmental documentation (e.g., supplemental NEPA analysis) during pre-construction engineering and design (PED) phase).

The non-Federal sponsor (Port of Tacoma) supports the Recommended Plan. The sponsor is capable and willing to pay the required cost-sharing for the Recommended Plan and understands and is willing to meet the other non-Federal requirements for project implementation.

Table of Contents

***Sections marked with an asterisk are required content for compliance with the National Environmental Policy Act**

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List of Acronyms and Abbreviations

AAEQ	Average Annual Equivalent	NEPA	National Environmental Policy Act
AEP	Annual Exceedance Probability	NFS	Non-Federal Sponsor
APE	Area of Potential Effects	NHPA	National Historic Preservation Act
BCR	Benefit Cost Ratio	NMFS	National Marine Fisheries Service
BMP	Best Management Practice	NOAA	National Oceanic and Atmospheric Administration
CAA	Clean Air Act	NOx	nitrogen oxides
CAD	Confined Aquatic Disposal	NWPCAS	Northwest Ports Clean Air Strategy
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act	NWSA	Northwest Seaport Alliance
CFR	Code of Federal Regulations	O_3	ozone
CH_4	methane	O&M	Operations and Maintenance
CHAT	Climate Hydrology Assessment Tool	OMRR&R	Operations, Maintenance, Rehabilitation, Repair, and Replacement
CO	carbon monoxide	OSE	Other Social Effects
CO_2	carbon dioxide	OU	Operable Unit
CY	cubic yards	PAH	polycyclic aromatic hydrocarbons
dB_{RMS}	Decibel root mean square	PAL	Planning Aid Letter
DMMP	Dredged Material Management Program	PCB	polychlorinated biphenyl
DO	dissolved oxygen	PCT	Pierce County Terminal
DPM	diesel particulate matter	PED	Preconstruction Engineering and Design
DPS	Distinct Population Segment	PM	particulate matter
ECB	Engineering and Construction Bulletin	PPA	Project Partnership Agreement
EFH	Essential Fish Habitat	PPX	Post-Panamax
EM	Engineering Manual	PSDDA	Puget Sound Dredge Disposal Analysis
EOP	Environmental Operating Principles	RED	Regional Economic Development
EPA	Environmental Protection Agency	ROD	Record of Decision
EQ	Environmental Quality	ROGs	reactive organic gases
ER	Engineering Regulation	RORO	Roll-On/Roll-Off
ESA	Endangered Species Act	ROW	Right of Way
IFR/EA	Integrated Feasibility Report and Environmental Assessment	SCAQMD	South Coast Air Quality Management District
FWCA	Fish and Wildlife Coordination Act	SHPO	State Historic Preservation Officer
GCP	General Central Peninsula	SLC	sea level change
GHG	Greenhouse Gas	SMAQMD	Sacramento Metropolitan Air Quality Management District
GNF	General Navigation Features	SOx	sulfur oxides
HTRW	Hazardous, Toxic, and Radioactive Waste	STA	Station
HUC-8	Hydrologic Unit Code 8	TBT	tributyltin
IDC	Interest During Construction	TEU	Twenty-foot Equivalent Unit
LERRD	Lands, Easements, Rights-of-Way, Relocations, and Disposal	TPY	tons per year
LOA	Length Overall	TSP	Tentatively selected plan
LNG	Liquid Natural Gas	TWL	total water level
LSF	Local Service Facility	U&A	Usual and Accustomed
MHHW	Mean Higher High Water	U.S.	United States
MHW	Mean High Water	USCG	United States Coast Guard

MLLW	Mean Lower Low Water	USFWS	US Fish and Wildlife Service
MLW	Mean Low Water	WAC	Washington Administrative Code
MMPA	Marine Mammal Protection Act	WDFW	Washington Department of Fish & Wildlife
MTL	Mean Tide Level	WQC	Water Quality Certification
MSI	Maritime Strategies, Inc.	WRDA	Water Resources Development Act
N_2O	nitrous oxide	WUT	Washington United Terminal
NAAQS	National Ambient Air Quality Standards		
NAVD	North American Vertical Datum		
NED	National Economic Development		

1 Introduction

The U.S. Army Corps of Engineers, Seattle District (Corps), is investigating the feasibility of navigation improvements in Tacoma Harbor, Washington (Figure 1-1). This report documents the planning process for navigation improvements to demonstrate consistency with the Corps planning policy and meet the regulations implementing the National Environmental Policy Act (NEPA). The following sections provide background information regarding the basis for this study. The sections required for NEPA compliance are denoted with an asterisk (*).

1.1 Study Authority*

This study is authorized by Section 209, Rivers and Harbors Act of 1962, Public Law 87-874, stating:

> "The Secretary of the Army is hereby authorized and directed to cause surveys for flood control and allied purposes, including channel and major drainage improvements, and floods aggravated by or due to wind or tidal effects, to be made under the direction of the Chief of Engineers, in drainage areas of the United States and its territorial possessions, which include the following named localities:…Puget Sound, Washington, and adjacent waters, including tributaries, in the interest of flood control, navigation, and other water uses and related land resources."

Section 209, Rivers and Harbors Act of 1962, Public Law 87-874 allows for the evaluation of alternatives for navigation improvement, consideration of ecosystem restoration in the form of beneficial use of dredged material at Tacoma Harbor and, allows the inclusion of the non-Federal Sitcum waterway.

Evaluation of beneficial use of dredged material as part of this study is authorized by Section 204 of the Water Resources Development Act of 1992, as amended by Section 1038(2) of the Water Resources Reform and Development Act of 2014 and Section 1122(i)(2) of Water Resources Development Act 2016 - Regional Sediment Management. Section 204(d), as amended, provides that, in developing and carrying out a Federal water resources development project involving the disposal of dredged material, the Assistant Secretary of the Army for Civil Works (ASA(CW)) may select, with the consent of the non-Federal interest, a disposal method that is not the least cost option, if the ASA(CW) determines that the incremental costs of the disposal method are reasonable in relation to the environmental benefits.

1.2 Lead Federal Agency and Non-Federal Sponsor*

The Corps is the lead Federal agency, and the Port of Tacoma (Port) is the non-Federal sponsor. Together the Corps and the Port are conducting this feasibility study. As the non-Federal sponsor, the Port contributes 50% of the total feasibility study costs in the form of cash or in-kind contributions. The Corps and Port executed a Feasibility Cost Sharing Agreement on August 21, 2018.

While the Port is the cost-sharing non-Federal sponsor of the study, the Corps is also working with the Northwest Seaport Alliance (NWSA) during the study. Established in August 2015, the NWSA is a marine cargo operating partnership of the Ports of Seattle and Tacoma. The NWSA unifies the management of marine cargo facilities and cargo business to strengthen the Puget Sound gateway and attract more marine cargo and jobs for the region.

1.3 Location and Description of the Study Area*

Tacoma Harbor (Figure 1-1) is at the mouth of the Puyallup River in Puget Sound's Commencement Bay, at Tacoma, Washington. The Tacoma Harbor Federal navigation project consists of Hylebos Waterway, Blair Waterway, two training walls at the Puyallup River's mouth, and the Thea Foss Waterway.

The *study area* is the area within which significant impacts could occur and includes the potentially affected resources described and analyzed in Chapter 4. The feasibility study area to investigate navigation improvements in Tacoma Harbor includes the federally authorized Blair Waterway and the non-Federal Sitcum Waterway (Figure 1-2). Congress has addressed each of these waterways numerous times throughout the years. Congress originally authorized the improvements to the Federal Blair Waterway (originally referred to as the Port Industrial or Wapato waterway) in the Rivers and Harbors Act of 1935 (P.L. 74-409, 49 Stat. 1028, CH. 831 (Aug. 30, 1935)). Subsequent Congressional action regarding the modification, addition, or deletion of aspects of these Federal waterways occurred in 1954 (Rivers and Harbors Act (RHA) of 1954, P.L. 83-780, Ch. 1264), 1962 (P.L. 87-847; 76 Stat. 1173; Federal Blair Waterway), 1986 (Water Resources Development Act (WRDA), implementing a modification of House Doc. No. 96-26, (96^{th} Congress, 1^{st} session; Jan 15, 1979), in 100 Stat. 4082 (Nov. 17, 1986). The Corps also used the continuing authority provided under Section 107 of the RHA of 1950 (P.L. 86-645), as amended, to pursue deepening the existing Federal Blair Waterway in 1999 (Continuing Authorities Program Section 107 project).

In the 1986 WRDA, implementing a modification of House Doc. No. 96-26, (96^{th} Congress, 1^{st} session; Jan 15, 1979), Congress authorized the Corps to take over maintenance of the local Sitcum Channel and deepen it. Congress did not provide appropriated funds for this effort, however, and on June 26, 2003, the Federal Sitcum Waterway was de-authorized consistent with Sec 1001(B)(2) of WRDA of 1986, P.L. 99-662, 100 Stat. 4082-4273, as amended, which provides for the automatic de-authorization of water resource projects and separable elements if they are not funded within a particular time period.

Figure 1-1 Location of Tacoma Harbor in Western Washington State.

The boundaries of the Federal Blair Waterway and physical boundaries of non-Federal Sitcum Waterway are as follows:

The Federal Blair Waterway is approximately 2.75 miles long, including the turning basin. The entire length is dredged to -51 feet below mean lower low water (MLLW; hereafter expressed as -X MLLW, to indicate the number of feet below MLLW). The authorized dimensions of the Federal Blair Waterway appear in Table 1-1. The authorized channel depth is -51 MLLW. Non-Federal Sitcum Waterway is approximately 4,000 feet long. The pier head to pier head width is 500 feet. The channel depth is -51 MLLW.

Table 1-1 Current Federally Authorized Widths by Channel Station on Blair Waterway.

Stations along the channel	Authorized widths (ft.)
STA 0 to STA 12	520
STA 12 to STA 44	520 narrowing to 343
STA 44 to STA 52	520
STA 52 to STA 79	520 narrowing to 330
STA 79 to STA 100	330
STA 100 to STA 116	330 widening to 1,682
STA 116 to STA 140	1,682

In addition to upland placement for material determined to be unsuitable for in-water placement, this study will evaluate the placement of dredged material in two in-water disposal sites: Commencement Bay Dredged Material Management Program (DMMP) open-water, non-dispersive disposal site (Figure 1-3) and Saltchuk nearshore placement site. Saltchuk is a site the Port identified for potential beneficial use of suitable dredged material. The Saltchuk site is located approximately one mile northeast of Blair Waterway along the shoreline. The site is approximately 64 acres of low-quality aquatic habitat from about -5 to -50 MLLW. Of the 64 acres, approximately eight acres (13%) are covered in wood waste. The study will evaluate the Saltchuk site for potential placement of suitable dredged material to improve habitat conditions in Commencement Bay's subtidal and intertidal areas. A detailed description of the Saltchuk site is available in Section 1.5.2.6.

Although the Hylebos Waterway and Thea Foss Waterway are located within the study area, the Corps did not evaluate navigation improvement to these two waterways as these are outside the scope of proposed actions in this study. The Port considered these locations but did not request consideration of alternatives in these two waterways as part of this study.

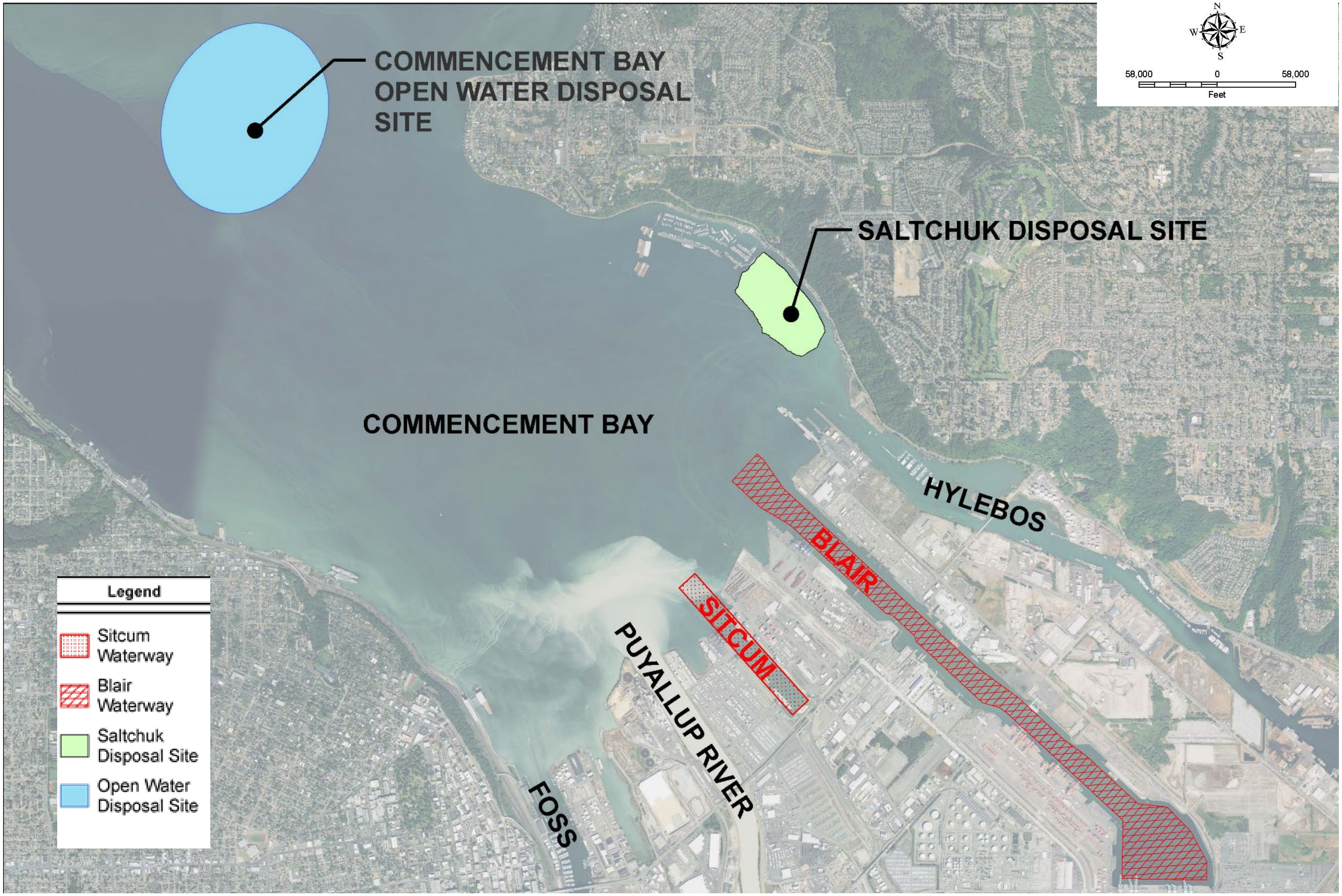

Figure 1-2 Tacoma Harbor, WA Navigation Improvement Project Study Area.

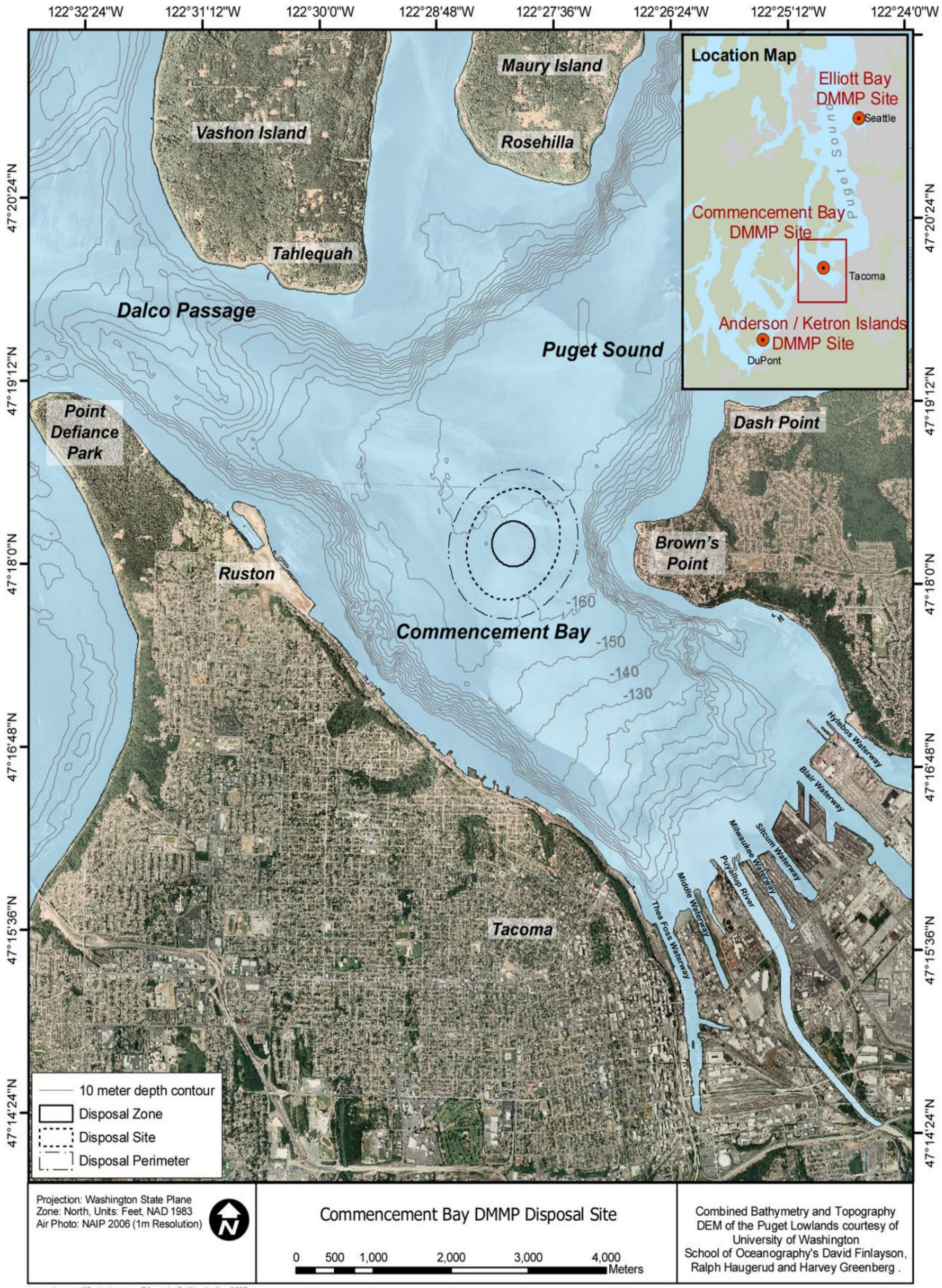

Figure 1-3 Map of the Commencement Bay DMMP open-water disposal site. The outermost perimeter line indicates a monitoring area; the middle dotted line indicates the disposal site, while the disposal zone is the innermost solid black line.

1.4 Study Purpose and Scope

The purpose of this study is to assess Federal interest in navigation improvements to Blair Waterway and Sitcum Waterway to allow for safe and efficient loading of 14,000 twenty-foot equivalent units (TEU) to 18,000 TEU ships as described below. TEUs are how the capacity and volume of container ships are measured; each TEU is equivalent to one 20-foot container. These large ships are forecasted to come to Tacoma Harbor. During this feasibility study, the Corps has analyzed alternatives for navigation improvements to Tacoma Harbor, including potential waterway deepening. The Corps will identify and evaluate a full range of all reasonable alternatives, including the No-Action Alternative. The initial scope the Port requested for this study was to analyze alternatives for navigation improvements to Blair Waterway and Sitcum Waterway. However, while still in the initial evaluation process, the Corps reduced the study's scope to focus on improvements to Blair Waterway alone (see Chapter 3 for details).

1.5 Summary of Existing and Future Without-Project Conditions

Corps planning policy requires an inventory and forecast of conditions and resources relevant to the problems and opportunities under consideration in the planning area. This information is used to further define and characterize problems and opportunities. The future without-project condition provides the basis from which alternative plans are formulated, and impacts are assessed in comparison to alternatives. In addition, NEPA requires analyzing whether the proposed action's incremental effect would cause a significant impact on the environment when added to past, present, and reasonably foreseeable future actions. This Section summarizes past actions that have affected the study area's environment, relevant conditions that exist today, and key future without-project conditions that influence the analysis of alternatives and environmental effects. Detailed information for each resource analyzed in this study is included in Chapter 4 (Affected Environment and Environmental Consequences of Alternatives.

1.5.1 Past Conditions and Actions

Information on Commencement Bay's historical conditions and development was summarized from Commencement Bay Cumulative Impact Study (Corps 1993) and is incorporated herein by reference.

Development of Commencement Bay as a port likely began with the Northern Pacific Railroad that crossed salt marsh from the City of Puyallup to Tacoma at Thea Foss Waterway in 1874. There was limited development before 1877, and the earliest photos and maps indicate that the main habitat types of Commencement Bay were 2,085 acres of intertidal mudflats and about 3,894 acres of salt/brackish marsh (Figure 1-4).

Development began to increase mostly on the west side of Commencement Bay over the next 20 years as wharves, piers, and warehouses were built to store and transfer cargo to or from ships and the growing railroad system. Mudflats were excavated to create log storage ponds and associated wharves for the growing lumber industry. Millions of cubic yards of material were dredged from 1894 to 1907 for further development and the creation of Thea Foss Waterway and Middle Waterway. Flooding and heavy sedimentation from the Puyallup River led to dredging in the river and relocation attempts that altered the river delta and modified the intertidal areas by obstructing the outflow and increasing deposition. By 1907 there were 1,469 acres of mudflat and 3,495 acres of salt/brackish marsh.

Shoreline development on the east side of Commencement Bay began to increase around 1907, and the next decade would see the loss of 542 acres of mudflat habitat and 100 acres of salt/brackish marsh habitat. The Milwaukee Slip, Middle Waterway, and Hylebos Waterway were dredged to expand Tacoma Harbor. Mostly lumber trade vessels called at Hylebos Waterway. Grain and freight warehouses, ocean freight, coal bunkers, and the Oriental Dock along the waterfront were owned and serviced by Northern Pacific Railroad. Flour mills and lumber mills expanded to the north with grain elevators, conveyors, and log storage ponds, while the Tacoma Smelting Company used slag to fill in Commencement Bay. Around this time, dikes, ditches, and tide gates were installed to convert land for agriculture. The lack of tidal influence and continued freshwater input from the Puyallup River reduced salinity and converted saltmarsh to brackish or freshwater marsh habitat; this continued into the 1950s.

In 1917, the Blair Waterway, named Wapato Waterway for Wapato Creek at the head of the waterway, was dredged for the first time up to South 11th Street. The sidecast material was used to create land for piers, wharves, and other infrastructure. In the 1920s, the industrial footprint multiplied with additional freight storage and transit terminals, grain and flour mills, lumber mills, oil and coal bunkering, the vegetable oil trade, and shipbuilding plants and wharves. At this time, the Blair Waterway was used for lumber, heavy freight, freight storage, and a marine repair plant. Construction focused on wharves along the Hylebos Waterway. Another 75 acres of salt/brackish marsh and 162 acres of mudflat were converted for industrial use by 1927.

From 1927 to 1941, many of the waterways were extended, widened, and deepened. This extension and widening included Hylebos, Blair, and Sitcum Waterways; the St. Paul Waterway, which was used as a log storage pond, was excavated. The Blair Waterway was extended, and the turning basin was created with Navy shipyards on the east side, a grain elevator on the bay end, two piers for general cargo, a public moorage pier, and two wharves for marine repair and lumber on the west side. In this period, 1,587 acres of salt/brackish marsh and 445 acres of mudflat habitat were lost. From 1941 to 1999, the main activities in Commencement Bay were deepening channels and filling adjacent areas, which resulted in the loss of 1,557 acres of freshwater marsh and 105 acres of intertidal mudflat. Between 1993 and 1999, salt/brackish marsh went from 57 to 50 acres, and mudflats went from 187 to 180 acres. Over approximately 120 years, human development replaced almost all the natural habitat in Commencement Bay (Figure 1-5).

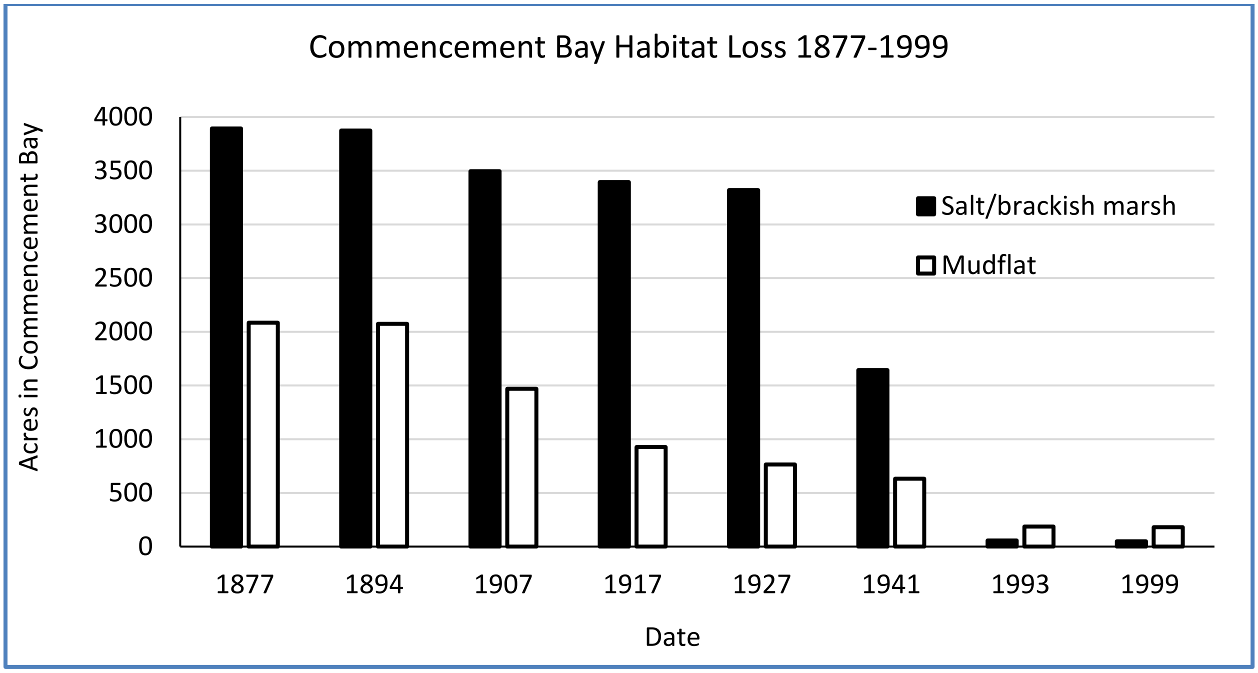

Figure 1-4 Commencement Bay habitat loss 1877-1999 (Corps 1993; Kerwin 1999).

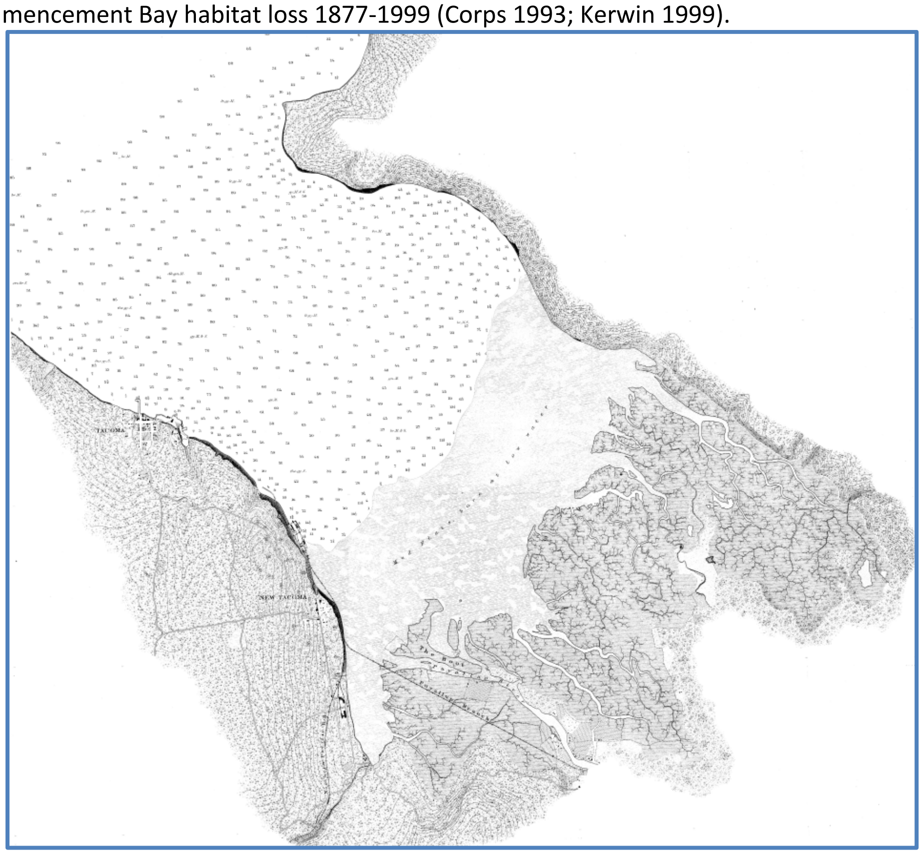

Figure 1-5 Nautical Chart of Tacoma Bay, in the late 1800s. From the National Oceanic and Atmospheric Administration's (NOAA) Office of Coast Survey Historical Map & Chart Collection (https://historicalcharts.noaa.gov).

The Commencement Bay Trustees include the National Oceanic and Atmospheric Administration (NOAA), U.S. Fish and Wildlife Service (USFWS), Ecology, the Puyallup Tribe of Indians, and the Muckleshoot Tribe.

Since 1998, they have restored over 300 acres of habitat throughout the Puyallup River Watershed. EarthCorps acts as steward for 17 Natural Resource Damage Assessment (NRDA) restoration sites in Commencement Bay (EarthCorps 2015). 1996 and 2010, Commencement Bay NRDA restoration sites have restored a total of 235 acres of habitat, with about 12 acres of emergent marsh and 26 acres of mudflat habitat (EarthCorps 2015; Figure 1-6). In addition, numerous shoreline restoration projects are in progress by the Port and other organizations (City of Tacoma, 2012; Appendix C). The Port has developed, funded, or preserved 21 habitat sites (about 216 acres) since mid-1980 as compensatory mitigation for development or remediation impacts, NRDA sites, or preservation of open space for the public (Port of Tacoma 2018; Appendix C).

In 2015, the Port of Tacoma joined with the Port of Seattle in the operating partnership NWSA. As a cargo operating partnership, the two ports are the fourth-largest container gateway by tonnage in North America. Cargo placed in standard shipping containers, handled interchangeably on vessels in terminals, and moved via inland transport, is considered containerized. Containerized cargo includes most goods imported into the United States (U.S.).

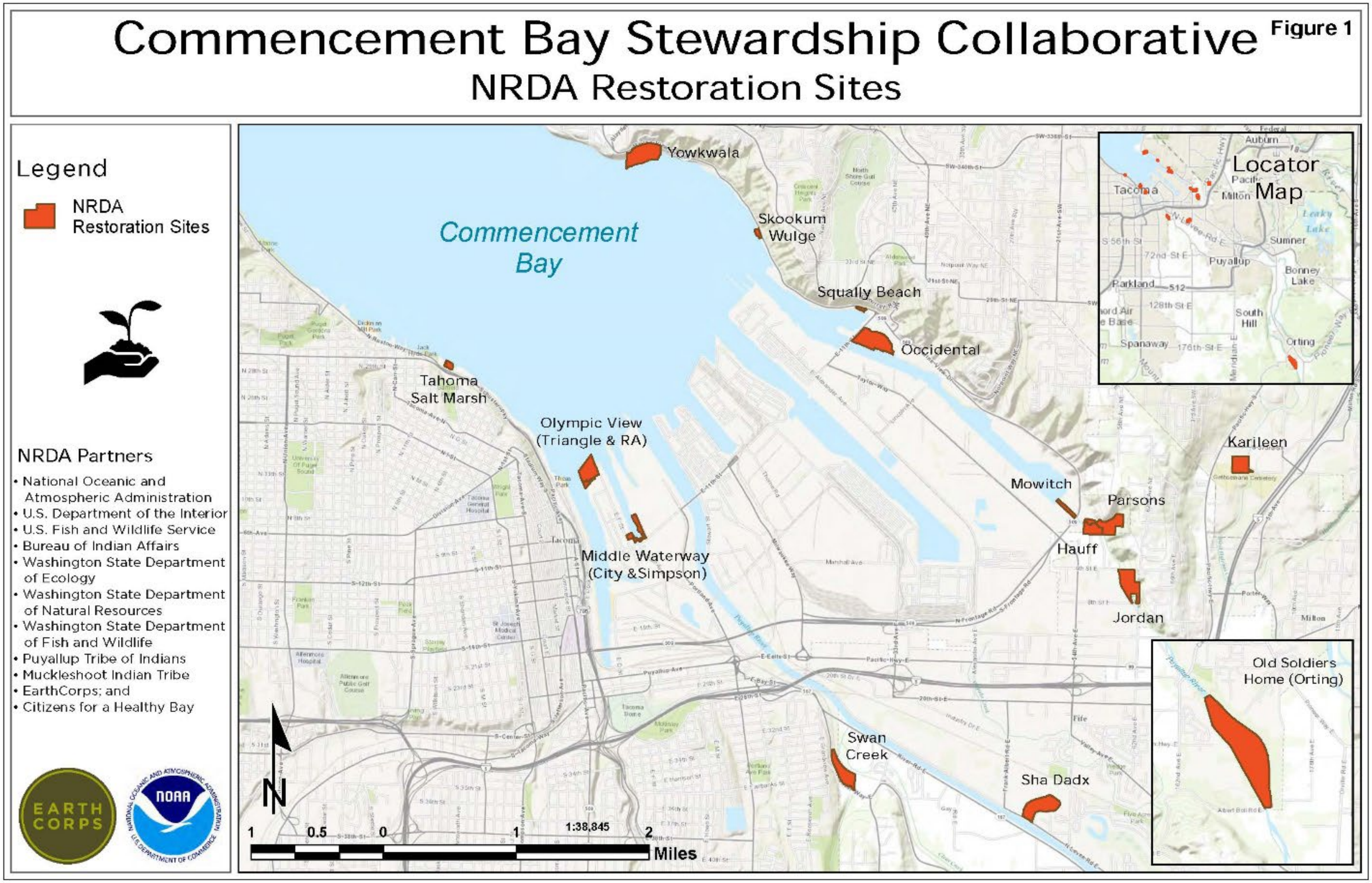

Figure 1-6 Natural Resource Damage Assessment Restoration Sites in Commencement Bay and the Lower Puyallup River (EarthCorps 2015).

1.5.2 Present Conditions and Actions

Tacoma Harbor is a top 10 container port in the U.S. in terms of cargo volume[1]. In 2019, the harbor had a container throughput of over 1.5 million loaded TEUs, including incoming and outgoing units[2]. As one of the top 10 container ports, it is of national importance for trade and is important to the national and local economies that it maintains its ability to receive calls as ships increase in size. Tacoma Harbor already receives calls from the 14,000 TEU capacity vessels, including the *Thalassa Axia*, which began calling in November 2018.

Newly built containerships continue to increase in size and capacity. As carriers deploy newer vessels on Asia to Europe routes, carriers typically cascade large vessels currently serving longer-distance routes to transpacific services. This fleet transition results in increased efficiency in transporting goods on Asia to U.S. West Coast services as larger vessels can realize economies of scale through lower per-unit transportation costs. However, larger ships require more channel depth and width, larger berths, and taller cranes to operate efficiently, putting pressure on channel and port capacity.

The current channel depth of -51 MLLW in the Blair Waterway limits the efficiency of larger vessels (14,000 TEU or more). Figure 1-7 lists common drafts by vessel class. Post-Panamax ships with maximum drafts up to -51 MLLW call Tacoma Harbor frequently. From 2013 through 2017, approximately 72% of calls to Blair Waterway were Post-Panamax vessels. This portion increased to 81% from 2017 through 2019. The 14,000-18,000 TEU vessel class is expected to call Tacoma Harbor more frequently over the study period. Under current channel dimensions, these vessels will be draft constrained. These constraints lead to transportation cost inefficiencies as vessels must wait to transit during high tide or light-load. Current channel dimensions are especially costly for exports. Most exports from the Pacific Northwest (mostly agricultural products such as fruit, hay, and grain) are heavy and densely loaded into containers. The weight of Tacoma's exports requires deeper drafts for ships on departure (Figure 1-8).

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[1] Tacoma Harbor ranks 9th in the 2019 Waterborne Commerce Statistics Center Loaded TEU Volume Data

[2] 2019 Waterborne Commerce Statistics Center Loaded TEU Volume Data

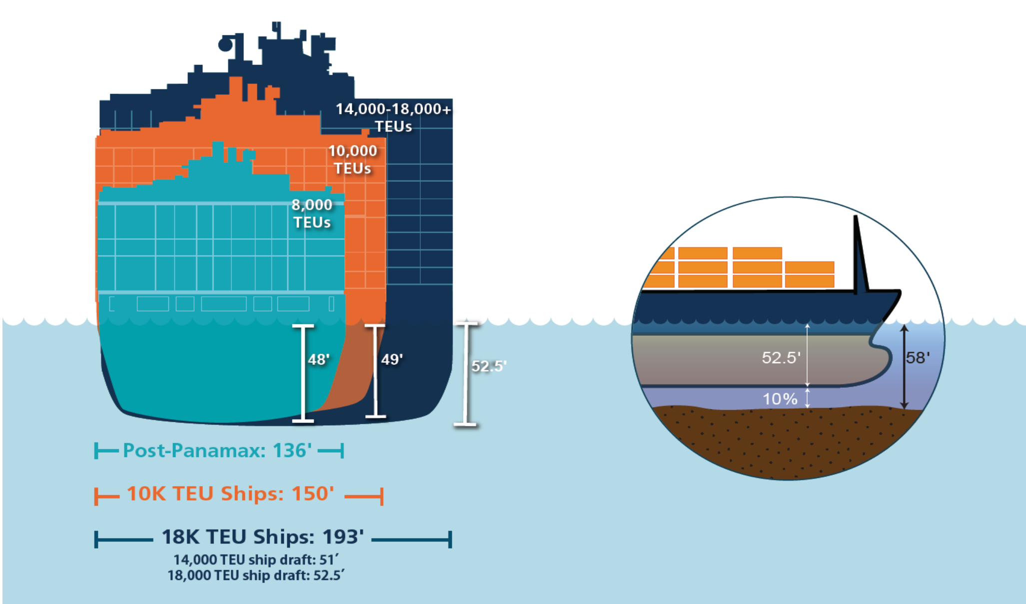


Figure 1-7 Changes in ships' draft as they increase in size.

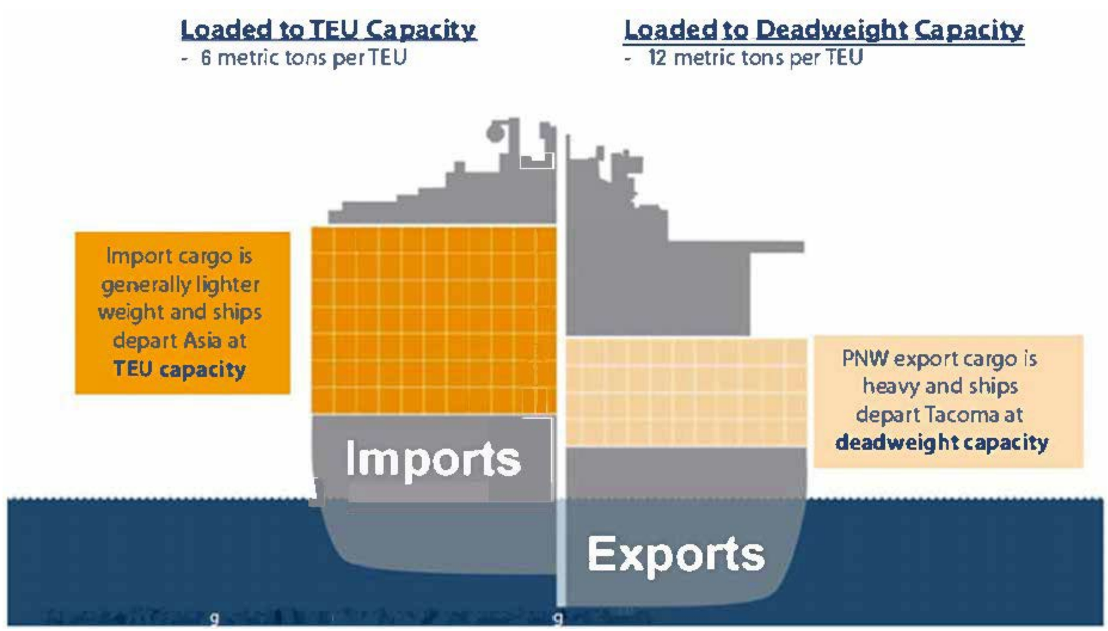


Figure 1-8 Import TEU capacity versus export deadweight capacity.

Tacoma Harbor is a nationally significant port and a critical regional and national export gateway. Average foreign throughput tonnage at Tacoma Harbor from 2013 through 2017 totaled 19.6 million metric tons, consisting of 7.8 million and 11.8 million metric tons of imports and exports, respectively. Average annual foreign throughput tonnage dropped approximately 4 percent for 2017 through 2020, primarily the result of a temporary drop in trade in 2020 associated with the global pandemic. Containerized trade was 52% of foreign throughput tonnage at Tacoma Harbor from 2013 through 2017. Trade with China consisted of 40% of the total, followed by Japan (20%), South Korea (10%), and other Asian markets (26%). The Port's inland markets extend to Chicago, Memphis, and St. Louis, making it an ideal gateway for the import and export of goods moving between Asia and the U.S. Midwest. The Midwest makes up nearly two-thirds of the Port's hinterlands (the areas a port serves for exports and imports; Figure 1-10).

Major lines (also called *services*) calling at the harbor include Ocean (CMA-CGM/APL, COSCO Shipping, Evergreen, and OOCL), The Alliance (Hapag-Lloyd, Yang Ming, Ocean Network Express), HMM, and Westwood. All current services call from Asia via transpacific routes. In 2017, Tacoma Harbor Container Terminals received 420 foreign vessel calls importing and exporting 1.2 million loaded TEUs. The Port received approximately 360 calls in both 2018 and 2019 at the same time as average vessel TEU capacity increased 12 percent.

Tacoma Harbor is an essential part of the national transportation system, and the current depths hinder the Port's competitiveness. There is insufficient capacity in the region or nation for larger vessels to divert to other, deeper ports. Even with the recent authorization to deepen Seattle Harbor approximately 30 nautical miles north of Tacoma, there is insufficient capacity for the forecasted traffic in the U.S. Pacific Northwest. Without the capacity to efficiently accommodate larger ships at Tacoma Harbor, the U.S. may lose trade to deeper Canadian ports.

1.5.2.1 Facilities and Infrastructure

Tacoma Harbor includes facilities in the Blair, Hylebos, and Thea Foss waterways, including liquid and bulk handling operations. Local service facilities (LSF) on the Blair Waterway include terminals, transfer facilities, docks, and berthing areas. Blair Waterway is home to four main terminals, which appear in Figure 1-9: Husky Terminal, Washington United Terminal (WUT), Pierce County Terminal (PCT), and Totem Ocean Trailer Express Terminal (TOTE). Husky, WUT, and PCT handle the largest international TEU volumes on Blair Waterway and are Post-Panamax capable docks. These three docks are the primary focus of the study. TOTE primarily services vessels carrying domestic cargo to Alaska. Appendix A (Economics) describes these facilities in more detail.

East Sitcum and West Sitcum Terminals on the Sitcum Waterway are outside the Blair Waterway and primarily handle domestic tonnage or international cargo carried on smaller Sub-Panamax, Panamax, and Post-Panamax Generation 1 vessels.

Stormwater is conveyed through numerous outfalls around the Blair Waterway (Appendix C). Stormwater outfalls are managed under the Port of Tacoma Stormwater Management Program as a condition of the Western Washington Phase I Municipal Stormwater Permit. Impacts on outfalls from the channel redesign will be evaluated further following feasibility in pre-construction engineering and design (PED).

Blair Waterway contains several terminals for non-containerized goods. U.S. Oil and Refining Company, purchased by Par Pacific in January 2019, has a refinery near the head of the Blair Waterway and two docks between Husky Terminal and WUT. Their terminal has two docks; one handles ships and barges (-41 MLLW) while the other handles only barges (-23 MLLW; U.S. Oil and Refining Co. 2019). Oil products handled at this terminal are crude oil, gasoline, jet fuel, diesel, vacuum gas oil, and marine fuels. The Puyallup Tribe of Indians docks the EQC Riverboat at a berth across the channel from WUT and owns a facility at the dock.

The container terminals on Blair and Sitcum Waterways are detailed below, and Table 1-2 provides a summary of information for Blair and Sitcum container terminals.

Husky Terminal

Husky Terminal is a 91-acre facility at the entrance of the Blair Waterway. The Port completed a berth reconfiguration at Husky Terminal in late 2017. This reconfiguration created two berths with nearly 3,000 feet of dock length capable of simultaneously berthing two Post-Panamax Generation IV (PPX4) vessels. The Port installed eight new super-post-Panamax cranes in 2018 and 2019. Husky Terminal has on-dock rail access.

Washington United Terminal (WUT)

WUT is a 128-acre facility located approximately 1.5 miles from the entrance of the Blair Waterway. WUT is a two-berth facility capable of simultaneously berthing two post-Panamax vessels and operates six post-Panamax cranes along its 2,600 feet of berth length. WUT has on-dock rail access.

Pierce County Terminal (PCT)

PCT is a 166-acre facility located at the Blair Waterway's terminus, roughly 2.5 miles from the entrance. PCT operates two berths capable of loading two Panamax vessels or one post-Panamax vessel at a time. Together, the terminal has 2,087 feet of berth length and seven post-Panamax cranes. Like Husky Terminal and WUT, PCT has on-dock rail access.

TOTE Terminal

TOTE Terminal is a wheeled container operation handling primarily domestic cargo. This 48-acre facility has three “RoRo” (roll-on/roll-off) ramps, and the berth accommodates Panamax and Sub-Panamax vessels. TOTE primarily exports manufactured and food products.

Sitcum Container Terminals

The West Sitcum Container Terminal serves domestic vessels to Alaska. The facility operates two berths with a combined 2,200 feet of length. The facility covers 135 acres and operates five cranes capable of servicing two Panamax vessels simultaneously.

The East Sitcum Terminal, formerly Olympic Container Terminal, is smaller than West Sitcum at only 54 acres. East Sitcum Terminal has four cranes for one berth. East Sitcum handles all Westwood services at Tacoma Harbor, consisting of three Asian services using Panamax-sized vessels.

Table 1-2 Summary Information for All Tacoma Harbor Container Terminals.

Terminal	Size	No. Berths (Total Length)	Berth Depths	No. Cranes x Reach	In/Out Truck Lanes	Scales	Reefer Plugs	Rail Ramps
Husky	93 acres	2 (2960 ft.)	51 ft.	8 8x24 wide	7/4	6	875	Near-dock
WUT	123 acres	2 (2600 ft.)	51 ft.	6 4x18 wide 2x24 wide	9/4	7	884	On-dock
PCT	140 acres	2 (2087 ft.)	51 ft.	7 7x23 wide	10/6	6	654	On-dock
West Sitcum	135 acres	2 (2200 ft.)	51 ft.	5 4x18 wide 1x14 wide	8/6	6	875	Near-dock

East Sitcum	54 acres	1 (1100 ft.)	51 ft.	4 3x15 wide 1x14 wide	5/2	2	300	On-dock
TOTE	48 acres	3 RoRo ramps	51 ft.	N/A	5/4	4	140	Off-dock

Figure 1-9 Terminals on Blair and Sitcum Waterway. East Sitcum Terminal (Terminal 7) is on the Sitcum Waterway, and Husky Terminal (Terminal 4) is on the Blair Waterway.

In May 2017, the Tacoma City Council initiated the subarea planning process for the Port of Tacoma/Tacoma Tideflats, which is designated as a Manufacturing/Industrial Center (MIC). Subarea planning allows for the establishment of a shared, long-term vision and a more coordinated approach to development, environmental review and protection, and strategic capital investments in the MIC; in addition, a subarea plan would support the MIC's eligibility for and prioritization of transportation funding. After the subarea planning process was initiated, interim regulations were established by the City of Tacoma in Ordinance 28470 for actions associated with heavy industrial use permits, new non-industrial uses, new residential development, and certain types of new heavy industrial uses in the MIC. The navigation channel is an existing use of the Blair Waterway within the MIC. The subarea plan is scheduled to be complete around 2023.

Puget Sound Energy is building a liquefied natural gas (LNG) facility at Tacoma Harbor to provide residential, commercial, and local transportation companies, including TOTE Maritime Alaska vessels, on the Blair Waterway, with LNG as a fuel.

1.5.2.2 Other Port Facilities

Tacoma Harbor includes liquid and bulk handling operations on the Blair Waterway: U.S. Oil and Refining Company, Concrete Tech, Blair Dock, and East Blair One (EB1). U.S. Oil and Refining Company operates a marine fuels dock on the Blair Waterway, which typically handles Panamax-sized oil and chemical tankers. The facility includes a refinery near the head of the Blair Waterway and two docks between Husky Terminal and WUT (U.S. Oil and Refining Co. 2019). Oil products handled at this terminal are crude oil, gasoline, jet fuel, diesel, vacuum gas oil, and marine fuels.

Concrete Tech is a graving dock for project cargo. Blair Dock is a breakbulk (non-containerized cargo) and RoRo facility between Husky and WUT. EB1 is a breakbulk and RoRo facility on the southeast end of WUT.

TEMCO is the largest non-container facility in Tacoma Harbor, primarily exporting agricultural products, including corn and soybeans. The facility is on the south shore of Commencement Bay near the mouth of the Thea Foss Waterway, outside the study area.

1.5.2.3 Terminal Expansions and Landside Infrastructure

The NWSA and Port of Tacoma's Strategic Business Plan include long-term development goals along the Blair Waterway. As part of a three-phase plan at the Husky Terminal and adjacent backlands between the Blair and Sitcum waterways (referred to as General Central Peninsula, or GCP), the Port expanded berthing space and added eight new super-post-Panamax container cranes at Husky Terminal. These improvements will allow the simultaneous loading of two PPX4 vessels. The final phase at the GCP will include an expansion in rail capability and development of more nearby support services, such as warehousing and transload facilities, where containerized cargo is transferred for truck or rail shipment. The Port does not have plans for new infrastructure or footprint expansion at WUT and PCT; however, the Port is designing a 30-acre near-dock support facility to service all facilities on the GCP. In its strategic plan, the Port included expansion of the width and depth of the waterways to ensure efficient navigation and set a goal to reach three million TEUs in throughput container volume over the next decade.

1.5.2.4 Port Hinterland

Tacoma Harbor and the Puget Sound Region are a natural gateway for transpacific cargo bound for the large population centers in the Midwest and Northeast. Figure 1-10 provides the average shipping time from Tacoma Harbor to destinations across the U.S. Top international trading partners include China/Hong Kong, Japan, Republic of Korea, Taiwan, Vietnam, Thailand, Canada, Malaysia, and Indonesia. The value of this two-way international trade totaled more than $76 billion in 2017.

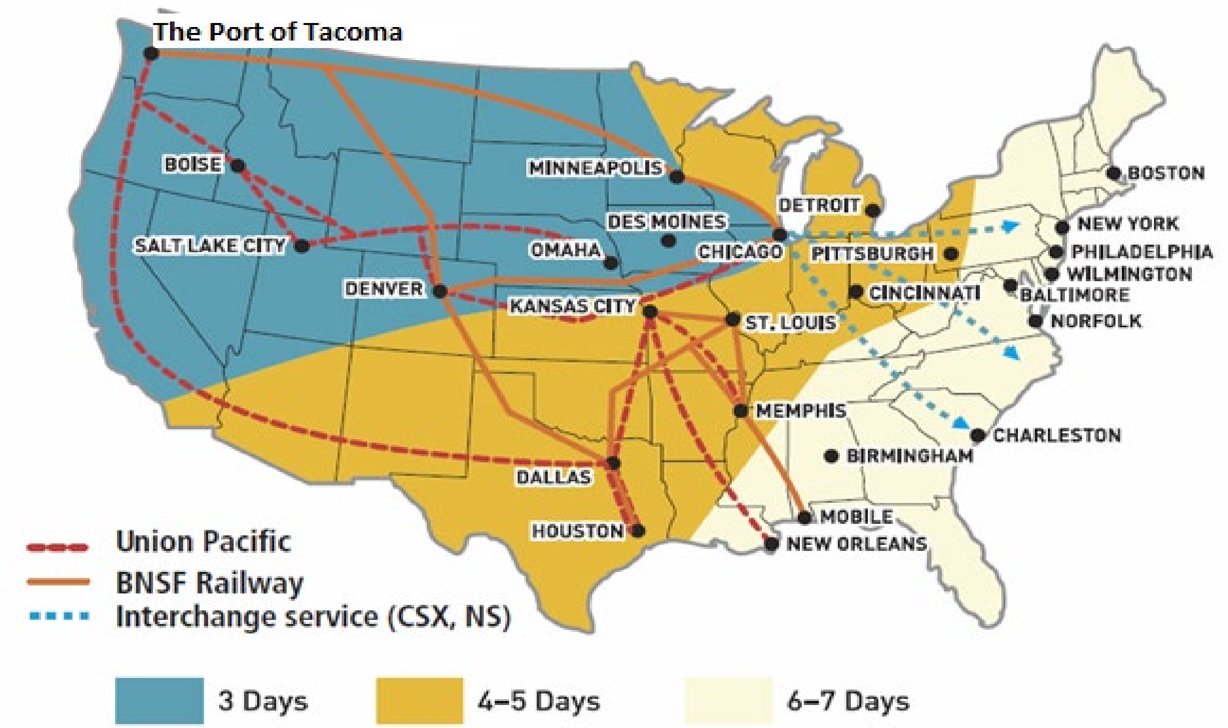


Figure 1-10 Port of Tacoma Hinterlands.

Tacoma Harbor is a critical transportation link for the export of containerized agricultural products from the Pacific Northwest and the U.S. heartland. Oregon, Idaho, and Washington exported over $18.3 billion of food and agricultural products in 2017, over 80% of which originated in Washington – the third largest exporter of food and agriculture commodities in the nation. Tacoma Harbor's strategic proximity to Washington's agricultural heartland via Interstate 90, and its site on the Pacific Rim, make it a natural gateway for agricultural exports from the region destined for Asian markets. Additionally, export commodities (mostly Washington agricultural products, including apples [Figure 1-11]) typically weigh substantially more than imports. Tacoma Harbor also sees a large volume of heavy forest products. The weight difference means they are more expensive to transport longer distances due to additional fuel costs. The additional transport cost makes them less competitive in the international market as they are shipped farther from the point of origin. The heavy weight of export commodities loaded in Tacoma Harbor means that ships can depart with close to a full draft.

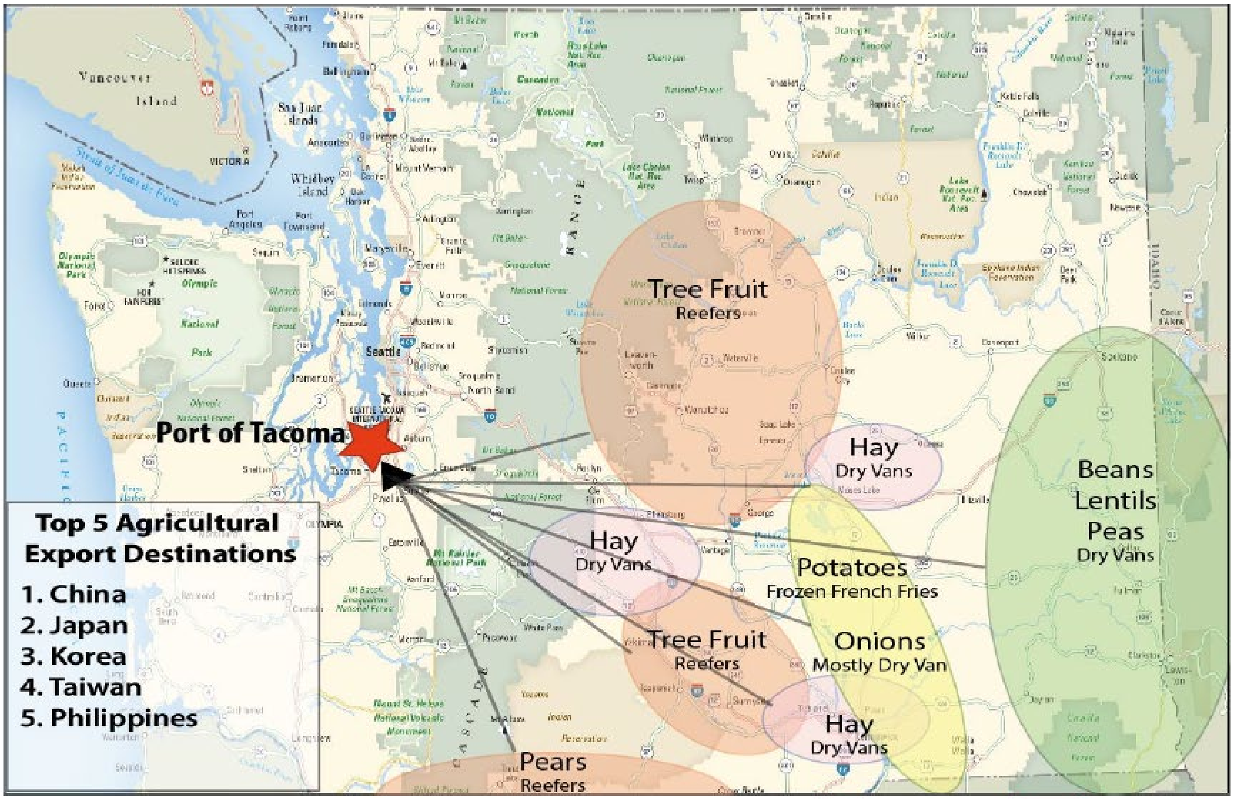


Figure 1-11 Washington Exports.

1.5.2.5 Hazardous, Toxic, and Radioactive Waste

Due to the highly industrialized nature of Commencement Bay, numerous investigations and remedial actions targeting hazardous materials cleanup have occurred in and around Blair Waterway. Within an approximate half mile search radius of the study area, there are 43 Model Toxics Control Act (MTCA) sites surrounding Blair Waterway, along with six Resource Conservation and Recovery Act (RCRA) sites, and several CERCLA sites, most notably the Commencement Bay Nearshore Tideflats Superfund Site (see Appendix H for a map of sites). Fifteen of these sites have known contaminated groundwater and are located immediately next to, but not overlapping, Blair Waterway. Five additional sites are located one block farther away from Blair Waterway. It is not known if these sites are leeching contaminated groundwater into Blair Waterway, but it is possible depending on the extent and direction of the plume of contaminated groundwater and the geologic material. Two of the NPL sites listed, Commencement Bay Nearshore Tideflats and Glenn Springs Holdings, are among the contaminated groundwater sites immediately next to, but not overlapping, Blair Waterway.

The most notable HTRW site within the study boundary is the Commencement Bay Nearshore Tideflats Superfund Site, placed on the NPL in 1981. The United States Environmental Protection Agency (EPA) issued the record of decision (ROD) for the site in September 1989. Blair Waterway was originally included as a component of the Superfund Site. The Operable Units (OUs) associated with Blair Waterway include the Commencement Bay/Nearshore Tideflats Sediments OU (OU1) and the Commencement Bay/Nearshore Tideflats Source OU (OU5; see Appendix H for a map of the Superfund Site). The EPA issued a partial deletion in 1996 pertaining to the portions of the two separate OUs addressing sediments contained in and properties draining to the Blair Waterway (EPA 2014). As such, no further Federal action is required for remediation of sediments or associated sources to Blair Waterway. The other notable action in Blair Waterway includes the dredging of tributyltin (TBT) contaminated sediments at Pier 4 as part of a Time Critical Removal Action. This action was completed in 2016 by the Port of Tacoma under the EPA's regulatory authority and included the removal of 71,000 CY of contaminated sediment to support the development of Pier 4. Several other Washington State-led cleanup actions are in various phases of remediation immediately adjacent to Blair Waterway (see Appendix H for associated figures of site locations). There are no identified active cleanups within the proposed navigation channel footprint for Blair Waterway or Saltchuk. However, side slopes do pose a potential conflict with active or completed cleanup sites and are evaluated in Section 4.10. Additional HTRW site descriptions appear in Sections 4.10 and 4.10.2. There are no HTRW sites overlapping the Saltchuk Site. Historically, the Sitcum Waterway (OUs 1 and 5) contained a 55-acre area of contaminated marine sediments in the main navigational channel and berth areas. Sediments were contaminated with metals (arsenic, cadmium, copper, lead, nickel, and zinc) and polycyclic aromatic hydrocarbons (PAHs), as identified in the Commencement Bay/Nearshore Tidelands ROD. Primary contaminant sources included historical releases of metal ores handled at Terminal 7 (East Sitcum) and releases from a stormwater outfall (outfall locations appear in Appendix C). The remedial action for Sitcum Waterway included dredging approximately 400,000 CY of contaminated sediments for disposal in the Milwaukee Waterway nearshore confined disposal facility. The remedy in Sitcum Waterway was monitored for several years after completion of construction; the remedy is complete and protective of human health and the environment.

1.5.2.6 Saltchuk Site

Habitat of the Saltchuk site is degraded due to previous log raft storage at the site. The wood waste present at Saltchuk results from historic logging practices that utilized waterways for storage and transport timber products. The wood waste present at Saltchuk is not known to be chemically treated and thus not a suspected source of HTRW. Lower shore zone habitat (LSZ; from +5 to -10 MLLW) is composed of a coarse substrate that transitions to sand and silt near MLLW. LSZ and deeper habitat includes wood waste. One large area of wood waste was observed from shore during a low tide event (GeoEngineers 2014a, as cited in GeoEngineers 2015). Based on previous wood waste studies, this wood waste concentration extends to a depth of approximately -30 MLLW. Macroalgae in the LSZ is largely composed of sea lettuce (Ulva ssp.) and was observed at approximately the MLLW line. No eelgrass was observed within Saltchuk; however, one patch of eelgrass was identified to the southeast of Saltchuk at depths of approximately -6 feet to -10 MLLW during an underwater video survey conducted in August 2014.

The site contains approximately 53 acres of deep subtidal zone habitat (below -10 MLLW). This habitat at the site has been incompletely assessed during a SCUBA dive survey in 1999 (GeoEngineers 2015) and through a limited underwater video recorded in August 2014 (GeoEngineers 2014b, as cited in GeoEngineers 2015). Most of the deep subtidal habitat at the site consists of brown and black silt with wood waste over gray clay (Anchor 2008, as cited in GeoEngineers 2015). Wood waste has accumulated over approximately 100 years due to log storage at the Saltchuk site. Log storage is visible on a 1931 aerial photograph as well as all subsequent aerial photographs (Tacoma 2014) but is no longer used for log storage. Three primary locations within the log storage area were observed to contain the wood waste during the 1999 dive survey. Of the entire 64-acre Saltchuk site, approximately 13% (8 acres) is covered by wood waste.

Macroalgae is present in the deep subtidal habitat areas and generally consists of brown or red algae (Anchor 2008, as cited in GeoEngineers 2015). Invertebrates were observed during the dive survey, including polychaetes (unidentified species; only burrows observed), anemone (*Metridium senile*), sea stars (*Evasterias trochelii* and *Piaster ochraceus*), red rock crab (*Cancer productus*), ghost shrimp (*Neotrypaea californiensis*), nudibranch (*Dirona albolineata*) and egg masses, and rosy octopus (*Octopus rubescens*;) (GeoEngineers 2015). At least 63 creosote-treated timber piles approximately 12 inches in diameter are present in the shallow subtidal zone (GeoEngineers 2014a).

1.5.2.7 Additional Considerations

Air quality has been a local concern in the neighborhoods surrounding Tacoma's industrial area, including the study area. The Port has been implementing emissions reduction programs and achieving a net reduction. Section 4.6 provides more detail on air quality.

1.5.3 Future Without-Project Conditions and Actions

The future without-project conditions are the same as the No-Action Alternative for comparison with the action alternatives. Taking no action would mean continuing standard operations at Tacoma Harbor with no improvements to the Federal navigation channel. Based on information from the Port, all physical conditions at the time of this analysis are assumed to remain with the exception of the planned terminal and facility upgrades described in Section 1.5.2. Current maintenance operations would be executed within the Federal navigation channel. These operations consist of periodic bathymetric surveys to evaluate any sediment accumulation above authorized depths (-51 MLLW) and intermittent Port maintenance dredging of the berths.

1.5.3.1 Facilities and Infrastructure

The NWSA created a 10-year strategic business plan in 2015. The plan involves investment in strategic terminals that have the berth length, water depth, storage acreage, and on-dock rail facilities to handle the largest containerships in the world fleet. The NWSA identified Terminal 5 in Seattle Harbor and the GCP development in Tacoma for strategic investment. As part of the GCP development in Tacoma, the Port completed a berth reconfiguration at Husky Terminal in late 2017. This reconfiguration creates two berths with nearly 3,000 feet of dock length capable of simultaneously berthing two PPX4 vessels. The Port installed eight new Super-Post-Panamax cranes at Husky Terminal in 2018 and 2019. The Port does not have substantive plans for new infrastructure at WUT and PCT.

TOTE and U.S. Oil and Refining Company would continue their current operations on the Blair Waterway. Berth deepening at these terminals is not included in the project scope but could be pursued by individual terminal owners. The LNG facility would complete construction and begin their operations without the deepening of the Blair Waterway.

In its strategic plan, the Port included expansion of the width and depth of the waterways. This expansion is to ensure efficient navigation and set a goal to reach 3 million TEUs in throughput container volume over the next decade. It is highly unlikely that channel deepening would occur without a Federal sponsor due to cost. To accommodate the 14,000-18,000 TEU ships forecast to continue to call at Tacoma Harbor without deepening the navigation channel, pocket dredging of the berths by the Port could occur. However, ships would still experience tidal delays and other inefficiencies.

The Stevedoring Services of America (SSA) has a remediation easement for one of the outfalls on Blair Waterway. Remediating groundwater was discharged through the pipe, but no more remediation is anticipated as it is complete. The SSA easement was scheduled to end in June 2020. After that, SSA is responsible for its removal and the removal of any contaminated soils around it.

1.5.3.2 Hazardous, Toxic, and Radioactive Waste

Sites surrounding the Blair Waterway and designated under Washington State cleanup programs, including MTCA and RCRA, will likely proceed. There are no anticipated future Federal cleanup actions in the Blair Waterway.

1.5.3.3 Saltchuk Site

The Port may restore the Saltchuk site independently if beneficial use is not included in the alternative selected for implementation as part of the project recommended in this study or if the project is not constructed. However, previous designs by the Port focused on parcels owned by the Port above -5 MLLW. There are no known current plans to place suitable material below -5 MLLW at this location, and, as such, the time for any other ecosystem restoration action at this site is uncertain and unknown. If designs are similar to the beneficial use of dredged material proposed in this document, obtaining enough suitable material may be difficult and could limit the scope and ecological benefit of habitat improvements.

1.6 Proposal for Federal Action

The proposal for navigation improvements to the Federal channel triggered analysis under NEPA to analyze potential environmental impacts of the alternatives. To do this, the Corps analyzed a range of length, width, and depth improvements. The plan formulation process described in Chapter 3 led to the proposal to deepen Blair Waterway to -57 MLLW with channel widths ranging from 450 feet to 864 feet, and the turning basin expanded to 1,935 feet to allow for the safe passage of the larger 14,000-18,000 TEU ships. The study period of the analysis is 50 years, from 2030 to 2079. The Corps and DMMP evaluated environmental impacts of disposal at the established Commencement Bay open-water disposal site in the following four documents, which are incorporated by reference:

1. Puget Sound Dredged Disposal Analysis (PSDDA) Unconfined, Open-Water Disposal Sites for Dredged Material Phase I (Central Puget Sound), Final Environmental Impact Statement (EIS). Prepared by the DMMP, 1988.
2. Puget Sound Dredged Disposal Analysis (PSDDA) Unconfined, Open-Water Disposal Sites for Dredged Material Phase II (North and South Puget Sound), Final EIS, Prepared by the DMMP, 1989.
3. Dredged Material Management Program (DMMP) Reauthorization of Dredged Material Management Program Disposal Site, Commencement Bay, Washington: Supplemental EIS. Prepared by SAIC for the DMMP, 2009.
4. Biological Evaluation for the Continued Use of Multiuser Dredged Material Disposal Sites in Puget Sound and Grays Harbor. Prepared by the U.S. Army Corps of Engineers, Seattle District, June 2015.

The National Marine Fisheries Service (NMFS) issued a Biological Opinion for the Multiuser Dredged Material Disposal sites in Puget Sound and Grays Harbor dated December 17, 2015. A letter of concurrence for the project was issued by the U.S. Fish and Wildlife Services (USFWS) dated July 28, 2015.

Information on the disposal sites and impacts of disposal provided in this document comes from the incorporated references and is discussed here for the benefit of overall project context and clarity.

The placement of dredged material for a range of beneficial use scenarios at the Saltchuk site is evaluated further in this report. Material determined during PED to be unsuitable for in-water disposal based on the full sediment characterization will be disposed of at an appropriate upland disposal facility to be determined upon further evaluation. Further information regarding upland disposal considerations are addressed in Appendix B, Section 3.7.3.4. Guidelines to inform suitability for open-water disposal and beneficial use at the Saltchuk site appear in Section 3.3.3, and Appendix B. Maintenance dredging frequency and scale have been analyzed for comparison of alternatives in this document, and existing environmental documentation would be supplemented at such time that maintenance would be needed.

1.7 Overview of Integrated FR/EA

This document is an integrated Feasibility Report and Environmental Assessment (IFR/EA). The purpose of the feasibility report is to identify the plan that reasonably maximizes the national economic development (NED) benefits, is technically feasible, and environmentally sustainable. The purpose of the EA portions of the report is to comply with NEPA requirements to identify and analyze the alternatives' environmental effects, incorporate environmental concerns into the decision-making process, and determine whether any environmental impacts are significant and warrant the preparation of an EIS. The six steps of the Corps planning process each align with a NEPA requirement. The planning steps, followed by the document chapter and NEPA element to which they relate, appear in Table 1-3. These six steps comprise the Corps risk-informed planning process.

Table 1-3 Planning Steps and Aligned NEPA Requirements.

Planning Step	NEPA Element and Document Chapter
Step 1: Problems and Opportunities	Purpose and Need for Action; Chapter 2
Step 2: Inventory and Forecast of Conditions	Affected Environment; Chapter 1 and 4
Step 3: Formulate Alternative Plans	Alternatives including Proposed Action; Chapter 3
Step 4: Evaluate the Effects of Alternative Plans	Environmental Consequences; Chapter 4
Step 5: Compare Alternative Plans	Alternatives including Proposed Action; Chapters 3
Step 6: Select the Recommended Plan	Agency Preferred Alternative; Chapter 5

This document integrates a review of factors underlying a determination of whether executing the project would be in the public interest, pursuant to Clean Water Act Section 404 and rules and regulations published as 33 CFR Part 335, "Operation and Maintenance of Army Corps of Engineers Civil Works Projects Involving the Discharge of Dredged or Fill Material into Waters of the U.S. or Ocean Waters"; 33 CFR Part 336, "Factors to be Considered in Evaluation of Army Corps of Engineers Dredging Projects Involving the Discharge of Dredged Material into Waters of the U.S. and Ocean Waters"; 33 CFR Part 337, “Practice and Procedure”; and 33 CFR Part 338, “Other Corps Activities Involving the Discharge of Dredged Material or Fill into Waters of the U.S.”

2 Need for and Objectives of Action

This chapter presents the results of the first step of the planning process, the specification of water and related land resources problems and opportunities in the study area. The chapter also establishes the planning objectives and planning constraints, which are the basis for the formulation of alternative plans.

2.1 Problems and Opportunities

The problems identified in the study include the following:

1. The authorized depth for the Blair Waterway is -51 MLLW, and the current depth of the non-Federal Sitcum Waterway is -51 MLLW. Container ships experience tidal restrictions, causing lost transportation efficiencies and lost cost efficiencies at Tacoma Harbor.
2. Ships at Tacoma do not realize economies of scale afforded by the larger container ships projected to call in the future. Tide restrictions, light loading, or other operational inefficiencies will be more impactful for the future fleet.

Opportunities identified in this study to address the problems include the following:

1. Improve the efficiency of vessels transiting Tacoma Harbor's Blair and Sitcum Waterways.
2. Explore the potential for beneficial use of dredged material.

2.2 Purpose and Need for Action*

The purpose of the proposed Federal action is to achieve transportation cost savings (increased economic efficiencies) at Tacoma Harbor. Depths of the Blair Waterway and the Sitcum Waterway force container ships to load at suboptimal drafts or wait for sufficient tide to transit the channel. Tidal restrictions and draft restrictions are operational inefficiencies that create national economic transportation costs.

2.3 National Objective

The Federal objective of water and related land resources project planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements.

2.4 Planning Objectives

A planning objective states the intended effects of alternative plans over the period of analysis. The study assumes a 50-year period of analysis beginning the first year a project would be operational (for purposes of analysis, assumed to be 2030 through 2079). The study objectives are as follows:

1. Achieve transportation cost savings through increased economic efficiencies at the Blair and Sitcum waterways of Tacoma Harbor over the 50-year period of analysis.
2. To the extent practicable, consider ancillary environmental benefits over the 50-year period of analysis within the project's study area.

The objectives include Blair and Sitcum Waterways because the Port initially asked the Corps to evaluate navigation improvements to both waterways. During plan formulation, however, the Corps removed Sitcum Waterway from the study based on further evaluation. As a result, the evaluation and comparison of alternatives, plan selection will focus on Blair Waterway only. Please see Section 3.2 for a discussion of the removal of Sitcum Waterway from the study.

2.5 Planning Constraints

The following constraints identified for the study are the following:

1. The study area is within Treaty-reserved usual and accustomed (U&A) fishing areas for the Puyallup Tribe of Indians and Muckleshoot Indian Tribe. Plans will avoid or minimize impacts to tribal fishing consistent with treaty obligations.
2. Threatened and endangered species and species of concern occur within the project footprint. Avoidance and minimization of impacts to protected species will be consistent with applicable laws and consultation under the Endangered Species Act (ESA).
3. ER 1165-2-132, para 6.a sets forth the Corps' guidance that: "Construction of Civil Works projects in HTRW-contaminated areas should be avoided where practicable. … Where HTRW contaminated areas or impacts cannot be avoided, response actions must be acceptable to EPA and applicable state regulatory agencies." The guidance states the non-Federal sponsor is responsible for ensuring that the development and execution of Federal, State, and locally required HTRW response actions are accomplished at 100% non-project cost. Similar Corps guidance is also set forth in ER 1105-2-100, para 2-4p for Corps planning. Based on this guidance, the Corps will focus on alternatives development and evaluation to avoid HTRW where practicable, including landward locations. No project actions taken through dredging or potential beneficial reuse would be performed as incidental remediation of HTRW.

2.6 Public Scoping Comments and Resources of Concern*

The Corps scoped the feasibility study using several outreach strategies, including notifying local Native American tribes via letters, a news release distributed by the Public Affairs Office, notices mailed for display at public libraries around the study area, and by emailing and mailing postcards to natural resource agencies, tribes, and residents within the study area and surrounding communities. The Corps introduced the study to natural resource agencies and tribes at a semi-annual coordination meeting for Corps dredging projects on October 25, 2018. In response to these outreach efforts, participants did not propose additional resources that the Corps had not already identified for detailed analysis. The Corps attended a follow-up meeting with Puyallup Tribe of Indians staff to hear the Tribe's initial concerns.

On December 21, 2018, the Corps published a Notice of Preparation indicating its intent to prepare an EA to analyze alternatives for navigation improvements to the Blair Waterway of Tacoma Harbor, including potential deepening and widening of the waterway, and soliciting public comments for 60 days on the environmental impact of the proposal and issues for consideration in the EA. Additionally, the Corps and Port hosted a public information meeting in Tacoma on January 17, 2019, to provide further information about the proposed project and solicit feedback from the public regarding issues they believe the Corps should evaluate during the alternative evaluation process. Seven comment cards were collected at the public information meeting held in two sessions (morning and evening) with identical information presented. The Corps and the Port based the study's scope on issues raised by the tribes, natural resources agencies, and public comments received during scoping. The study scope has included issues that have commonly arisen during other dredging and port facility construction projects in the Pacific Northwest region. Comments raised during scoping also identified concerns related to the protection of tribal treaty resources and the export of natural gas or other petroleum products. Additionally, the Corps has met with the U.S. Coast Guard and Puget Sound Pilots and has considered their comments. Table 4-1 in Section 4.2 provides the results of the scoping of resources studied.

3 Plan Formulation

Corps guidance for conducting civil works planning studies, Engineering Regulation (ER) 1105-2-100 (Planning Guidance Notebook), requires the systematic formulation of alternative plans that contribute to the Federal objective. The plan formulation process requires a systematic and repeatable approach to ensure the Corps makes sound decisions concerning the development of alternatives and plan selection. This chapter presents the results of the plan formulation process. The Corps and Port developed a range of alternatives in consideration of study area problems and opportunities as well as study objectives and constraints. To develop and evaluate the alternatives, the Corps used the four evaluation criteria described in the Council for Environmental Quality Principles and Guidelines (Paragraph 5(d); completeness, effectiveness, efficiency, and acceptability). The Corps and Port evaluated and compared alternatives to narrow down the array and identify a Recommended Plan.

3.1 Management Measures and Screening

A *management measure* is a feature or activity that can be implemented at a specific geographic site to address one or more planning objectives. The study team identified the following structural and non-structural measures to improve navigation in the Blair and Sitcum waterways.

3.1.1 Non-Structural Measures

- Tug Assists: Use additional tug assists to help larger vessels and vessels with decreased maneuverability transit the harbor.
- High-Tide Transiting: Vessels wait for high tides when there is enough clearance to transit the channel under existing project conditions.
- Light Loading: Light-load the larger vessels to allow the current fleet (larger than the existing project's design vessel) to transit the harbor under existing project conditions.
- Lightering: Transfer cargo between vessels of different sizes to allow vessels to enter the harbor.

3.1.2 Structural Measures

- Channel Deepening: Deepen the channels to allow for efficient transit of larger, deep-draft vessels.
- Channel Widening: Widen the footprint of the Federal channels within the waterway to allow for efficient transit of wider vessels.
- Approach Channel Deepening and Widening: Deepen and widen the entrance area of the waterway to allow for efficient transit of larger vessels and safer access to terminals for vessels.
- Expand Turning Basin: Increase the size (length, width, or depth) of the Blair Waterway turning basin within the waterway to allow for additional maneuverability of vessels.
- Construct Approach Channel Breakwaters/Jetties: Construct breakwaters or jetties to allow for less wind/current effect on vessels entering the waterways.
- Improve existing training structures: Improve the existing training structure at the mouth of the Puyallup River, west of the Sitcum Waterway.
- Construct new waterway: Construct a new waterway at Tacoma Harbor.

3.1.3 Measures Screening

Screening is the process of eliminating measures based on the application of planning criteria to determine measures that will not be carried forward for consideration. Screening criteria for each planning study are based on the objectives, constraints, opportunities, and problems of the study/study area. Criteria used to screen measures and qualitative metrics associated with each criterion included:

- Is the measure already being carried out by a non-Federal entity? (YES/NO); measure is screened if the response is "yes".
- Does the measure meet the primary planning objective? "Achieve transportation cost savings to and from Tacoma Harbor to the extent possible." (YES/NO); measure is screened if the response is "no".
- Can the measure be designed to avoid or minimize the impacts outlined in the planning constraints? (YES/NO); measure is screened if the response is "no".
- Based on site-specific conditions, is the measure technically feasible or applicable as a navigation improvement measure? (YES/NO); measure is screened if the response is "no". Table 3-1 displays the outcomes of measures screening.

Table 3-1 Measures Screened from Further Evaluation and Cause for Screening.

Measure	Screening Criteria			
	Already carried out by a non-Federal entity?	Meets primary planning objective?	Avoids planning constraints?	Technically feasible?
Tug Assists	Yes	No	No	Yes
High-Tide Transiting	Yes	No	No	Yes
Light Loading	Yes	No	No	Yes
Lightering	No	No	No	Yes
Channel Deepening	No	Yes	Yes	Yes
Channel Widening	No	Yes	Yes	Yes
Approach Channel Deepening or Widening	No	No	Yes	Yes
Expand Turning Basin	No	Yes	Yes	Yes
Construct Approach Channel Breakwaters/Jetties	No	No	No	No
Improve Existing Training Structures	No	Yes	Yes	Yes
Construct new waterway	No	No	No	No

Based on the screening summarized above, tug assists, high-tide transiting, and light loading were screened out. These measures are already carried out by a non-Federal entity and would not achieve significant transportation cost savings to meet the primary planning objective. Lightering was screened out primarily due to potential safety concerns associated with the increased number of vessels required to transit the channel during lightering activities. The approach channel deepening/widening was initially screened out because the channel outside of the waterways becomes deep quickly, and existing information indicated no safety-related need to widen. The Corps later added this measure to Blair Waterway alternatives, based on a feasibility-level ship simulation exercise (Section 3.3.2). Breakwaters or jetties are technically infeasible in Commencement Bay due to the deep approach channel. New waterway construction would not meet the primary planning objective nor avoid planning constraints and is technically infeasible because the surrounding area is already highly developed. Based on this screening, the following measures were carried forward for alternatives formulation:

- Channel Deepening
- Channel Widening
- Expand Turning Basin
- Improve Existing Training Structures

All measures carried forward for plan formulation and analysis meet the study's primary planning objectives. They can be designed to avoid or minimize impacts outlined in the planning constraints, are not being implemented by a non-Federal entity, and are considered technically feasible.

3.2 Formulation of Alternatives

Alternative plans are a set of one or more management measures that function together to address one or more planning objectives. An initial array of alternative plans was formulated using combinations of management measures and the assumptions and considerations listed below.

Alternatives considered in the study include the No-Action Alternative, as required by NEPA. This alternative represents the future without-project condition and describes the system's future if no new actions result from the planning effort. Taking no action at Tacoma Harbor would mean continuing standard operations with no improvements to the Federal navigation channel. At the time of this analysis, all physical conditions are assumed to remain except for the planned terminal and facility upgrades described in Section1.5. The No-Action Alternative is described in detail throughout Chapter 4. This condition is the basis for comparison with every action alternative.

3.2.1 Design Vessel Assumptions

The identification of a design vessel assists the study team by informing design parameters for alternatives. For deep draft navigation projects, the design ship(s) is/are selected based on economic studies of the types and sizes of the ship fleet expected to use the proposed channel over the project life. The design vessel represents the maximum or near-maximum size ship in the forecasted fleet.

The study team considered the design vessel used in a recently completed feasibility study at Seattle Harbor (USACE 2017). Based on the applicability of the fleet forecast used in the completed study in Seattle, and Tacoma Harbor’s ability to accommodate this vessel, a PPX4 containership is recommended for Tacoma Harbor economic evaluation and channel design. PPX4 design vessel parameters have been updated based on a review of Clarkson World Fleet Register Listing and IHS Sea-web ships databases, which contain information on the world fleet to account for the range of breadths, lengths, drafts, and other vessel parameters for containerships that are in service, under construction, or on order. Parameters for the PPX4 containership are as follows:

- 175 to 194 feet in beam (extreme breadth (XB))
- Design Beam = 184 feet
- 1,295 to 1,315 feet LOA

- Design Length = 1,302 feet
- 47.6- to 52.5-foot maximum summer loadline draught (MXSLLD)
- Design Draft = 52.5 feet
- Nominal TEU intake of approximately 15,500 to 19,200 TEUs
- Deadweight (DWT) rating of 155,000 to 205,000 metric tons

3.2.2 Channel Length Assumptions

Proposed channel lengths for each alternative have been determined based on the physical limitations of the channels. The Blair Waterway is 2.75 miles long, and the Sitcum Waterway is 4,000 feet long. There is no proposed lengthening of waterways beyond the physical limitations of the channels.

3.2.3 Channel Width Assumptions

The proposed channel widths for each alternative were initially determined based on the currently Federally authorized width of Blair Waterway, the current physical limitations of the Sitcum Waterway as described in Section 1.3, as well as the design vessel for the study as described above.

According to the Engineering Manual (EM) recommendations for Hydraulic Design of Deep Draft Navigation Projects (EM 1110-2-1613), the navigation channel width should be 2.5 times the beam of the design vessel to accommodate all environmental and operating factors. This design recommendation informed the initial alternatives formulation for the study.

Feasibility-level ship simulation refined the channel width design. The study assumes that the design vessel can transit the channel under the future without-project condition. Widening recommended by ship simulation and engineering design primarily relates to Federal authorization of channel space already in use. Additional widening is required to maintain appropriate channel dimensions per engineering design (referred to herein as “associated widening”).

3.2.4 Channel Depth Assumptions

Proposed channel depths for each alternative were based on existing surveys and draft (depth) requirements for the design vessel. Most areas of Blair Waterway and Sitcum Waterway are maintained to -51 MLLW. Larger ships require a greater depth to transit efficiently the waterways. The Corps analyzed costs and impacts of alternatives ranging from -52 to -58 MLLW. Alternatives shallower than existing depths would not meet study objectives. Depths greater than -58 MLLW are unlikely to increase economic benefits while shallower depths begin to limit vessel maneuverability when underkeel clearance and vessel draft are considered. Economic and engineering criteria are satisfied at a depth of -57 MLLW. Determining depth for all alternatives is a joint economic-engineering optimization process that evaluates one-foot depth increments to find the alternative that best satisfies economic and engineering criteria.

3.2.5 Turning Basin Assumptions

The study area includes a Federal turning basin at the terminus of the Blair Waterway. Turning basin use is necessary for vessels docking at PCT. Pilots have the option of “backing out” stern-first or using the turning basin for vessels docking at WUT. Based on existing operations and input from the Port of Tacoma and pilots, the study team assumes that pilots will prefer to use the turning basin for PPX3 and PPX4 vessels docking at WUT, especially during high wind conditions. The turning basin improves pilots’ ability to manage risk. Sufficient depth exists outside the Federal turning basin for the transit of the design vessel in the future without-project condition. Alternative plans would modify the turning basin's Federal boundary to accommodate the design vessel as recommended in EM 1110-2-1613 and further expanded by the ship simulation exercise for safety reasons listed above and detailed in Section 4.4.

3.2.6 Dredged Material Disposal Assumptions

Disposal sites are evaluated as a part of each action alternative. At this stage of alternatives formulation and evaluation, three disposal sites (open-water, upland, and beneficial use) are being carried forward. Each alternative includes more than one site for disposal (i.e., alternatives include both open-water and upland disposal at a minimum; and may include two sites total for in-water disposal if Saltchuk is used). The Commencement Bay open-water disposal site is located within the vicinity of Tacoma Harbor, approximately three miles away. Saltchuk is a potential alternative placement site for beneficial use and is located approximately one mile northeast of Blair Waterway. The Corps conducted feasibility level sediment sampling to inform alternatives evaluation and disposal sites included in the alternatives (Section 3.3.3). Not all dredged material suitable for open-water disposal will be suitable for beneficial use due to additional considerations for material placed in nearshore habitat. The Corps did not evaluate the construction of a confined aquatic disposal (CAD) site for unsuitable material given the potential environmental liabilities associated with a CAD site. Sediment that is not suitable for open-water disposal would be placed at an appropriate upland disposal site. Further information regarding upland disposal considerations are addressed in Appendix B, Section 3.7.3.4.

3.2.7 Local Service Facility Assumptions

Local service facilities (LSF) include terminals and transfer facilities, docks, berthing areas, and local access channels. LSFs are 100% non-Federal costs and considered economic costs in the benefit cost analysis.

Blair Waterway: LSF costs assumed for the Blair Waterway include berth deepening at Husky, WUT, and PCT to match the channel depth and associated slope strengthening at each terminal for depths greater than -54 MLLW. The Port provided estimated lengths of slope strengthening for each container facility: 1,140 feet, 2,010 feet, and 2,090 feet at Husky, WUT, and PCT, respectively.

Sitcum Waterway: LSFs would include removing the east dock to allow passage of larger vessels around a docked vessel at the west dock and lengthening the west dock to accommodate larger ships.

A summary of the initial array of alternatives appears in Table 3-2.

Table 3-2. Summary of Initial Array of Alternatives.

Alternative	Measure			
	Channel Deepening	Channel Widening	Expand Turning Basin	Improve Existing Training Structures
Alternative 1: No-Action	No Change	No Change	No Change	No Change
Alternative 2: Blair Waterway Deepening	Deepen up to -58' + overdepth (2') for entire authorized waterway (based on evaluation of one-foot depth increments)	None assumed, based on the initial formulation	Yes	NA
Alternative 2a: Blair Waterway Deepening through Husky Terminal	Deepen up to -58' + overdepth (2') for the segment from the entrance to STA 41+85.18 (based on evaluation of one-foot depth increments)	None assumed, based on the initial formulation	NA	NA
Alternative 3: Sitcum Deepening (Single Berth)	Deepen up to -58' + overdepth (2') for the entire existing waterway (based on evaluation of one-foot depth increments)	No	NA	Yes
Alternative 4: Sitcum Deepening and Widening (2 Berth)	Deepen up to -58' + overdepth (2') for the entire waterway, including under the existing dock (based on evaluation of one-foot depth increments)	Yes; requires structural modification to east dock	NA	Yes
Alternative 5: Blair and Sitcum Deepening	Combine Alternatives 2 & 3	Combine Alternatives 2 & 3	Yes	Yes
Alternative 6: Blair Deepening and Sitcum Deepening/Widening	Combine Alternatives 2 & 4	Combine Alternatives 2 & 4	Yes	Yes

3.3 Refining the Initial Array of Alternatives

3.3.1 Removal of Sitcum Waterway

Following the initial plan formulation, additional evaluation has shown that the Sitcum Waterway does not meet the criteria for inclusion in further alternatives evaluation in this study. As a result, the Corps removed Sitcum Waterway from the study. *Completeness, effectiveness, efficiency,* and *acceptability* are the four evaluation criteria specified in the Council for Environmental Quality Principles and Guidelines (Paragraph 5.(d)) in the evaluation and screening of alternative plans. The Corps used these criteria to evaluate the Sitcum Waterway.

Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects.

Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities.

Efficiency is the extent to which an alternative plan is a cost-effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the nation's environment.

Acceptability is the workability and viability of an alternative plan with respect to its acceptance by State and local entities, tribes, and the public, and its compatibility with laws, regulations, and public policies.

The Port wants to strategically focus its financial and staff resources on Post-Panamax traffic in the Blair Waterway. Larger vessels have begun calling on Blair Waterway, as evidenced by a 13,800+ TEU ship, which began regular service to Pierce County Terminal in Blair Waterway in November 2018. As the Port is unlikely to be able to budget for the improvements needed to make deepening Sitcum functional, it raises concerns that Sitcum Waterway improvements would not be complete.

Sitcum does not currently have enough width to berth large ships on both sides of the channel. Widening the channel would involve significant landside improvements, including moving the existing rail ramp on the east side of Sitcum (between Sitcum Waterway and Husky Terminal on Blair) and removing the existing east side dock, which is in poor condition. Initial design and cost analysis showed that Sitcum Waterway would require a very significant investment in docks, toe walls, and backlands to facilitate larger vessels calling on that waterway.

Sitcum Waterway improvements would not be effective because the current carrier does not foresee a need for larger vessels in the near future. The current lessee of the West Sitcum Terminal (a domestic carrier) has a 10-year lease in place and no plans to service vessels requiring deeper channel depth. Additionally, the Port of Tacoma does not support channel deepening at Sitcum and would not make the infrastructure improvements necessary for larger containerships, which would be necessary for the project to realize benefits.

The projected cost to widen an already developed port affects the overall efficiency of the project negatively. Given the Port's recent and near-term investments in Seattle Harbor and Tacoma Harbor, a major investment in Sitcum Waterway was determined to be unlikely within the next 10 years. Sitcum Waterway navigation improvements would not be acceptable due to the cost described above and no anticipated need for deepening over the study period.

3.3.2 Ship Simulation

The Corps conducted a feasibility-level ship simulation exercise at the Corps Engineering Research and Design Center (ERDC) in April 2019. The simulation informed the team on the width and alignment needs in the Blair Waterway to achieve the planning objectives safely.

The proposed Blair Waterway channel used for the simulation included deepening and widening the Federal navigation channel, a section of realignment, and modification to the turning basin. The depth used in the simulation was -58 MLLW within the proposed channel. As simulations progressed and the captains provided feedback, the proposed channel alignment underwent minor adjustments resulting in the channel's final version, shown in red. The currently authorized channel is also shown as a dashed black line in Figure 3-1. The vessel used for feasibility-level ship simulation was the *Superium Maersk* (1307' LOA x 191' Beam x 53 draft), which represents the design vessel class described in Section 3.2.1. albeit not the exact dimensions of the design vessel for the study. The exact dimensions of the design vessel will be built into the simulation to be performed during PED for consistency. The Corps will perform a more refined ship simulation during PED, the details of which can be found in Section 5.8.3.

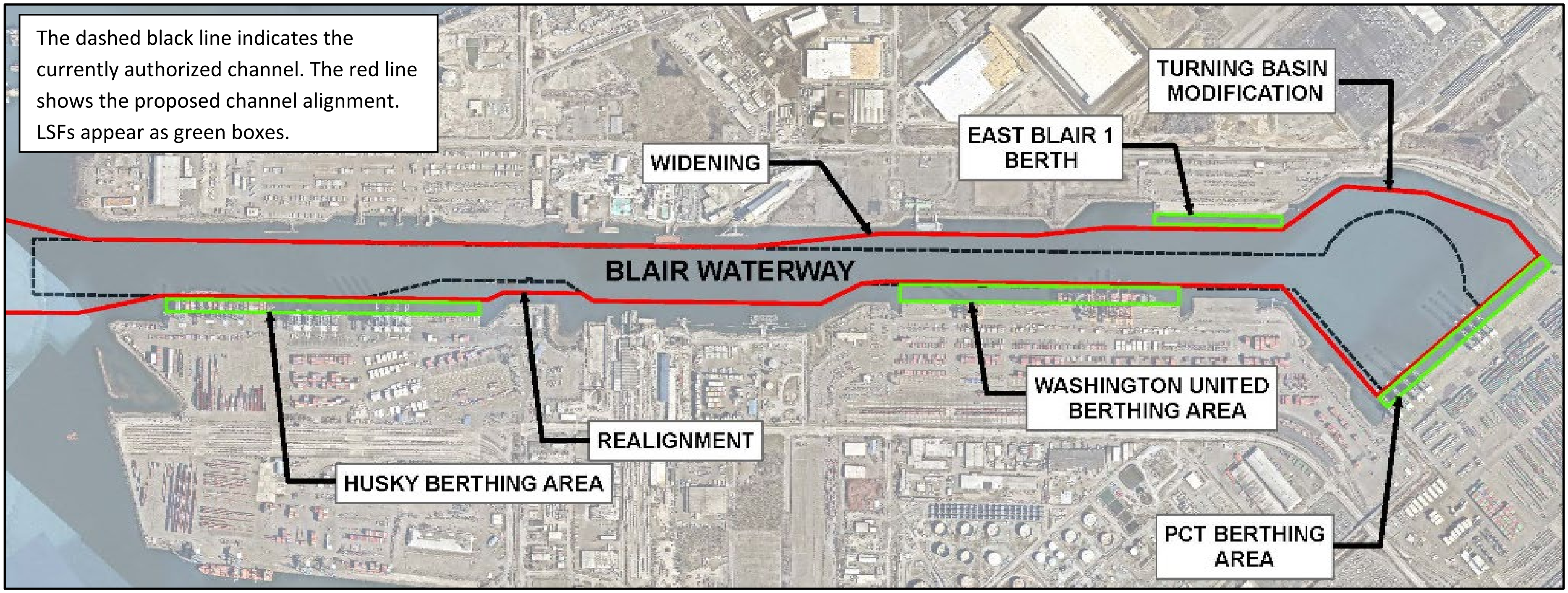


Figure 3-1. Proposed Blair Waterway used in Ship Simulation.

The ship simulation confirmed the initial design, based on EM 1110-2-1613, and appears to be acceptable for the design vessel used during feasibility. Minor modifications to the turning basin and entrance to the channel were incorporated to make the transit safer as per Puget Sound Pilot input.

Ship simulation also confirmed the need for consistent depth between the channel and turning basin. Maintaining controlled outward transits proved difficult for stern-first movements from WUT to the entrance channel under windy conditions. While pilots may continue "back-out" practices with PPX3 and PPX4 vessels berthed at WUT under good weather conditions, strong Southwest winds and low visibility conditions could create higher incident risk for "back-out" transits. NOAA gage 9446482 contains wind records from 2007 through 2018. Wind speeds exceeding 10 knots are present about 10% of the time, with more severe winds exceeding 20 knots 2% of the time. Inclusion of the turning basin improves the pilot's ability to manage environmental risk and prevents limitations on PPX3 and PPX4 vessels, which could make docking at WUT operationally challenging and potentially unsafe.

The Corps integrated the suggested modifications from ship simulation and further refined the design to make ship maneuvering safer. The simulation and design modification did not result in channel overlap with berthing areas. Appendix B (Engineering) contains detailed information on the ship simulation.

3.3.3 Dredged Material Sediment Suitability

The Dredged Material Management Program (DMMP) is an interagency group consisting of four agencies that work collaboratively to ensure that the material proposed for dredging in Washington State is appropriately tested and managed. The DMMP agencies are the Corps-Seattle District, the EPA Region 10, the Washington Department of Ecology (Ecology), and the Washington Department of Natural Resources (WDNR).

The Corps conducted a feasibility-level sediment sampling and partial DMMP testing in February-June 2019 to evaluate material for open-water disposal at the DMMP Commencement Bay site and beneficial use of dredged material at the Saltchuk site (DMMP 2019; Appendix B Engineering). The Corps will conduct a full suitability determination in PED. For the feasibility-level sampling, 25 cores were collected, and 63 samples were analyzed. The elevation of native sediment was identified in 20 out of 25 cores; the native interval could not be identified in the other five cores and is assumed all non-native material. Estimates of the likelihood that material would be suitable for open-water disposal at the DMMP Commencement Bay site were made based on a comparison of chemical results to 2018 DMMP screening levels. For example, if 50% of the samples within a given area passed for open-water disposal, then the assumption is 50% of the material within that area is likely to be suitable for open-water disposal (see Appendix B for additional detail). Chemical results were compared to the Washington State Sediment Management Standards, National Marine Fisheries Service's (NMFS) proposed PAH screening level for the protection of fish, and natural background levels for dioxin, to estimate the likelihood of suitability for beneficial use at Saltchuk to assist in planning for this feasibility study. These guidelines were based on coordination with EPA Region 10, Ecology, WDNR, and WDFW. The final determination of material suitability guidelines for Saltchuk will be made in PED after further coordination with natural resource agencies and tribes during the feasibility study, and ESA consultation is complete.

Throughout the waterway, native sediments are 95% likely to be suitable for open-water disposal or beneficial use, whereas non-native sediments had varying levels of suitability. At the mouth of the waterway, non-native sediments are less likely to be suitable for open-water disposal (90% suitable) or beneficial use (85%). In the middle portion of the waterway, sediments are much less likely to be suitable for open-water disposal (60%) or beneficial use (40%). Non-native sediments in the turning basin did not have any screening level exceedances and are estimated to be 100% suitable for open-water disposal or beneficial use. Based on preliminary sediment characterization and the amount of native material that would be dredged from the Blair Waterway, it is likely there would be sufficient suitable material for beneficial use at Saltchuk (Scenario E; Section 3.6.2.2). Further information is in Appendix B (Engineering). The potential for off-site migration of dredged material at the Commencement Bay disposal site is discussed in the DMMP's advisory memo (Appendix B Engineering). Recommendations are for baseline physical monitoring of the disposal site, in addition to physical monitoring to ensure dredged material is remaining on-site after every 500,000 CY or at the end of each dredge year, are included in the Corps' estimated project costs. If physical monitoring reveals significant off-site migration of dredged material, the DMMP agencies may implement additional institutional controls to manage the site. These controls are discussed in the 2009 Supplemental EIS for Re-authorization of the Commencement Bay disposal site and could include shifts in the target zone, shifts in the direction of barge travel over the site, or restrictions on the timing of disposal based on the tidal cycle.

3.3.4 Side Slope Stability

Side slopes have the potential for additional stabilization at four locations in the Blair Waterway described below and appear in Figure 3-4. This information informs the geotechnical stability analysis.

- Site 1: South side of Blair Waterway adjacent to Husky Terminal (Station 44+00 to 48+00). Current bathymetry reveals an approximately 2 Horizontal:1 Vertical (2H:1V) slope. Site investigation, including borings, conducted by Hart Crowser on July 21, 2015, characterized soils at Station 40+00 as loose to medium dense silty sand with layers of soft silt (0 to -25 feet below the mudline), underlaid by medium dense to very dense sand to silty sand (-25 to -50 feet) underlaid by medium dense to very dense silty sand interbedded with layers of soft to stiff silt to sandy silt (-50 to -150 feet).
- Site 2: North side of Blair Waterway at Lincoln Avenue, Puyallup Tribal Trust Property (Station 74+50 to 82+00). Current bathymetry reveals an approximately 2H:1V slope. Previous site investigations/borings by others in this area were not identified but may exist.
- Site 3: North side of Blair Waterway, Puyallup Tribal Fee Property (Station 94+00 to 98+00). Current bathymetry reveals an approximately 2.5H:1V slope. Site investigation, including borings, conducted by GeoEngineers on September 1, 2009, characterized soils at Station 110+00 on the south side of the waterway is brown-gray silt with organics and occasional sand, soft, wet (8 to -2 feet); fine to medium grained sands with silt and shells, medium dense to dense, wet (-2 to -65 feet).
- Site 4: North side of Blair Waterway turning basin (Station 118+00 to 125+50). Current bathymetry reveals an approximately 2H:1V slope. Site investigation, including borings, conducted by GeoEngineers on May 28, 2004, characterized soils at Station 127+00 as silt and

silt with fine sand, soft, wet (10 to -2 feet); fine to medium sand, loose, moist (-2 to -9 feet); silt and silt with fine sand, medium stiff/medium dense, moist (-9 to -28 feet); fine to medium sand, medium to very dense (-28 to -55 feet).

The feasibility-level ship simulation and additional engineering analysis have identified areas that would need side slope stabilization for the proposed navigation channel. The Corps cannot determine specific stability measures without additional analysis to be completed in PED (Section 5.9.3). An evaluation of potential slope stability measures on the Blair Waterway according to engineering, environmental, and cost criteria appears in Table 3-3.

Engineering criteria are constructability, long-term effectiveness and sustainability, and cost. Once constructed, the structures would be incorporated into the District's coastal structures inspection program, which inspects Federal coastal and navigation structures periodically. Criteria were qualitatively ranked as high, medium, or low (H/M/L) or yes or no (Y/N) according to the following guidelines:

- Constructability (Y/N): If the measure is feasible to implement according to professional engineering judgment that factors in the bathymetry, geotechnical conditions, and site conditions, it is constructible (Y).
- Sustainability: All sustainability rankings imply that the structure is designed for and expected to last for the 50-year period of analysis. A high sustainability ranking is given to a structure expected to last for 50 years needing nothing but routine inspections. A medium sustainability ranking is given to a structure that may need maintenance beyond the routine inspections within 50 years. This rating is mostly reserved for structures comprised of riprap or armor stone, where stronger storm events could cause some shifting of the individual armor stones. Finally, a low sustainability ranking is given where the structure is expected to need maintenance during its service life.
- Cost: The cost for each alternative was analyzed as a percentage of the total project cost. Stabilization methods were ranked as low when the estimated construction cost is less than 15% of the total project cost, as a medium when the cost less than 25% of the total project cost, and anything over 25% was considered high. Lifespan and O&M costs were estimated as well in the event that this breakdown would be insufficient for identifying the preferred alternative.

The environmental criteria are fish and wildlife effects, the approximate area of fill, mitigation needs, and staging area effects. Staging areas are expected to be on previously developed property and provided by the Port, so this is not included as a consideration in the table. The Corps ranked and compared criteria qualitatively according to the following guidelines:

- Fish and wildlife effects: Effects on fish and wildlife mainly occur during construction. Highly disruptive techniques, such as impact hammer pile driving for sheet pile installation, have a high impact, while auger or vibratory pile installation for secant pile installation and riprap placement, have similar noise levels and a medium impact. No stabilization (i.e., only dredging) has a low impact on fish and wildlife due to lack of additional noise or construction beyond dredging.

- Approximate area of fill: Linear feet was used for walls, and volume was used for riprap.
- Mitigation needed: Temporary effects of construction do not require mitigation. Side slope habitat in the Blair Waterway is currently in poor condition because it is highly riprapped and has multiple structures such as piers and berthing areas. The Corps evaluated mitigation requirements for ESA-listed species and determined the proposed action will not substantially degrade critical habitat from current conditions. Mitigation for fill greater than 1/10th of an acre under Section 404 of the Clean Water Act will be evaluated in PED.

The real estate criterion is simply whether the sponsor would have to acquire real estate from landowners for the proposed stability measure. A measure is more likely to be carried forward if the sponsor does not have to acquire real estate.

Table 3-3 Evaluation of slope stability measures at four areas along the Blair Waterway.

		Engineering Criteria			Environmental Effects Criteria			Real Estate Criteria	Evaluation
	Measure Description	**Constructability** (Y/N)	**Sustainability** (H/M/L)	**Cost** (H/M/L)	**Fish and Wildlife (F&W) effects** (H/M/L)	**Approx. Area of Fill or Length** (acres or linear feet)	**Mitigation Needed** (Y/N/Maybe)	**Sponsor would have to acquire Real Estate** (Yes/No)	Carried Forward or Eliminated
Site 1	a. Secant pile wall	Yes	High	High	Medium	500 linear feet	Maybe. Determined by amount of fill.	No.	Carried Forward
	b. Sheet pile wall	Yes	High	Medium	High	500 linear feet	Maybe. Determined by amount of fill.	No.	Eliminated due to adverse effects to F&W during construction.
	c. Excavate steepened slopes to 1.5:1 and stabilize as needed with slope protection.	Yes	Medium	Medium	Medium	1.3 acres	Yes.	No.	Carried Forward
	d. Narrow the proposed navigation channel	No. This area of the channel has physical constraints pilots use to navigate, so narrowing the channel would result in dangerous navigation conditions.	High	Low	Low	None	No.	No.	Eliminated due to lack of constructability.
Site 2	a. Secant pile wall	Yes	High	High	Medium	750 linear feet	Maybe. Determined by the amount of fill.	Yes.	Carried Forward
	b. Sheet pile wall	Yes	High	Medium	High	750 linear feet	Maybe. Determined by amount of fill.	Yes.	Eliminated due to adverse effects to F&W during construction.
	c. Excavate steepened slopes to 1.5:1 and stabilize as needed with slope protection.	Yes	Medium	Medium	Medium	2.5 acres	Yes.	Yes.	Carried Forward
	d. Narrow the proposed navigation channel	Yes. PED analysis will include a narrowing of the channel to try and keep side slopes from daylighting into the uplands. If successful, the refined ship simulation will help validate the narrower channel for navigation.	High	Low	Low	None	No.	No.	Carried Forward
Site 3	a. Secant pile wall	Yes	High	High	Medium	380 linear feet	Maybe. Determined by amount of fill.	Yes.	Carried Forward
	b. Sheet pile wall	Yes	High	Medium	High	380 linear feet	Maybe. Determined by amount of fill.	Yes.	Eliminated due to adverse effects to F&W during construction
	c. Excavate steepened slopes to 1.5:1 and stabilize as needed with slope protection.	Yes	Medium	Medium	Medium	0.92 acres	Yes.	Yes.	Carried Forward
	d. Narrow the proposed navigation channel	Yes. PED analysis will include a narrowing of the channel to try and keep side slopes from daylighting into the uplands. If successful, the refined ship simulation will help validate the narrower channel for navigation.	High	Low	Low	None	No.	No.	Carried Forward
Site 4	a. Secant pile wall	Yes	High	High	Medium	870 linear feet	Maybe. Determined by amount of fill.	No.	Carried Forward
	b. Sheet pile wall	Yes	High	Medium	High	870 linear feet	Maybe. Determined by amount of fill.	No.	Eliminated due to adverse effects to F&W during construction.
	c. Excavate steepened slopes to 1.5:1 and stabilize as needed with slope protection.	Yes	Medium	Medium	Medium	2.8 acres	Yes.	No.	Carried Forward
	d. Narrow the proposed navigation channel	Yes	High	Low	Low	None	No.	No.	Carried Forward

3.4 Alternatives Considered but Not Carried Forward

The following four alternatives were considered but not carried forward as a result of removing the Sitcum Waterway from the study scope (Section 3.3.1):

- Alternative 3: Sitcum Deepening (Single Berth)
- Alternative 4: Sitcum Deepening and Widening (2 Berth)
- Alternative 5: Blair and Sitcum Deepening
- Alternative 6: Blair Deepening and Sitcum Deepening/Widening

Creating a new waterway is a measure considered as a standalone alternative that did not meet the screening criteria and was screened out prior to the initial array of alternatives (Section 3.1.3).

3.5 Final Array of Alternatives

A summary of the final array of alternatives is included below.

Alternative 1 - No-Action Alternative. The Corps defines the No-Action Alternative as the future without-project conditions for comparison with the action alternatives. The No-Action/future without-project conditions are discussed further in Section 1.5.3. Taking no action would mean continuing standard operations at Tacoma Harbor with no improvements to the Federal navigation channel (Figure 3-2). Based on information from the Port, all physical conditions at the time of this analysis are assumed to remain with the exception of the planned terminal and facility upgrades described in Section 1.5.2 and 1.5.3 and continued environmental investigations and remedial actions in Sections 1.5.2.5 and 1.5.3.2. It is assumed current maintenance operations would continue within the Federal navigation channel; this consists of periodic bathymetric surveys to evaluate any sediment accumulation above authorized depths (-51 MLLW) and intermittent maintenance dredging of the berths. Any material removed during maintenance dredging would be evaluated by the DMMP and disposed of appropriately. Maintenance dredging of the Federal Blair Waterway has not been required since the Blair Waterway deepening was completed in 2001. Supplemental NEPA documentation would be prepared to address future O&M dredging events, as needed.

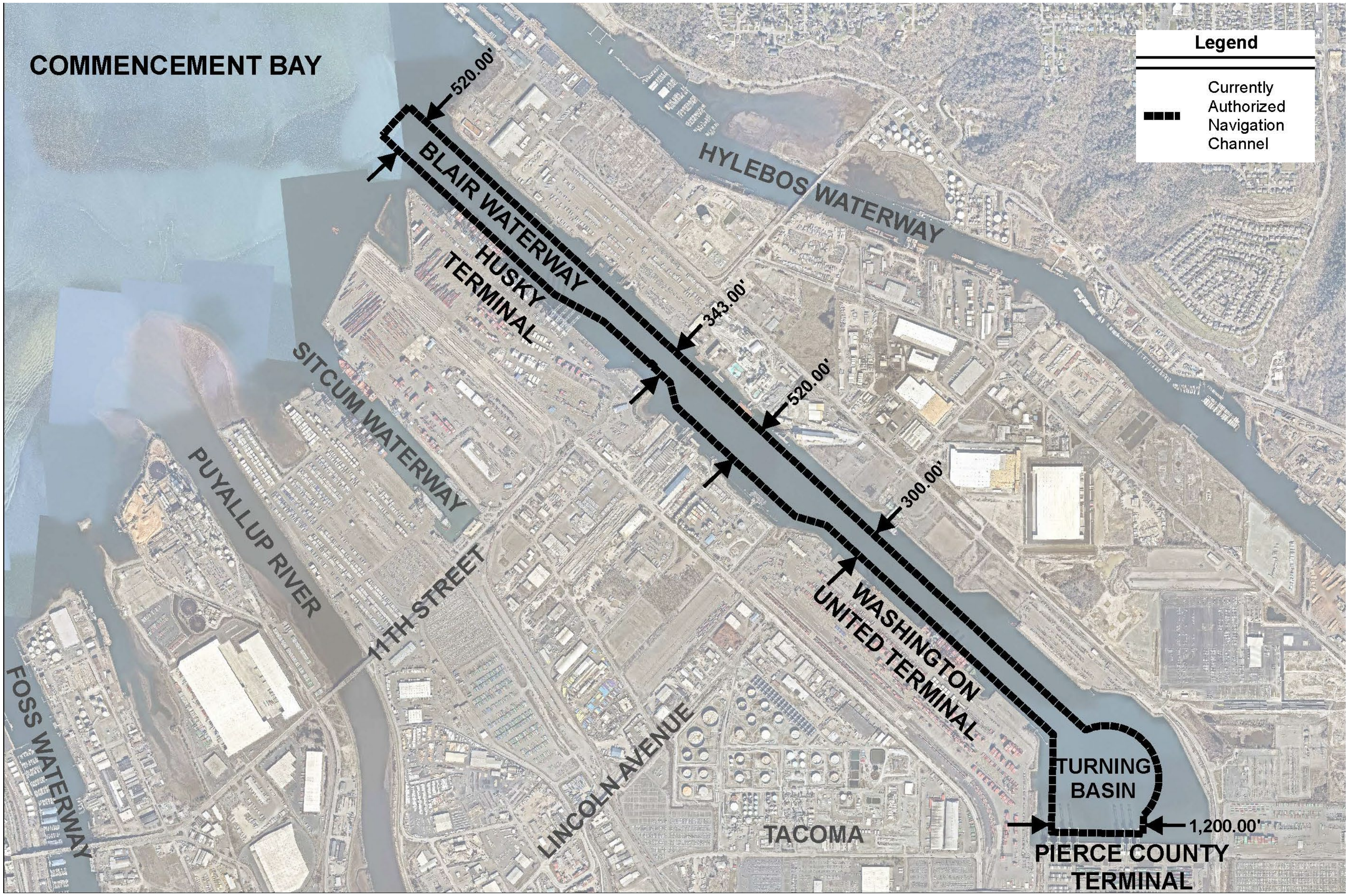


Figure 3-2. Currently authorized navigation channel and No-Action Alternative for Blair Waterway.

Alternative 2 - Blair Waterway Deepening to -58 MLLW. To analyze a range of depths for improving navigation, the study team determined that the deepest channel would be -58 MLLW. Alternative 2 (Figure 3-3 and Table 3-4) would deepen the channel and turning basin from an authorized depth of -51 MLLW to -58 MLLW with associated channel widening for design vessel navigation. Alternative 2 widens the Federal channel boundary to between 450 feet and 865 feet and expands the Federal turning basin boundary to a diameter of 1,935 feet. Turning basin expansion is necessary for Alternative 2 to allow for the use of WUT and PCT.

Side slopes would be 2:1 throughout the proposed channel, with potential for additional stabilization at the four areas called out in Figure 3-4. Feasibility-level ship simulation and additional engineering analysis identified areas that would need side slope stabilization for the proposed navigation channel. As such, they would be general navigation features (GNF). Stabilization needs will be confirmed as the design is refined.

HTRW material remains in place in the uplands at the Lincoln Avenue Ditch and Former Lincoln Avenue Ditch adjacent to the east side of Blair Waterway (Figure 3-4), with institutional controls in place to limit disturbance of the site in the upland (upland is land elevated above shore land, in an area above where water flows). Based on conceptual design information, the Corps assumes there is enough distance between the proposed navigation channel and existing institutional controls that extend approximately 30 feet from the top of the bank to allow for an engineering solution that completely avoids the remaining contamination in this upland area. If an engineering solution cannot be formulated to avoid existing HTRW, the non-Federal sponsor is required to address contamination consistent with ER 1165-2-132, as discussed in Section 5.10.2.2.

If Alternative 2 is selected, a detailed design for this alternative would be completed in PED.

Table 3-4 Federally Authorized and Alternative 2 Widths by Channel Station (STA) at Blair Waterway.

Stations along the channel	Authorized widths (ft.)	Proposed width (ft.)
STA -5 to STA 0		865
STA 0 to STA 12	520	800
STA 12 to STA 44	520, 343	520
STA 44 to STA 52	520	520
STA 52 to STA 79	520,330	520
STA 79 to STA 100	330	450
STA 100 to STA 116	330, 1,682	525
STA 116 to STA 140	1,682	1,935

Up to approximately 3,211,000 CY would be dredged from the Blair Waterway. This quantity assumes the proposed maximum depth of -58 MLLW with up to two feet of overdepth in the Blair Waterway channel and turning basin. Overdepth accounts for the inherent imprecision of the dredging process. Proposed widths are described above and appear in Figure 3-3.

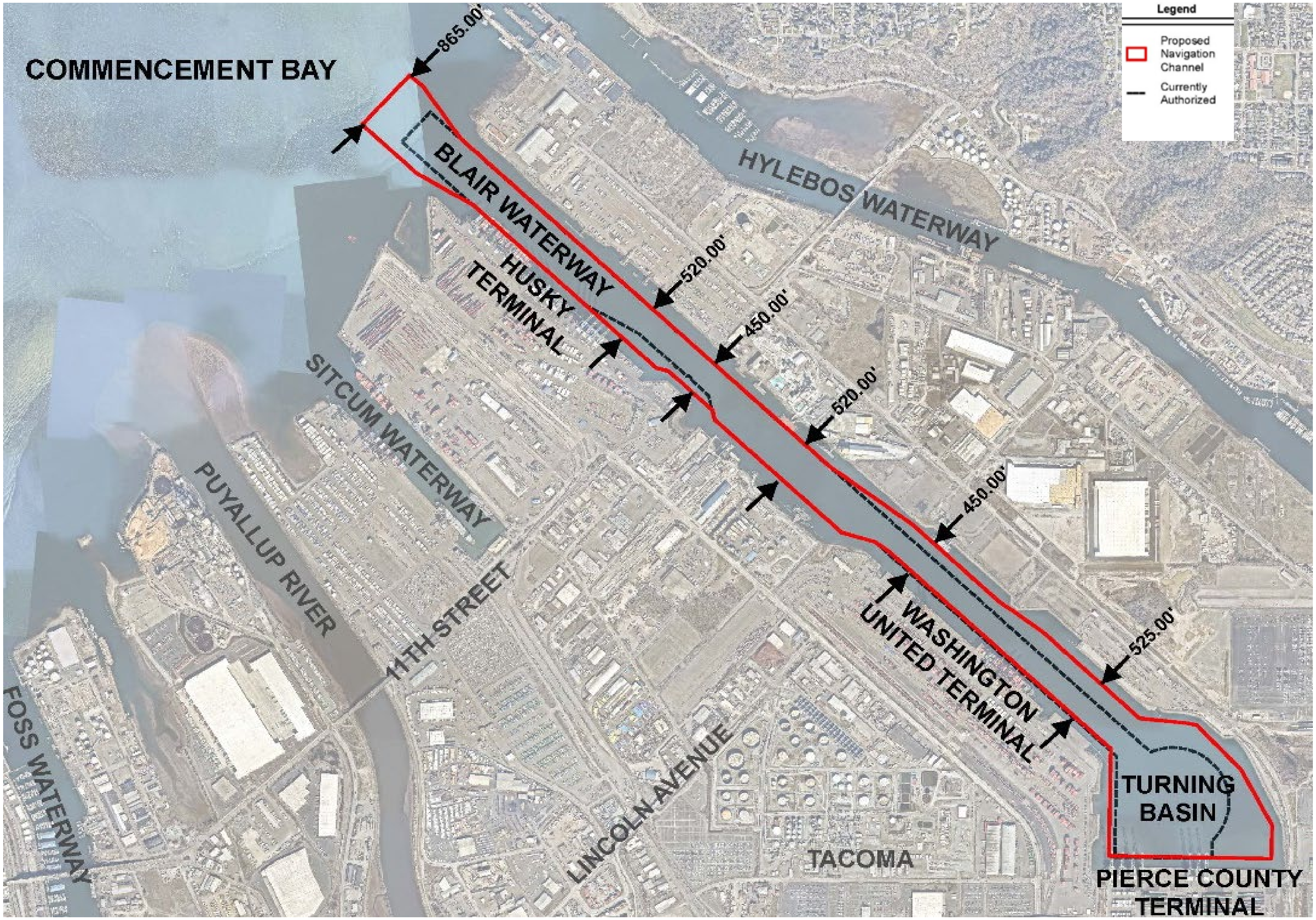


Figure 3-3. Alternative 2 Blair Waterway Deepening.

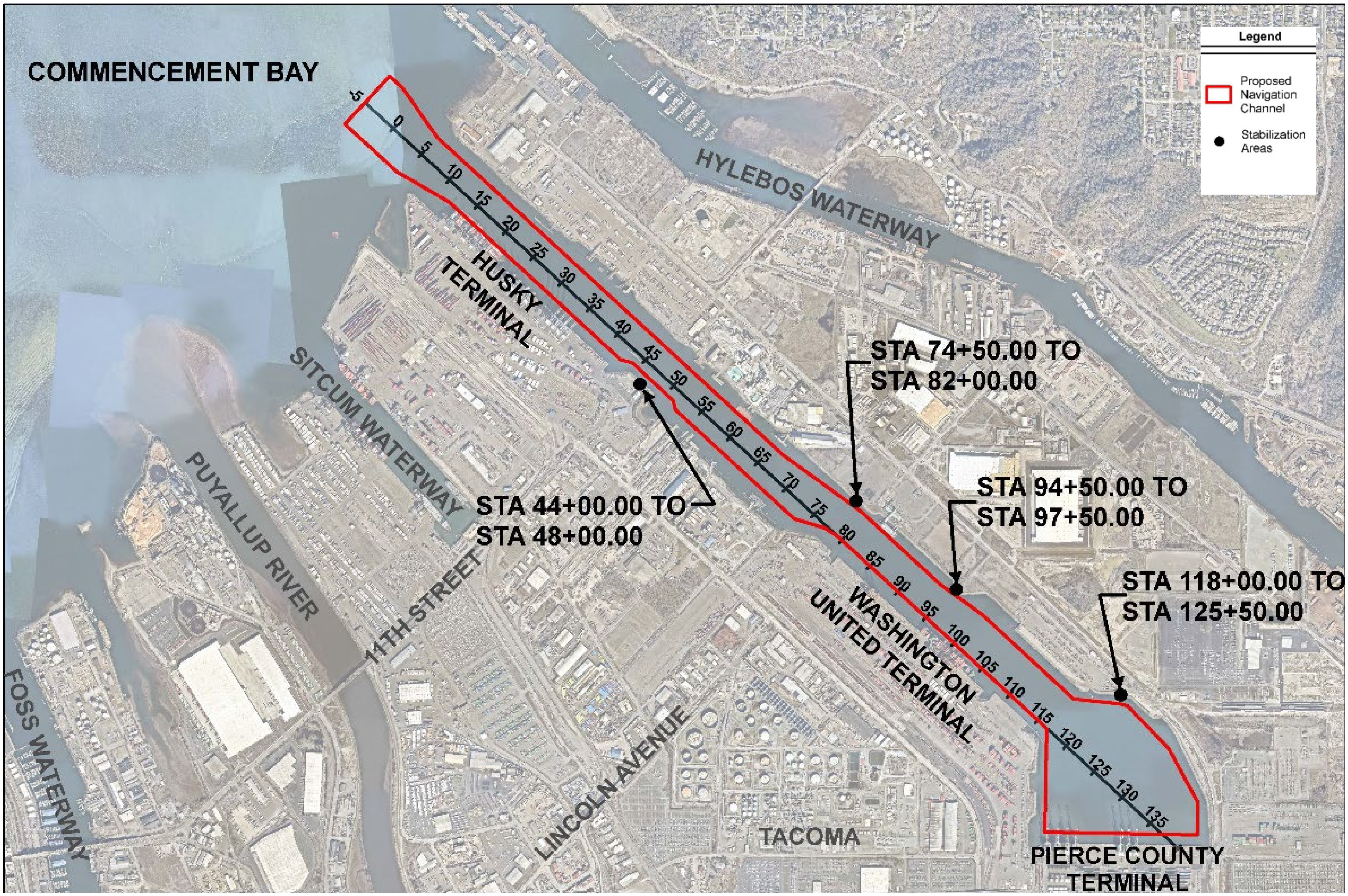


Figure 3-4. Potential side slope stabilization areas by station in Alternative 2 (indicated by black dots).

The dredging method is mechanical, which would use a digging clamshell bucket to remove the material suitable for open-water disposal. An environmental bucket would be used for any material unsuitable for open-water disposal. An environmental clamshell bucket is different from a standard clamshell bucket in that it has several features to minimize resuspension of sediment and can more completely remove all unsuitable sediment. These features include a design for a clean and level cut of the sediment, overlapping sideplates and rubber seals for no loss of sediment, and a closing system to eliminate material loss as the bucket rises through the water. Environmental buckets are used where unsuitable sediment is a concern. All dredged material would be placed on a barge adjacent to the dredge.

Three sites are possible for disposal of dredged material: Commencement Bay, Saltchuk, or upland disposal. The Corps will evaluate these options to identify the base plan (i.e., the least-cost plan) and the cost shares for disposal. The potential for beneficial use is discussed in Section 5. The quantity of material estimated to be suitable for open-water disposal is 2,783,000 CY overall, with approximately 933,000 CY suitable for placement in the DMMP Commencement Bay site and approximately 1,850,000 CY suitable for either beneficial reuse at Saltchuk or placement in Commencement Bay. The remaining approximately 428,000 CY is not suitable for open-water disposal and would be removed by barge, de-watered, and transported by truck to an appropriate upland disposal site, likely the LRI Landfill in Graham, Washington.

Material suitable for open-water disposal at the Commencement Bay open-water disposal site would be transported via bottom-dump barge and released to fall to the seafloor. The use of the Commencement Bay open-water disposal site has been addressed under NEPA in a Final EIS – Unconfined Open-Water Disposal Sites for Dredged Material, Phase 1 Central Puget Sound, and the accompanying ROD (PSDDA 1988). The program changed its name from PSDDA to DMMP in 1998 when disposal sites outside Puget Sound were included. The Commencement Bay disposal site capacity was expanded to 23,000,000 CY in 2009 and addressed in a supplemental NEPA EIS (DMMP 2009). The original capacity analyzed at the Commencement Bay site was 8,690,000 CY. At the current rate of placement (280,000 CY/year), the site will reach capacity in 51 years.

Dependent on funding and suitability for nearshore aquatic placement, dredged material for this project may be placed at the Saltchuk site. Based on the capacity of Saltchuk, the quantity estimated for nearshore placement is up to 1,850,000 CY from the Blair Waterway that would be transported by barge and placed via bottom-dump barge for the first bench (up to -20 MLLW; Section 3.6.2). For placement of dredged material shallower than -20 MLLW, additional equipment such as flat-deck barges and a barge-mounted excavator would be required to place and shape the material.

The remaining quantity of approximately 428,000 CY in the Blair Waterway that does not meet open-water disposal criteria would be transported by barge to a transloading facility to be dewatered and hauled by truck to an appropriate upland disposal site. The study team identified multiple upland disposal sites with the appropriate certification to receive the material that does not meet aquatic disposal criteria. The LRI Landfill in Graham, WA, is assumed to be the upland disposal site for unsuitable material. LRI Landfill meets all state and Federal environmental compliance requirements to receive the type of material that will be dredged in this proposed action.

The estimated time required to dredge the Blair Waterway is up to four years, partly due to limiting the work to the in-water work window. The in-water work window, established by State and Federal agencies, minimizes potential impacts to important fish, wildlife, and habitat resources. The in-water work window for material disposal at the Commencement Bay open-water disposal site is August 16 through February 15 to avoid impacts to vulnerable life stages of sensitive fish species, such as migration, spawning, and rearing. The Washington Administrative Code (WAC) and Corps' Regulatory Program authorize all other in-water work in Commencement Bay, including dredging, to occur July 16 through February 15 (WAC 220-660-330; USACE 2019). However, the Corps will delay the start of the in-water work window to August 16 to reduce potential effects to late-migrating smolts by limiting the number of juvenile Chinook exposed to construction (Section 4.14). All in-water work windows would be coordinated with Federal and State agencies, as well as potentially affected Tribal governments and local agencies.

To execute construction, several pieces of equipment would be operating up to 24 hours per day during the in-water work window (August 16 through Feb 15) for up to four years. Only one dredge maneuvered by a tugboat would operate at a time and would run continuously except for breaks for crew change or machinery maintenance. Vessels associated with transport and disposal activities are primarily tugboats with barges. One tugboat for towing barges is expected to be employed for this project's duration transiting between the waterway and the Commencement Bay open-water disposal site. A survey vessel would slowly transit the area to measure dredging progress. All appropriate best management practices (BMPs; Section 4.6) would be employed to minimize turbidity and risk of pollution, and a water quality monitoring plan would be in effect.

O&M dredging after deepening to -58 MLLW is assumed to be minimal based on historic shoaling information. The Corps estimates there would be one O&M dredge event every 25 years. Dredged material for future O&M dredging would be characterized through the DMMP process and disposed of at an appropriate in-water or upland location based on the results of the characterization. Supplemental NEPA documentation would be prepared to address future O&M dredging events, as needed.

Alternative 2a - Blair Waterway Deepening through Husky Terminal to -58 MLLW. Alternative 2a applies the same depths and widths as Alternative 2 to allow access for larger ships to Husky Terminal (Figure 3-5). The channel from the entrance (STA -5+00.00) to just past Husky Terminal (STA 41+85.18) would be deepened from the authorized depth of -51 MLLW to -58 MLLW with associated channel widening for design vessel navigation, ranging from 520 feet to 864 feet. Side slopes would be at a 2:1 ratio along the proposed channel. No side slope stabilization measures would be necessary under this alternative.

Approximately 780,000 CY would be dredged from the Blair Waterway. These quantities assume the proposed maximum depth of -58 MLLW with up to two feet of overdepth in the Blair Waterway channel to just past Husky Terminal with proposed widths as described above and appear in Figure 3-5. The dredging method is mechanical, with the same usage of a digging bucket and an environmental bucket as described for Alternative 2. To execute the construction for Alternative 2a, the same equipment as described for Alternative 2 would be employed for the work. The only difference would be that construction would only take about one year to remove the sediment due to the smaller footprint, and less dredged material would be available for Saltchuk compared to Alternatives 2 and 2b (about 1,150,000 CY less). Alternative 2a does not provide enough dredged material for a best buy scenario that accomplishes beneficial use (Section 3.5). A smaller beneficial use footprint may be necessary under this alternative; in this event, the Corps would prepare supplemental environmental compliance documentation as needed.

The same disposal sites (open-water, upland, and Saltchuk) and disposal criteria for open-water disposal of dredged material in Alternative 2 would be used for Alternative 2a. The Corps will evaluate these options to identify the base plan, and cost shares will be identified for disposal. The feasibility level sediment sampling indicates that 697,000 CY of material dredged from this area should be suitable for open-water disposal sites, and 83,000 CY would be unsuitable, requiring upland disposal. Costs for upland disposal of contaminated sediments at a permitted waste disposal facility would be a non-federal expense.

The estimated time required to dredge the Blair Waterway through Husky Terminal is one year and would accomplish dredging and disposal within a single in-water work window (August 16 through February 15). The in-water work window established by State and Federal resource agencies minimizes potential impacts to important fish, wildlife, and habitat resources. The in-water work window for material disposal at the Commencement Bay open-water disposal site is from August 16 through February 15, based on avoiding impacts on the vulnerable life stages of sensitive fish species, including migration, spawning, and rearing (WAC 220-660-330; Corps 2017b). O&M dredging after deepening is assumed to be minimal based on historical information. For this project, it is assumed that there would be one O&M dredge event every 25 years or the same as Alternative 2. All dredged material for future O&M dredging events would be characterized through the DMMP process prior to dredging and disposed of at an appropriate in-water or upland location based on the results. Supplemental NEPA documentation would be prepared to address future O&M dredging events.

Alternative 2b - Blair Waterway Deepening to -57 MLLW. After analyzing a range of depths for improving navigation, the study team determined the optimized channel for the greatest economic benefit would be -57 MLLW. Alternative 2b would deepen the channel and turning basin from an authorized depth of -51 MLLW to -57 MLLW with associated channel widening for design vessel navigation. Side slopes would be 2:1 and the potential for stabilization measures remains the same as for the previous cases. Turning basin expansion is necessary for Alternative 2b to allow for the use of WUT and PCT.

The feasibility level sediment sampling indicates that out of the estimated total 2,803,000 CY of dredged material from this area, approximately 2.411 million CY should be suitable for open-water disposal sites, and 392,000 CY would be unsuitable, requiring upland disposal. These quantities assume the proposed depth of -57 MLLW, a quantity representing the average rate of accumulation between the current channel survey and the initiation of construction, and that the contractor removes the 2-foot allowable overdepth. Dredged material volume calculations and assumptions for disposal appear in Section 4.4 and Appendix B. The dredging method is mechanical, with the same usage of a digging bucket and an environmental bucket described for Alternative 2. To execute the NED construction, the same equipment as described for Alternative 2 would be employed for the work. The only difference would be that construction would take slightly less time due to the smaller amount of material needed to dredge to -57 MLLW, but would still take approximately four years to complete. The same disposal sites (open-water, upland, and Saltchuk) and disposal criteria for Alternative 2 would be used for Alternative 2b.

O&M dredging is assumed to be minimal based on historical information, and supplemental NEPA documentation would be prepared to address future O&M dredging events as needed. Alternative 2b includes ongoing evaluation of beneficial use of the suitable dredged material for in-water disposal as a form of ecosystem restoration, based on preliminary analysis that shows further evaluation is warranted. Full placement at Saltchuk (Section 3.6.1.1) would involve the placement of about 1.8 million CY of suitable dredged material, reducing the quantity of material going to the DMMP Commencement Bay open-water disposal site by an equal amount. The estimated time to dredge is approximately 4 years and slightly less time than what is described in Alternative 2. This alternative has been determined to be the NED Plan and is identified as the agency preferred alternative.

Figure 3-5. Alternative 2a- Blair Waterway Deepening through Husky Terminal (STA -5+00.00 to STA 41+85.18).

3.6 Evaluation and Comparison of Final Array of Alternatives*

The alternatives evaluation process for this study comprehensively evaluates potential action on the Blair Waterway. Economic evaluation to identify the national economic development (NED) plan focused on optimizing the alternatives presented in Section 3.6.1. The evaluation and comparison process incorporated four accounts to facilitate the evaluation and display of effects of alternative plans: NED, environmental quality (EQ), regional economic development (RED), and other social effects (OSE). The Federal objective is to determine the project alternative that reasonably maximizes net benefits for NED while protecting or minimizing effects on the environment.

3.6.1 National Economic Development

The NED account displays changes in the economic value of the national output of goods and services. The study team performed a benefit-cost analysis for each incremental foot of deepening from -51 MLLW through -58 MLLW. The economic evaluation of the final array of alternatives focuses on optimizing the alternatives for depth up to -58 MLLW, assuming both open-water disposal at Commencement Bay for suitable material and upland disposal of material determined not to be suitable for open-water disposal at an appropriate upland facility.

The Corps also evaluated LSF requirements (e.g., terminals and transfer facilities, docks, berthing areas) for each alternative. The study assumes LSF improvements will be required for all container berths, including slope strengthening.

Table 3-5 presents cost estimates for each of the alternatives at October 2019 prices and FY20 discount rate (2.75%). Costs include all economic costs: project first costs (construction cost), associated LSF costs, interest during construction (IDC), and operations, maintenance, rehabilitation, repair, and replacement (OMRR&R) dredging expenses. OMRR&R costs are constant across depths based on analysis summarized in Section 3.11 of Appendix B, which considers specific shoaling rates independent of channel depth and includes consideration of sea level change (Section 4.9). No specific aids to navigation (ATONs) have been identified to date and, therefore, are not included in project first cost or other associated economic costs. The benefit cost analysis presented in Table 3-5 and Table 3-6 reflect initial cost estimates completed for alternatives selection. The study developed subsequent cost estimates for the NED Plan, as presented in Section 5 and the Executive Summary. Additional cost estimate information appears in Appendix F.

Table 3-5 Cost Estimate ($1,000s, October 2019 Price Level, 2.75% Discount Rate).

Alternative	Depth	Project First Costs	IDC	LSF	Total Economic Cost	Total OMRR&R	AAEQ Cost
Alternative 2 (Blair Waterway Deepening)	-52 MLLW	$135,496	$1,863	$4,148	$141,507	$9,265	$5,373
	-53 MLLW	$163,360	$4,523	$4,740	$172,623	$9,265	$6,525
	-54 MLLW	$180,886	$5,009	$5,362	$191,256	$9,265	$7,216
	-55 MLLW	$202,967	$8,501	$110,805	$322,273	$9,265	$12,069
	-56 MLLW	$222,254	$9,309	$111,450	$343,013	$9,265	$12,837
	-57 MLLW	$242,274	$10,147	$112,101	$364,523	$9,265	$13,634
	-58 MLLW	$264,690	$14,913	$112,753	$392,356	$9,265	$14,665
Alternative 2a (Blair Waterway Deepening to Husky)	-52 MLLW	$27,195	$30	$2,244	$29,469	$129	$1,162
	-53 MLLW	$31,488	$34	$2,312	$33,835	$129	$1,325
	-54 MLLW	$35,742	$39	$2,384	$38,165	$129	$1,487
	-55 MLLW	$63,468	$45	$25,259	$88,772	$129	$2,539
	-56 MLLW	$68,461	$51	$25,338	$93,851	$129	$2,729
	-57 MLLW	$73,489	$57	$25,421	$98,966	$129	$2,920
	-58 MLLW	$78,530	$63	$24,135	$102,728	$129	$3,112
Alternative 2b (Blair Waterway Deepening NED Depth)	-57 MLLW	$242,274	$10,147	$112,101	$364,523	$9,265	$13,634

Table 3-6 displays the origin-destination transportation cost savings analysis results, where the bold lines identify the depths that maximize net benefits. Section 4.3 and the Economics Appendix (A) detail the transportation cost savings analysis. Alternative 2b (-57 MLLW) reasonably maximizes total net benefits and is, therefore, the NED Plan. Although Alternative 2a at -54 MLLW has the greatest benefit-cost ratio of 17.6, Alternative 2b (-57 MLLW) maximizes net benefits and has the greatest return on investment for NED.

Table 3-6 Benefit Cost Analysis (October 2019 Price Level, 2.75% Discount Rate).

Alternative	Depth	Total AAEQ Costs	Total AAEQ Benefits[1]	Net Benefits	BCR
Alternative 2 (Blair Waterway Deepening)	-52 MLLW	$5,373,000	$25,158,000	$19,785,000	4.7
	-53 MLLW	$6,525,000	$48,687,000	$42,161,000	7.5
	-54 MLLW	$7,216,000	$70,573,000	$63,357,000	9.8
	-55 MLLW	$12,069,000	$93,227,000	$81,159,000	7.7
	-56 MLLW	$12,837,000	$114,762,000	$101,926,000	8.9
	-57 MLLW	***$13,634,000***	***$136,195,000***	***$122,561,000***	***10.0***
	-58 MLLW	$14,665,000	$136,195,000	$121,530,000	9.3
Alternative 2a (Blair Waterway Deepening to Husky)	-52 MLLW	$1,162,000	$9,308,000	$8,146,000	8.0
	-53 MLLW	$1,325,000	$18,014,000	$16,689,000	13.6
	-54 MLLW	$1,487,000	$26,112,000	$24,625,000	17.6
	-55 MLLW	$2,539,000	$34,494,000	$31,955,000	13.6
	-56 MLLW	$2,729,000	$42,462,000	$39,733,000	15.6
	-57 MLLW	**$2,920,000**	**$50,392,000**	**$47,472,000**	**17.3**
	-58 MLLW	$3,112,000	$50,392,000	$47,280,000	16.2
Alternative 2b (Blair Waterway Deepening NED Depth)	***-57 MLLW***	***$13,634,000***	***$136,195,000***	***$122,561,000***	***10.0***

[1]Transportation costs computed using FY16 VOCs from EGM 17-04 in coordination with DDN-PCX

3.6.1.1 Summary of the National Economic Development (NED) Plan

The primary decision criteria for identifying the NED Plan includes reasonably maximizing net benefits while remaining consistent with the Federal objective of protecting the nation's environment. Contributions to NED are increases in the net value of the national output of goods and services, expressed in monetary units. For this study, the contributions to NED are the direct net benefits that accrue in the planning area and the rest of the nation. The NED Plan consists of deepening the entire Blair Waterway from -51 MLLW to -57 MLLW with associated channel widening for design vessel navigation. Costs of the NED Plan assume the least cost, open-water dredged material disposal at Commencement Bay for suitable material (the Base Plan), and unsuitable material disposal at an appropriate upland facility.

3.6.2 Dredged Material Disposal Plan Evaluation

Per ER 1105-2-100, this study establishes the Base Plan for the project (Section 3.6.2.1) and assesses the potential for beneficial uses of dredged material (Section 3.6.2.2). The selection of the NED Plan was completed using the costs of the Base Plan for disposal. This section evaluates whether the beneficial use of dredged material should be included in the Recommended Plan.

3.6.2.1 Base Plan Least Cost Disposal Alternative

The study evaluated three sites for disposal. Two open-water disposal sites, Commencement Bay DMMP open-water disposal site and Saltchuk beneficial use site, and a suitable upland disposal site for material unsuitable for in-water disposal. Corps policy recommends dredged material disposal in the least costly manner consistent with sound engineering practice and pursuant to all Federal environmental standards, including the environmental standards established by Section 404 of the Clean Water Act of 1972 or Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972, as amended. These criteria determine the "base plan" for dredged material disposal.

Per ER 1105-2-100, the Corps encourages consideration of in-water disposal that provides opportunities for aquatic ecosystem restoration. Where environmentally beneficial use of dredged material is the least cost, environmentally acceptable disposal method, it is cost shared as a navigation cost. Where a beneficial use option is not part of the base plan, the base plan shall serve as a reference point for determining the incremental costs of the ecosystem restoration features that are attributable to beneficial use. Based on costs developed for each of the two in-water disposal sites, Commencement Bay is the least cost and, therefore, the base plan and reference point for determining incremental costs for beneficial use at Saltchuk.

3.6.2.2 Beneficial Use

The Corps is evaluating environmentally beneficial use of dredged material at the Saltchuk site under a range of five scenarios. No scenario is the least cost disposal option and, therefore, is not the Base Plan. For environmentally beneficial disposal methods with incremental Federal costs that exceed 25% of total base plan disposal costs or $300,000, Corps guidance requires the incremental costs be justified by demonstrating that the monetary and non-monetary benefits (outputs) of the ecosystem restoration project justify its incremental costs above the base plan. The analysis must demonstrate the value of the environmental resources restored by the placement method, describe and quantify the environmental outputs, and show Federal and State resource agencies support for the environmentally beneficial disposal method.

The objective of beneficial use of dredged material at Saltchuk is to restore nearshore intertidal and subtidal habitat substrate conditions for several fish and wildlife species, including ESA-listed species. The target ESA-listed species to benefit from the proposed project include juvenile and adult Chinook salmon, steelhead, and bull trout. Restoration actions aim to improve habitat conditions for these species and their prey species, such as forage fish and epibenthic and benthic invertebrates. Appendix C describes the resource significance and quantifies the environmental benefits to demonstrate that the incremental cost of the beneficial use placement measure to create a nearshore habitat at the Saltchuk site is reasonable in relation to the environmental benefits it achieves.

The NMFS developed the Nearshore Habitat Valuation (NHV) Model in 2015. The purpose of the NHV model is to quantify habitat services for threatened juvenile Puget Sound Chinook and Hood Canal summer-run chum salmon in the Puget Sound nearshore zone during ESA consultations (Ehinger et al. 2015). The model only evaluates benefits to juvenile Chinook salmon due to the project location in Commencement Bay. The Corps received approval from the Corps' Eco-PCX for the one-time use of this existing model to evaluate beneficial use scenarios on January 28, 2020. This model is not intended for programmatic use or use with other Corps projects unless approved by the Corps' Eco-PCX.

The NHV model uses a checklist scoring system to define habitat value, based primarily on elevation, vegetation, substrate conditions, anthropogenic impacts, and landscape context to provide a criteria-based, replicable method for establishing habitat value. NMFS provided guidance to use the NHV model with Habitat Equivalency Analysis, but the Seattle District evaluated beneficial use of dredged material using the IWR Planning Suite, the Corps-certified planning model built for the formulation and evaluation of ecosystem restoration scenarios. Appendix C contains the model justification documentation and complete cost effectiveness/incremental cost analysis.

The Corps used the NHV model to calculate preliminary Nearshore Habitat Values (NHV) of the deep zone (DZ; below -10 MLLW) and LSZ (+5 to -10 MLLW) nearshore habitats in Puget Sound for ESA-listed juvenile and adult Puget Sound Chinook salmon. The NHV model scores habitat related to physical and biological features of Chinook salmon critical habitat. The DZ provides migratory and rearing habitat, but the depth and lack of submerged aquatic vegetation (SAV) mean the DZ does not provide as much cover or food as the LSZ. The LSZ ends at the lower limit of forage fish spawning and encompasses the approximate upper and lower extents of eelgrass growth (+5 to -10 MLLW; Ehinger et al. 2015). The LSZ is within prime critical habitat for juvenile Chinook because it can contain SAV for food production and cover and shallow water refuge for smaller juveniles from predators (Ehinger et al. 2015). The Saltchuk site is 64 acres, of which 60.7 acres is DZ, and 3.3 acres is LSZ in the existing and future without-project condition. The Corps analyzed five beneficial use scenarios. Scenarios are additive and focus on raising the elevation of three benches (Figure 3-7). The design uses benches to sequentially achieve habitat elevations associated with juvenile Chinook salmon critical habitat needs within the available space. Using benches allows sequential evaluation of habitat classes (DZ and LSZ), different construction techniques, and associated costs for placing material in deep water (via bottom-dump barge for the first and second benches) and shallow water (via excavator for the third bench and islands). The Corps analyzed five scenarios for beneficial use:

- **Scenario A** (No-Action; Figure 3-6): no beneficial use of dredged material;
- **Scenario B**: Build the First Bench to -20 MLLW;
- **Scenario C**: Build the First Bench to -20 MLLW and the Second Bench to -10 MLLW;
- **Scenario D** (Figure 3-7): Build the First Bench to -20 MLLW, the Second Bench to -10 MLLW, and the Third Bench to -5 MLLW;
- **Scenario E** (Figure 3-8): Build the First Bench to -20 MLLW, the Second Bench to -10 MLLW, and the Third Bench to -5 MLLW, and create intertidal islands on top of the three benches.

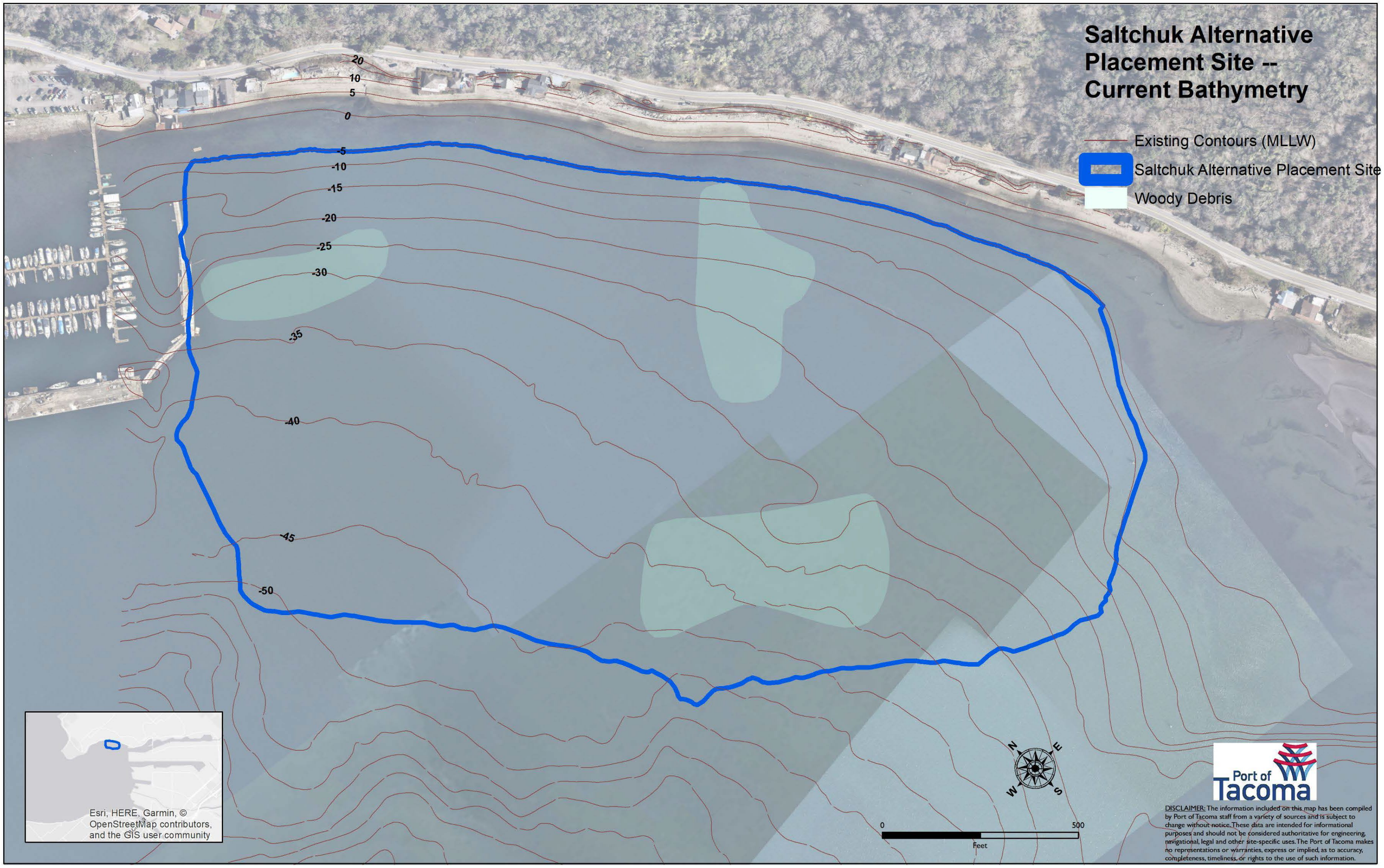


Figure 3-6. Current bathymetry at Saltchuk representing the No-Action Alternative.

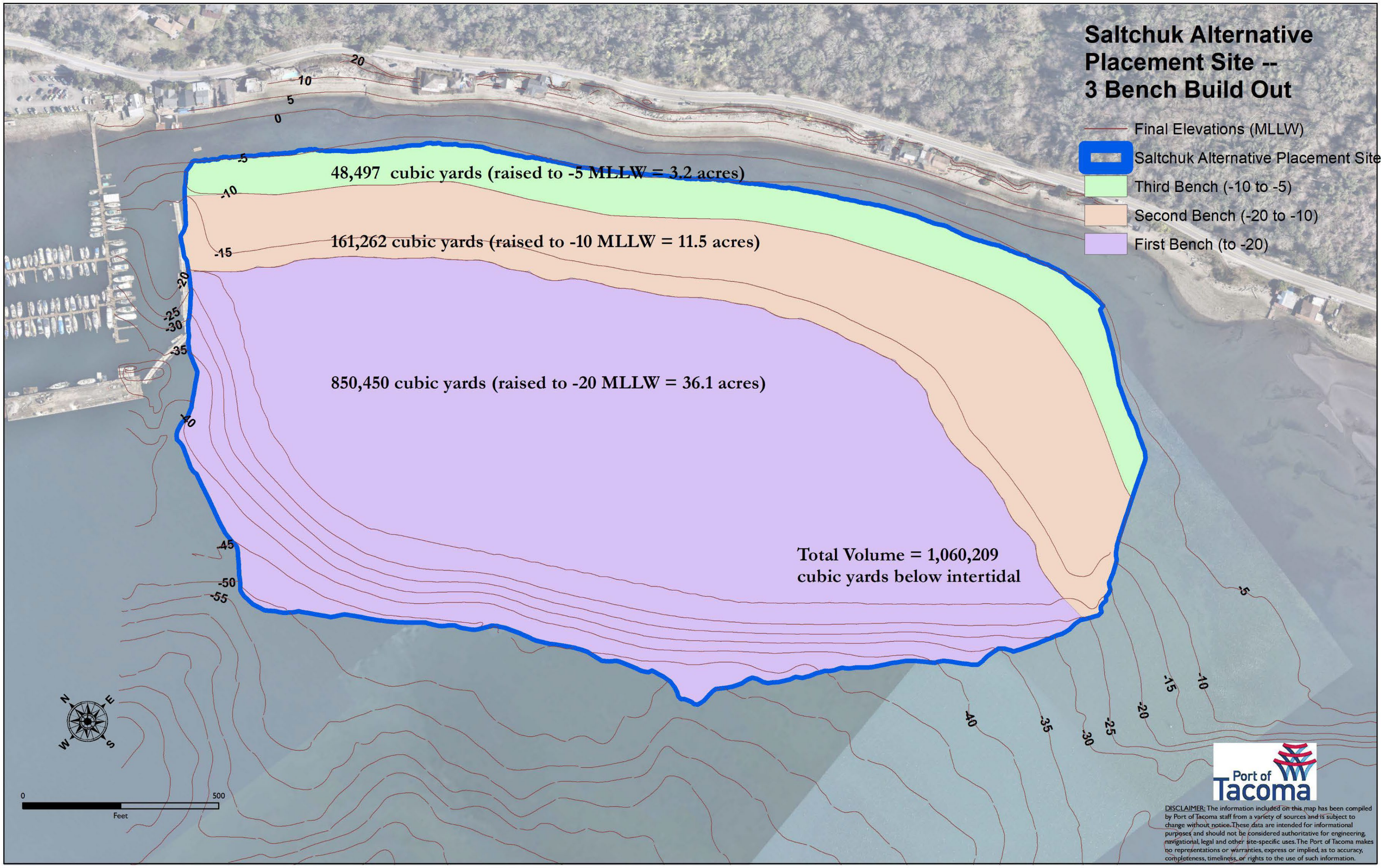


Figure 3-7. Proposed beneficial use of dredged material at Saltchuk. The first bench (to -20 MLLW) is Scenario B, the second bench (to -10 MLLW) is Scenario C, and the third bench (to -5 MLLW) is Scenario D.

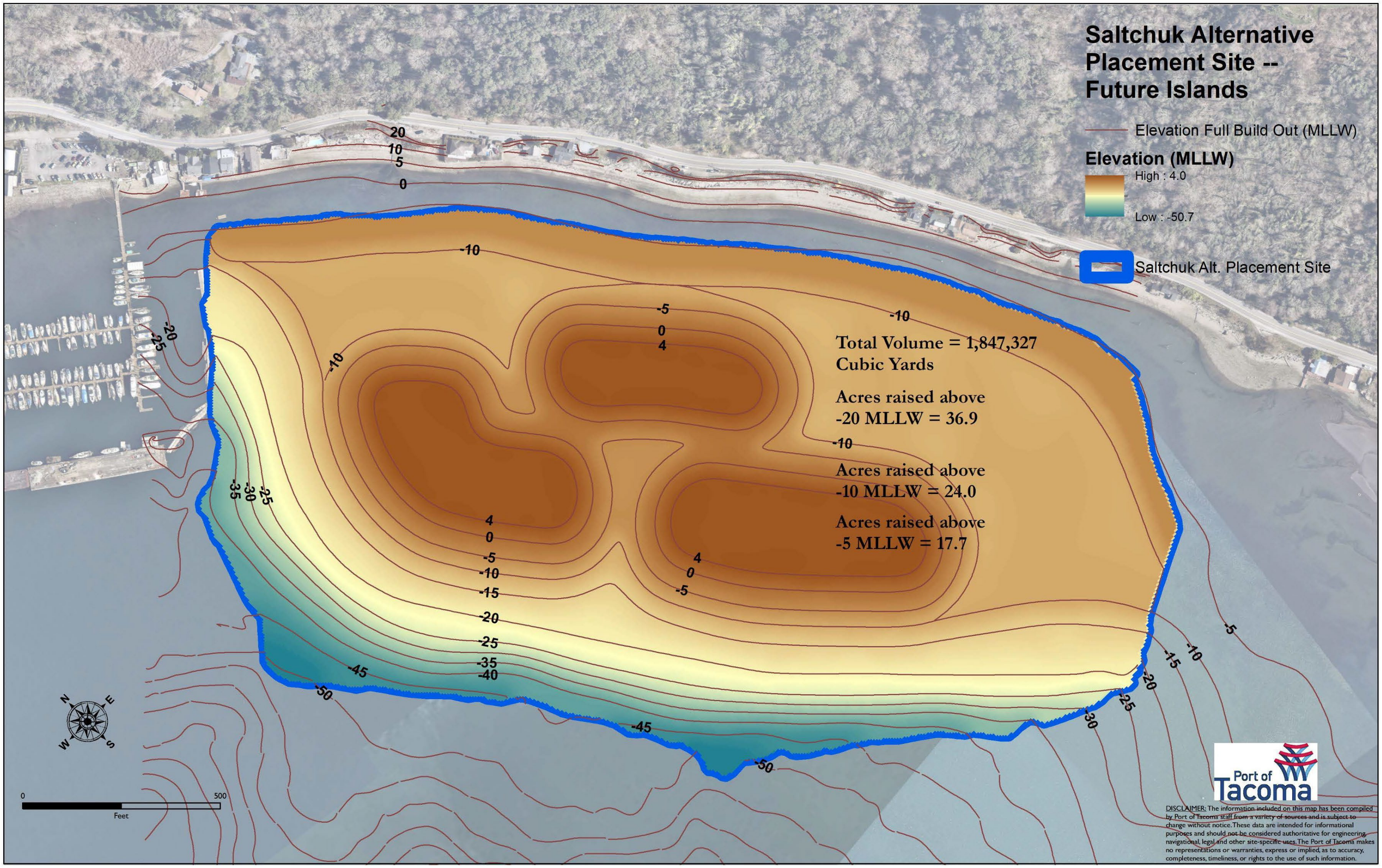


Figure 3-8. The full build-out of Saltchuk (Scenario E) has intertidal islands placed after the three benches (Scenarios B, C, and D) are constructed.

The NHV model provides normalized scores, where the maximum score for DZ habitat is 0.3, and the LSZ habitat is 1.0. The majority of the DZ habitat within the study area will be converted to LSZ as the material is added from Scenarios B to E. LSZ habitat will be extended waterward to replace up to approximately 40.9 acres of DZ habitat under the full build-out Scenario E (Table 3-7). LSZ habitat type provides the highest functional values in the NHV model. Table 3-7 summarizes the NHV scoring of each scenario in years 0, 3, and 50, where year 3 represents the year to fully functioning ecosystem restoration benefits.

Table 3-7. Saltchuk Scenario Acreages, NHVs, and AAHUs. The net AAHU gain is the scenario benefit compared to taking no action.

	Scenario A (No-Action)		Scenario B		Scenario C		Scenario D		Scenario E	
Metric	DZ	LSZ	DZ	LSZ	DZ	LSZ	DZ	LSZ	DZ	LSZ
Acreage	60.7	3.3	60.7	3.3	49.8	14.2	49.3	14.7	23.1	40.9
Year 0 NHV	0.20	0.34	0.20	0.34	0.20	0.35	0.20	0.43	0.20	0.43
Year 3 NHV	0.20	0.34	0.20	0.48	0.20	0.50	0.20	0.57	0.20	0.57
Year 50 NHV	0.20	0.34	0.20	0.48	0.20	0.50	0.20	0.57	0.20	0.57
AAHUs	13.3		13.7		16.9		18.2		27.8	
Net AAHU Gain (Benefit)	0.0		0.4		3.6		4.9		14.5	

The Corps conducted a cost effectiveness and incremental cost analysis on the environmental outputs and incremental disposal costs for a range of Saltchuk scenarios using IWR Planning Suite. This is an alternative to the benefit-cost analysis used when the primary outputs or benefits of a plan are not measured in dollars (i.e., non-monetary). Environmental outputs or benefits are average annual habitat units (AAHUs) computed over the 50-year period of analysis; the AAHUs incorporate changes in habitat quality and quantity over time. The costs are those incremental costs above the base NED Plan in Section 3.6.1. Cost effectiveness ensures that the least cost alternative is identified for a given level of environmental output or AAHU in this case. Table 3-8 displays the preliminary costs, environmental benefits, and outcomes of the cost effectiveness analysis. All five scenarios are cost effective. Incremental costs for placement scenarios at Saltchuk range from $2,616,000 to $10,205,000 above the base plan for in-water disposal at Commencement Bay and upland disposal of unsuitable material for Blair Waterway deepening to -57 MLLW. The most expensive beneficial use scenario adds less than 5% to project construction costs while adding 37.6 acres of LSZ to the study area.

Table 3-8. Cost Effective Plans (Oct 2019 price level, 2.75% discount rate).

Scenario	Description	Incremental Project First Cost over Base Plan ($1000)	Cost (AAEQ Cost in $1000)	Benefit (Net AAHU Gain)	Average Cost ($1000/AAHUs)	Cost Effective?/ Best Buy?
A	No-Action	$0	$0	0	$0	Yes / Yes
B	Bench 1	$2,616	$101	0.4	$253	Yes / No
C	Benches 1 and 2	$3,520	$136	3.6	$38	Yes / No
D	Benches 1, 2 and 3	$3,915	$151	4.9	$31	Yes / No
E	All benches and islands	$10,205	$394	14.5	$27	Yes / Yes

The preliminary incremental cost analysis identified two of the five scenarios at Saltchuk as "Best Buy" plans, defined as those cost-effective plans that provide the greatest incremental increase in output for the lowest incremental increase in cost. The two best buy scenarios include Scenario A (No-Action) and placement Scenario E (all benches and islands). Figure 3-9 displays a bar graph of the incremental costs of the Best Buy scenarios. Scenario A (No-Action) is equivalent to the base plan and carries no incremental cost or AAHU output. Scenario E provides 14.5 AAHUs over Scenario A (No-Action) at an average annual cost of $27,000 per AAHU (shown as the green bar in Figure 3-9)[3]. Scenario E includes intertidal island creation that would restore scarce habitat for juvenile Puget Sound Chinook salmon in Puget Sound.

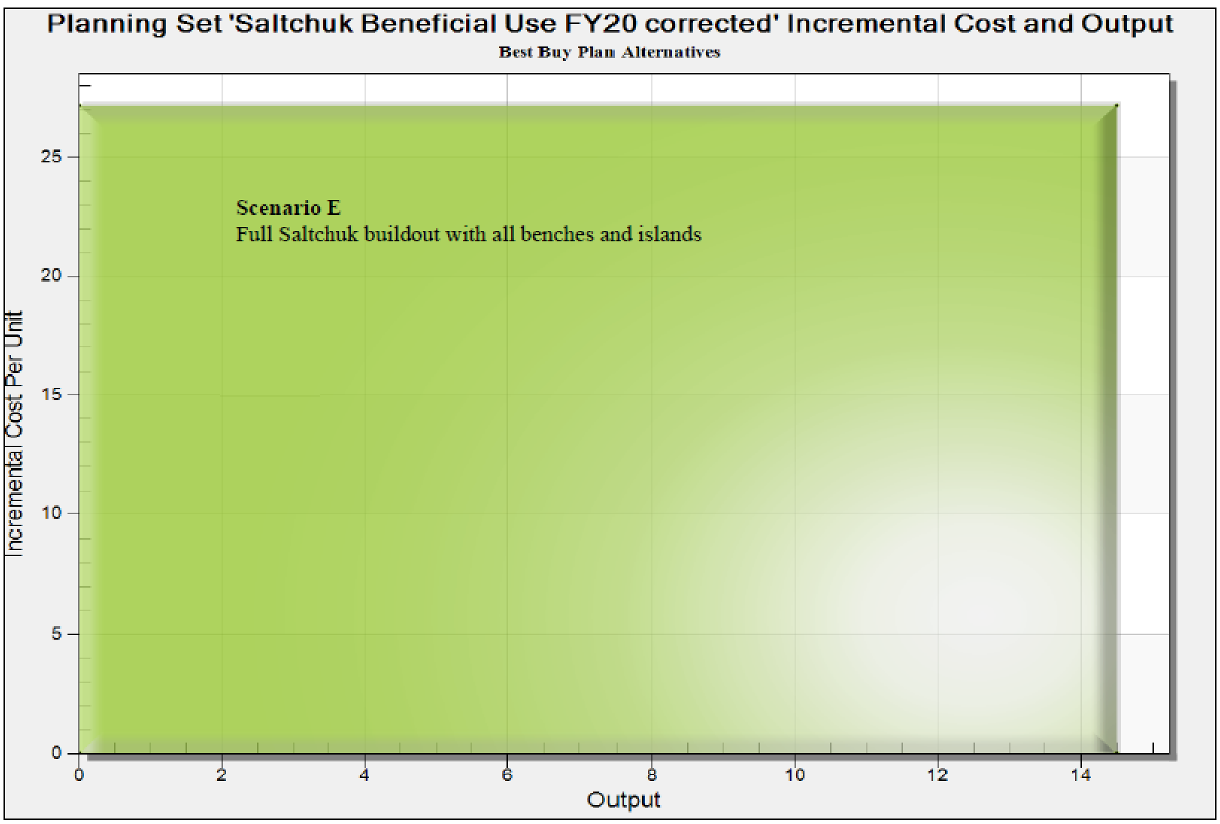


Figure 3-9. Best Buy Plan Incremental Costs.

[3] Costs updated in Section 5

Scenario E provides restoration of 64 acres of nearshore intertidal and subtidal substrate conditions for fish and wildlife species, including ESA-listed species, with the creation of nearly 38 LSZ acres at an average annual cost of $27,000 per AAHU. Full placement at Saltchuk under Scenario E would reduce the quantity of material going to the Commencement Bay open-water disposal site by approximately 1,850,000 CY of dredged material. Based on preliminary sediment characterization and the amount of native material that would be dredged from the Blair Waterway, it is likely there would be sufficient material for beneficial use at Saltchuk as described for Scenario E. Further information is in Appendix B (Engineering). The incremental cost is reasonable in relation to the environmental benefits achieved. Sufficient dredged material for Scenario E is dependent on the dredging recommendation of the Recommended Plan, Alternative 2b.

At this stage of design proposals and scenario analysis, the Corps and non-Federal sponsor evaluate only a conceptual-level design to determine whether any proposal for beneficial use would have environmental benefits and be a cost-effective scenario for one-time placement of dredged material. One aspect of dredged material placement at Saltchuk is that the action would bury wood waste deposits within the restoration area. Each scenario covers progressively more wood waste, with Scenario E covering all wood waste with the most material. Three primary areas of wood waste deposits cover approximately 13% (8 acres) of the 64-acre site. This aspect of the proposed action would require additional investigation for how to meet the Sediment Management Standards as set forth by Ecology and how best to achieve environmental benefits while avoiding additional impacts that can sometimes occur from burying wood waste, such as if pore water is forced upward from wood waste below (Ecology 2013).

Negative effects are not expected based on guidance for covering wood waste and the results of similar projects. In Puget Sound, three feet of material is often used for “capping” wood waste, although it is not the preferred method for thick deposits of wood (a thickness threshold as determined by the designer judgment; Breems and Goodman 2009). Saltchuk sediment grab samples of 30-centimeter depths identified wood waste throughout most samples, indicating at least a 30-centimeter-thick layer of wood in the deposits. A similar project as part of the Commencement Bay NRDA program covered wood waste in the Hylebos Waterway in 2012 with a 6- to 14-inch layer of sand on an intertidal mudflat between 0 and +12 MLLW. The purpose was a remedial restoration of benthic invertebrate prey resources that had been affected by wood debris and chemicals of concern (CoCs). The Hylebos Waterway project removed wood waste unless it was less than 50% surficial wood waste coverage and Total Volatile Solids (TVS) were less than 15% (Ecology 2013). These site-specific standards were established based on the increasing presence of toxicity observed where conditions exceeded these standards (Ecology 2013). Saltchuk is within those limits with about 13% surficial wood waste coverage and 9.8% or lower TVS (Gravity Consulting 2017). Post-construction monitoring was performed at the Hylebos Waterway site in 2013 and 2016 to verify the stability of the sand layer and confirm that surface sediment wood debris and CoC concentrations were reduced to local background levels (Anchor QEA 2016). In 2013, sediment sampling showed CoCs below EPA sediment quality objectives, and by 2016 the abundance of benthic prey resources (crustaceans, mollusks, and polychaetes) was not statistically different from the local background.

O&M needs of the Saltchuk site are assumed to be minimal based on preliminary information about the drift of material from the site but will be fully evaluated in PED and would be the responsibility of the non-Federal sponsor. Monitoring as part of a monitoring and adaptive management plan (Appendix C) would be cost-shared with the Port.

3.6.3 Multiport Considerations

The study assessed multiport competition qualitatively as it relates to shifting cargo from one port to another based on factors such as deepening of a harbor. The Recommended Plan includes a deeper channel to operate larger containerships more efficiently. Larger containerships alone do not drive growth for the harbor. Many factors may influence the growth of a particular harbor: landside development and infrastructure, location of distribution centers for imports, source locations for exports, population and income growth and location, port logistics and fees, business climate and taxes, carrier preferences, labor stability and volatility, and business relationships. Harbor depth is just one of many factors involved in determining growth and market share for a particular port. Additionally, justification of the Recommended Plan is not based on the assumption that cargo will shift to Tacoma Harbor with deepening alone. The analysis assumes Tacoma receives the same share of regional cargo volumes with or without deepening.

3.6.4 Regional Economic Development

The RED account measures changes in the distribution of regional economic activity that would result from each alternative plan. Evaluations of regional effects are measured using nationally consistent projections of income, employment, output, and population. The Regional Economic System (RECONS) is a tool designed to provide estimates of regional, state, and national contributions of Federal spending associated with Civil Works and American Recovery and Reinvestment Act projects. The model implements regional economic development multipliers to estimate the additional economic output, jobs, earnings, and value added to the region from alternative plans based on project implementation costs. As a result, larger, more expensive plans result in higher regional economic benefits. The study uses the RECONS model to evaluate the regional impact of the NED Plan and present the findings.

3.6.5 Environmental Quality

The EQ account considers non-monetary effects on ecological, cultural, and aesthetic resources. Under this account, the preferred plan should avoid or minimize environmental impacts in the study area to the extent practicable considering other criteria and planning objectives. Detailed descriptions of the analysis and impacts appear in Chapter 4. Table 4-1 provides the list of resources considered in the study and the rationale for inclusion or exclusion from detailed analysis. Section 5.8 summarizes the environmental consequences of the Recommended Plan.

3.6.6 Other Social Effects

Based on the absence of adverse impacts on human health and safety risk, this project would not have disproportionately high adverse impact(s) on human health and safety in any community, including environmental justice communities or children. See Appendix C and Section 6.14 for more detail.

3.6.7 Completeness, Effectiveness, Efficiency, and Acceptability

As explained in Section 3.3.1, *completeness, effectiveness, efficiency, and acceptabilit*y are the four evaluation criteria specified in the Council for Environmental Quality Principles and Guidelines (Paragraph 5.(d)) in evaluating and screening alternative plans. Alternatives considered in any planning study should meet minimum subjective standards of these criteria to qualify for further consideration and comparison with other plans.

Table 3-9 compares the final array of alternatives as well as optimized scales of the final array against these criteria.

Table 3-9. Principles and Guidelines Criteria Evaluation.

Alternative	Completeness	Effectiveness	Efficiency	Acceptability
Alternative 1: No-Action Alternative	Yes	No	No	Yes
Alternative 2: Blair Waterway Deepening				
Deepening to -52 MLLW	Yes	Yes	Yes	Yes
Deepening to -53 MLLW	Yes	Yes	Yes	Yes
Deepening to -54 MLLW	Yes	Yes	Yes	Yes
Deepening to -55 MLLW	Yes	Yes	Yes	Yes
Deepening to -56 MLLW	Yes	Yes	Yes	Yes
Deepening to -57 MLLW	Yes	Yes	Yes	Yes
Deepening to -58 MLLW	Yes	Yes	No	Yes
Alternative 2a: Blair Waterway Deepening through Husky Terminal				
Deepening to -52 MLLW	Yes	No	Yes	Yes
Deepening to -53 MLLW	Yes	No	Yes	Yes
Deepening to -54 MLLW	Yes	No	Yes	Yes
Deepening to -55 MLLW	Yes	No	Yes	Yes
Deepening to -56 MLLW	Yes	No	Yes	Yes
Deepening to -57 MLLW	Yes	No	Yes	Yes
Deepening to -58 MLLW	Yes	No	No	Yes
Alternative 2b: Blair Waterway Deepening to -57				
Deepening to -57 MLLW	Yes	Yes	Yes	Yes

Alternative 1 (No-Action Alternative) is complete (i.e., there are no changes in implementing the No-Action Alternative; therefore, there are no additional necessary investments). However, Alternative 1 is not an effective or efficient plan in that it does not meet any of the planning objectives. Given that the

plan maintains current and planned operations at Tacoma Harbor, the plan is acceptable in terms of existing regulations and public policies.

Alternative 2 meets all planning criteria. Alternative 2 is a complete plan in that it takes all necessary investment required to realize transportation cost savings at Blair Waterway into account. It effectively alleviates constrained vessel loading caused by inadequate channel depth, and it is efficient in that no other plan provides the same level of benefit for a lower cost. Alternative 2 is also acceptable in terms of existing laws, regulations, and public policies.

Like Alternative 2, Alternative 2a is a complete, efficient, and acceptable alternative. Given its limited scale, however, Alternative 2a is not completely effective. Deepening to Husky Terminal only does not alleviate WUT and PCT's constraints, as identified in the project objectives. Under Alternative 2a, the Blair Waterway does not address the navigation system as a whole; consequently, the alternative cannot realize the potential transportation cost savings expected under Alternative 2.

Alternative 2b takes the NED depth from Alternative 2 to become a wholly complete, effective, efficient, and acceptable alternative. Alternative 2b is complete and effective in that it includes all investments necessary to realize transportation cost savings across the entire Blair Waterway. The alternative is efficient by providing the same level of benefit as Alternative 2 at -58 MLLW at a lower cost. The alternative is also acceptable in terms of meeting all regulations and public policies.

3.7 Recommended Plan Selection (Agency Preferred Alternative)

Based on the evaluation of the Final Array of Alternatives summarized above, and following Corps and public reviews of the draft IFR/EA in December 2019, the Recommended Plan is the NED Plan as described in Section 3.6.1. The Recommended Plan includes the Beneficial Use Plan for dredged material disposal, which consists of Commencement Bay open-water disposal, upland disposal of unsuitable material, and beneficial use of dredged material at the Saltchuk site. Placement at the Saltchuk site will be based on dredged material suitability determination before construction. The effects of the Recommended Plan are described in Chapter 4, and the details of the Recommended Plan are described in Chapter 5. The Recommended Plan is considered the agency preferred alternative, which means it is the alternative the Corps has concluded would fulfill its statutory mission and responsibilities, giving consideration to economic, environmental, technical, and other factors.

4 Affected Environment and Environmental Consequences of the Alternatives*

This chapter provides the existing conditions and regulatory setting for each of the resources that could be affected by implementing any of the alternatives identified in Section 3.5. Existing conditions are the physical, chemical, biological, and sociological characteristics of the study area. The assessment of environmental effects is based on a comparison of conditions with and without the implementation of the proposed plan and a reasonable range of alternatives. In this case, various scales of one action alternative were formulated through the screening process and are compared to the No-Action Alternative. The spatial scale of analysis focuses on the Blair Waterway and surrounding environment. The time scale for analysis is a 50-year period from 2030 through 2079.

4.1 Alternatives Analyzed for Environmental Effects

Chapter 3 outlines the formulation, evaluation, and screening of alternatives for determining the action that maximizes net benefits (the difference between AAEQ benefits and AAEQ costs over the period of analysis) for NED. As described in Chapter 3, the plan formulation process for this project is intended to evaluate potential actions on the Blair Waterway comprehensively. This chapter compares the potential environmental effects of the No-Action Alternative to:

- Alternative 2 Blair Waterway Deepening to -58 MLLW
- Alternative 2a Blair Waterway Deepening through Husky Terminal to -58 MLLW (STA -5+00.00 to 41+85.18), and
- Alternative 2b Blair Waterway Deepening to -57 MLLW (the NED Plan; STA -5+00.00 to STA 137+24.11).

Alternative 2 represents the widest range of effects to consider (i.e., deepest and greatest spatial extent) compared to the No-Action Alternative. Alternative 2a provides for deepening and widening of the Blair Waterway, but only through Husky Terminal (STA -5+00.00 to 41+85.18), which allows for some economic benefits to be realized without pursuing slope stabilization. Alternative 2b (the NED Plan) is the economic optimization of a single alternative (Alternative 2 Blair Waterway Deepening) for depth, with continuing consideration of beneficial reuse of dredged material.

The Corps analyzed costs and impacts of alternatives ranging in depth from -51 MLLW to -58 MLLW. Alternatives shallower than existing depths did not meet study objectives. Alternatives deeper than -58 MLLW would require extensive slope stabilization measures in the channel and were not recommended for detailed evaluation for economic reasons. Quantities analyzed for the environmental analysis represent the high end of the range of possible dredging quantities to analyze the greatest possible environmental effects.

Three disposal sites (open-water, upland, and beneficial use) are carried forward for this analysis. Each alternative includes more than one site for disposal (e.g., each alternative includes both open-water and upland disposal; with further consideration of open-water disposal occurring at the DMMP Commencement Bay site and beneficial reuse at Saltchuk under five scenarios). The Commencement Bay open-water disposal site is located within the immediate vicinity of Tacoma Harbor (approximately 3 miles away; Figure 4-8). The upland site would likely be the LRI Landfill in Graham, Washington, approximately

30 miles south. Saltchuk is a beneficial use site located approximately one-mile northeast of Blair Waterway. Section 3.5 contains additional information on volumes and disposal options.

4.2 Resources Analyzed and Resources Screened from Detailed Analysis

The environmental analysis conducted in the NEPA process should provide the decision-maker with relevant and timely information about the action's environmental effects and reasonable alternatives to mitigate those impacts. Table 4-1 identifies resources the Corps evaluated for detailed analysis with a rationale for inclusion or exclusion. The Corps excluded resources from detailed analysis if they are not potentially affected by the alternatives or have no material bearing on the decision-making process. Each resource in Sections 4.3 through 4.17 is analyzed for direct and indirect effects and whether these would accrue a significant cumulative effect.

Table 4-1. Resources Considered for Detailed Effects Analysis and Rationale For inclusion or Exclusion.

Resource	Included in Detailed Analysis (Y/N)	Rationale for inclusion or exclusion
Navigation and Economic Conditions	Y	The purpose of the project is to contribute to national economic development. The analysis is required to determine whether there are sufficient economic benefits to support the project's justification.
Hydraulics and Geomorphology	Y	Problems identified are centered on relationships of geomorphology and hydraulics. The proposed action requires the study of these characteristics.
Geotechnology	Y	The proposed action requires a geotechnical analysis of the channel to evaluate side slope channel stability.
Groundwater	Y	The proposed action is limited to the sub-tidal environment. However, groundwater contamination cleanup and monitoring sites that are within the study area require analysis to determine if the proposed project will impact cleanup or monitoring activities.
Water Quality	Y	The analysis is required to determine the intensity of potential changes to turbidity or dissolved oxygen caused by the proposed action.
Air Quality	Y	Tacoma is a maintenance area for particulate matter (PM10 and PM2.5) and is no longer a maintenance area for carbon monoxide or ozone as of 2016. Analysis of diesel particulate matter emitted during construction is important, as it is the most harmful emission for human health.
Greenhouse Gas Emissions	Y	Emissions that would occur during construction and the potential changes to long-term vessel emissions are analyzed for impacts.
Sea Level Change	Y	Sea Level is Required to be analyzed by Corps policy in ER 1100-2-8162 (USACE 2013).
Underwater Noise	Y	Underwater noise from construction would occur during periods when sensitive receptors may be present in Commencement Bay. These include marine mammals, fish, and diving birds. The analysis is required to determine the intensity of effects and how to avoid or minimize impacts.

Resource	Included in Detailed Analysis (Y/N)	Rationale for inclusion or exclusion
Airborne Noise	N	Airborne noise from the action would be attenuated by distance from the source to any sensitive receptors and would not be audible above Port activities' ambient noise. Birds and other wildlife in the study area are assumed to be habituated to the noise of Tacoma Harbor.
Hazardous, Toxic, and Radioactive Waste	Y	The study area is known to have contaminants. The analysis is required to determine the level of effect due to construction activities for the proposed action.
Benthic Organisms	Y	Benthic macroinvertebrate populations recover quickly from the type of action proposed. Significant effects are not anticipated, but the analysis is required to determine the intensity of effects.
Fish	Y	The analysis is required to determine which species would be present, the intensity of effects, and how to avoid or minimize effects. Forage fish spawning takes place near the mouth of the Puyallup River.
Wildlife	Y	Marine mammals that may occur in Commencement Bay include harbor seals, harbor porpoises, river otters, killer whales, gray whales, sea lions, and their prey species. Terrestrial and marine birds may be present around the industrial port facilities.
Vegetation	N	Limited aquatic vegetation is in the study area, a small amount of patchy eelgrass south of the Puyallup River and Commencement Bay shorelines. Effects from turbidity to aquatic vegetation would be avoided and minimized by maintaining water quality standards.
Threatened and Endangered Species	Y	The proposed action may affect protected species in the study area. The analysis is required to determine the intensity of the effects.
Invasive Species	N	Trade routes, container ship sizes, and the number of containers will not change, so the risk of introducing species via hull or ballast water biofouling or in containers, such as Asian gypsy moth, would not change. New Zealand mudsnail has not been documented in the study area.
Cultural Resources	Y	No extant historic properties will be adversely affected by project implementation based on current Cultural Resource work conducted. Archaeological monitoring will occur during sediment sampling in PED.
Environmental Justice Communities	Y	Environmental Justice Communities are required to be analyzed by presidential executive order (Appendix C and Section 6.14).
Aesthetics	N	The proposed action would have no effect on the heavily industrialized study area's scenic resources or visual characteristics.
Recreation Resources	N	No major recreational resources occur in the study area, as this is an international shipping port with substantial industrial infrastructure. Recreational boat traffic and public access in Commencement Bay are generally distant from the study area and would not be affected. A kayak launch would be closed temporarily during Saltchuk material placement to prevent unsafe access during construction, but other access points are available in the study area (Section 4.17).

Resource	Included in Detailed Analysis (Y/N)	Rationale for inclusion or exclusion
Public Services and Utilities	N	The proposed action would have no substantial effect on electricity, water, wastewater and stormwater collection, sewer and solid waste, natural gas, oil/petroleum, or telecommunications services.
Public Health and Safety	Y	Removal of sediments for navigation improvement can cause re-suspension of chemicals that bioaccumulate in fish tissues, which may be consumed by humans who fish in the study area.
Land-based Transportation and Traffic	N	The same amount of material would move through the area in the future with- and without project conditions.
Marine-based Transportation and Traffic	Y	The proposed action is expected to reduce the overall number of cargo ships calling at Tacoma Harbor (included in Section 4.17, Public Health and Safety).

4.3 Navigation and Economic Conditions

Transportation cost savings result from more efficient loading of vessels and reductions in the number of calls required to satisfy commodity demand. The analysis assumes the same commodity demand under No-Action Alternative/future without-project conditions and future with-project conditions. Additional detail on the economic conditions appears in Appendix A.

4.3.1 Commodity and TEU Volume: Existing Condition

Table 4-2 shows historical containerized imports and exports moved through Tacoma Harbor from 2014 through 2020. From 2014 international imports fell from 5.4 million metric tons to 5.1 million metric tons in 2018, with a maximum volume of 5.6 million metric tons import in 2015. The top containerized imports at Tacoma Harbor are furniture, machinery and equipment, iron and steel, toys, games, sports equipment and accessories, and motor vehicle parts. A high percentage of imports are either consumer goods or raw or intermediate goods that will become consumer goods after going through a manufacturing process.

International exports have grown from 5.2 million metric tons in 2014 to 6.5 million metric tons in 2018. Top containerized exports are oilseeds, other agricultural products, primary wood products, and vegetable products. Average exports from all World regions from 2013 through 2017 was 5.4 million metric tons.

Overall, throughput volume increased from 10.5 million metric tons in 2014 to 11.6 million metric tons in 2018. Average throughput for Tacoma Harbor from 2014 through 2018 was 10.9 million metric tons, consisting of 5 million metric tons of imports and 5.8 million metric tons of exports. For reference, the table includes tonnage from 2019 and 2020. As shown, total throughput dropped, especially in 2020. This is primarily the result of a temporary trade disruption associated with the 2020 global pandemic. Cargo levels have begun to recover in the first quarter of 2021 and are expected to meet forecast expectations by the study Base Year.

Table 4-2. Historical Containerized Trade (Metric Tons), US Customs.

Trade	2014	2015	2016	2017	2018	Average (2014-2018)	2019	2020
Imports	5,347,000	5,622,000	4,652,000	4,607,000	5,143,000	5,074,000	4,515,000	3,968,000
Exports	5,165,000	4,958,000	6,423,000	5,992,000	6,468,000	5,801,000	5,981,000	4,923,000
Total	**10,512,000**	**10,580,000**	**11,075,000**	**10,599,000**	**11,611,000**	**10,875,000**	**10,496,000**	**8,891,000**

4.3.2 Vessel Fleet Characteristics: Existing Condition

Ten weekly container services called at the Port of Tacoma in 2019. Historically, more services have called, but the formation of shipping alliances has reduced the number of services worldwide. Of these ten services, three call at the Sitcum Waterway and seven call at the Blair Waterway. Vessels tend to be larger and call more frequently on the Blair Waterway services. Table 4-3 summarizes services considered for the economic evaluation, including the terminal, carrier(s), service name, vessel rotation, number of ships, and ship sizes. All services call from Asia via trans-Pacific routes. Major lines include COSCO, CMA CGM, OOCL, Hyundai, and Maersk. Importantly, every service currently calling the Blair Waterway is a “first” or “last” port of call for the WCUS. This implies greater volumes unloaded (“first”) and loaded (“last”) than intermediate port calls.

Table 4-3. Tacoma Carriers Services by Terminal (2019).

Terminal	Frequency	Carrier(s)	Service Name	Vessel Rotation	First	Last	No. of Ships	Ship Size in TEUs
PCT	Wkly	Ocean*	PNW 3	China – Taiwan – China –**Tacoma** – Vancouver BC – Japan – China	Y	Y	6	5,600-7,000
	Wkly	Ocean*	PSW8	China – Taiwan – Los Angeles – Oakland – **Tacoma** – Taiwan – China	N	Y	6	8,500
Husky	Wkly	THE Alliance**	PN1	China – Japan – **Tacoma** – Vancouver BC – Japan – China	Y	Y	6	8,500
	Wkly	THE Alliance**	PN2	Singapore – Thailand – Vietnam – Taiwan – China – **Tacoma** – Vancouver BC – Japan – Taiwan – Singapore	Y	Y	7	6,300-6,500
WUT	Wkly	THE Alliance**	PN4	China – Taiwan – Japan – **Tacoma** – Vancouver BC – Alaska – Japan – China	N	Y	6	6,500
	Wkly	HMM	PN2	China – Taiwan – China – S Korea– **Tacoma** – Vancouver BC – S Korea – China	Y	Y	6	4,500-5,700
	Wkly	HMM	PS1	China – S Korea – Long Beach –**Tacoma** – S Korea	N	Y	5	6,250-6,800

*Ocean Alliance: APL, CMA, COSCO Shipping, Evergreen, OOCL
**THE Alliance: Hapag-Lloyd, Ocean Network Express (ONE), Yang Ming

The analysis uses data from the Port, Puget Sound Pilots, Sea-web database maintained by IHS Global Insight, and Waterborne Commerce Statistics Center to develop the fleet forecast by vessel size. The analysis classifies vessels based on physical and operation characteristics, including LOA, design draft, beam, speed, and TEU capacity. It is common practice to separate the containership fleet into TEU bands or classes to analyze the industry's supply. However, due to the evolution of vessel design over time, these TEU bands do not correspond to a breakdown of the fleet by dimensions such as beam or draft. Accordingly, breakdowns by beam and draft straddle different classes. For instance, within the 3,900 to 5,200 TEU band, regarded as the Panamax range, several ships fall within that category yet have beams too large to pass safely through the Panama Canal, despite what their name suggests. Conversely, many Panamax vessels in the world fleet fit easily through the Panama Canal while carrying large volumes of TEUs. The economic analysis classifies vessels based on deadweight tonnage. While this creates some overlap in beam and LOA dimensions between classes, deadweight tonnage is a stronger indicator of vessel capacity, which is important to the analysis. The transportation cost savings analysis relies on six vessel classes: Sub-Panamax (SPX), Panamax (PX), Post-Panamax Generation 1 (PPX1), Post-Panamax Generation 2 (PPX2), Post-Panamax Generation 3 (PPX3), and Post-Panamax Generation 4 (PPX4). Table 4-4 summarizes the characteristics of each vessel class.

Table 4-4. Fleet Subdivisions on Draft, Beam, and LOA (in Feet).

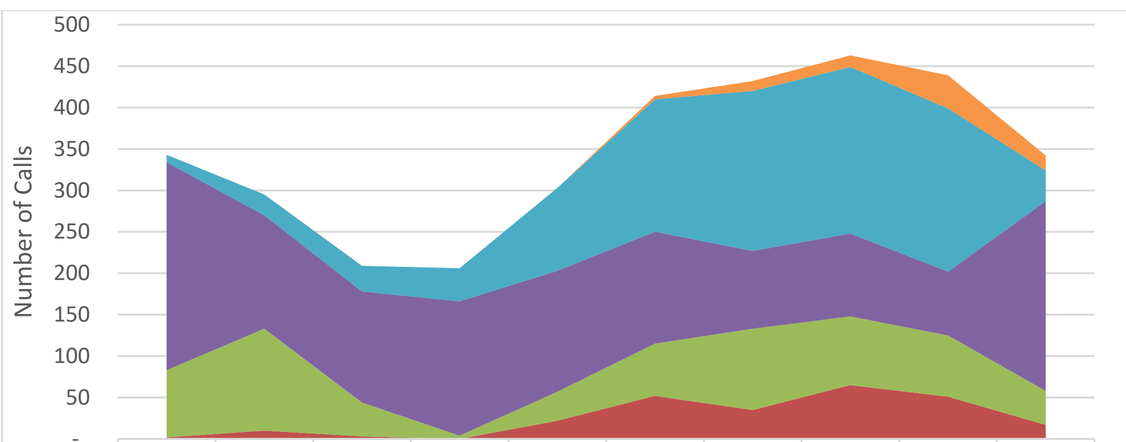
Vessel Fleet Subdivision (Containerships)	Dimension	From (feet)	To (feet)
Sub Panamax **(SPX)** (MSI[1] size brackets: 0.1-1.3, 1.3-2.9 k TEU)	Beam	0	98
	Draft	8.2	38.1
	LOA	222	813.3
	DWT	13,000	40,000
Panamax **(PX)** (MSI size brackets: 1.3-2.9, 2.9-3.9, 3.9-5.2, 5.2-7.6 k TEU)	Beam	98	106
	Draft	30.8	44.8
	LOA	572	970
	DWT	49,000	69,000
Post-Panamax (**PPX1)** (MSI size brackets: 2.9-3.9, 3.9-5.2, 5.2-7.6, 7.6-12 k TEU)	Beam	106	138
	Draft	35.4	47.6
	LOA	661	1,045
	DWT	66,000	86,000
Super Post-Panamax (**PPX2)** (MSI size brackets: 5.2-7.6, 7.6-12 k TEU)	Beam	138	144
	Draft	39.4	49.2
	LOA	911	1,205
	DWT	97,000	110,000
Ultra Post-Panamax (**PPX3)** (MSI size brackets: 5.2-7.6, 7.6-12, 12 k + TEU)	Beam	144	168
	Draft	40	53
	LOA	Up to 1,220	
	DWT	104,000	166,000
New Post-Panamax (**PPX4**) (MSI size brackets: 12 k + TEU)	Beam	168	200
	Draft	45	54
	LOA	1,150 and greater	
	DWT	150,000	205,000

[1] MSI = Maritime Strategies Inc.

Figure 4-1 shows the transit of Evergreen's 14,000 nominal TEU capacity ship *Thalassa Axia* on November 21, 2018, considered a PPX3 class vessel. The *Thalassa Axia* represents the largest regularly calling vessel at Tacoma Harbor.

Figure 4-1. *Thalassa Axia* in Blair Waterway.

Figure 4-2 presents the fleet transition at Tacoma Harbor. Figure 4-3 shows the continued transition to Post-Panamax vessels on Transpacific services calling Tacoma Harbor.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
PPX3	-	-	-	-	-	4	12	14	40	18
PPX2	9	25	31	40	100	160	193	201	197	37
PPX1	251	137	134	162	146	135	94	100	77	229
PX	81	123	41	4	35	63	98	83	74	41
SPX	2	10	3	-	22	52	35	65	51	17

Figure 4-2. Blair Waterway Calls by Class (2008-2017).

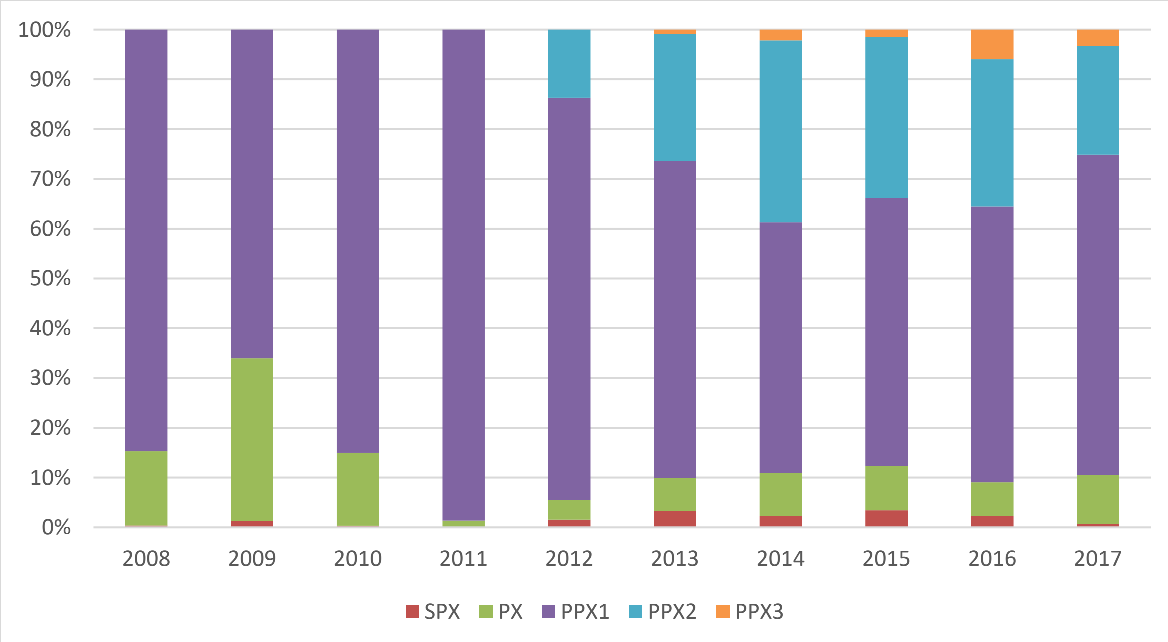


Figure 4-3. Blair Waterway Percentage of Throughput Cargo by Vessel Class.

4.3.3 Alternative 1 – No-Action Alternative/Future Without-Project Conditions

The study assumes that the No-Action Alternative will alter the commodity volume or vessel fleet composition at Tacoma Harbor over the study period. The hinterland and economic conditions affecting the port will remain the same in the future without-project and future with-project conditions. Under Alternative 1 (No-Action Alternative), cargo volume will continue to grow, leading to significant increases in container traffic on the Blair Waterway, and existing channel depths will pose increasing constraints on the growing size of the future fleet. The port will likely reach capacity during the study period, putting pressure on all Blair Waterway facilities to upgrade services and increase efficiency.

4.3.3.1 Commodity and TEU Volume: Future Without-Project Condition

The economic evaluation adapted the regional IHS Global Insight forecast used for the Seattle Harbor Navigation Improvement Project (SHNIP) to estimate containerized trade growth rates over the study period. IHS Global Insight based the forecast on data collection of macro, regional, and global economics; financial markets and securities; survey; U.S. economics; energy; industry; and regional trade. The forecast included over 7,800 export and 10,500 import country-specific commodity growth rates for the years 2016 through 2064. The analysis applies the growth rates to baseline commodity totals at Tacoma Harbor to estimate future throughput tonnage. Table 4-5 summarizes the results of the Tacoma Harbor Forecast. The analysis assumes that the Blair Waterway will reach capacity between 2030 and 2035, after which the analysis hold throughput tonnage constant.

Table 4-5. Tacoma Containerized Trade Forecast- Import and Export Tons.

Direction	Baseline	2030	2035
Import	5,074,000	7,254,000	8,271,000
Export	5,801,000	9,399,000	10,981,000
Total	10,875,000	16,653,000	19,252,000

The analysis uses average Metric Tons per TEU by import and export as well as the average percent empty TEU from 2013 through 2017 to estimate total laden and empty TEU throughput. Table 4-6 summarizes the Tacoma Harbor TEU forecast. The analysis assumes TEU volumes stay constant after 2035.

Table 4-6 Tacoma Total TEU Forecast by Route for Imports and Exports (TEUs).

TEUs	Baseline	2030	2035
Laden Import	675,000	1,057,000	1,217,000
Laden Export	495,000	889,000	1,041,000
Total Empty	335,000	586,000	684,000
Total TEUs	1,505,000	2,532,000	2,942,000

4.3.3.2 Vessel Fleet Characteristics: Future Without-Project Condition

In addition to a commodity forecast, a forecast of the future vessel fleet is required when evaluating navigation projects. The study simulates loading of the forecasted throughput tonnage for Tacoma Harbor onto each vessel class based on the World and regional fleet forecast of containerized tonnage distribution by vessel class developed by MSI and adapted for this study (Appendix A, Section 3) to develop the future fleet at Tacoma Harbor[4].

The fleet distribution at Tacoma Harbor relies on assumptions of fleet transition worldwide. Currently, most PPX3 and PPX4 vessels operate on the longest, most efficient trade lanes (Asia-Europe services). However, as shipbuilders put new PPX3 and PPX4 vessels into service, carriers transition older PPX3 and PPX4 vessels to slightly less efficient routes (e.g., Transpacific services calling Tacoma Harbor). PPX1 and PPX2 vessels already on Transpacific services cascade to shorter and less efficient routes such as Transatlantic services. This process tends to accelerate as carriers face excess vessel capacity on Asia-Europe services, which puts downward pressure on freight rates.

The study team assumes that between 2020 and 2030, the world fleet of PPX3 and PPX4 vessels will nearly double. This will add significant capacity to Asia-Europe services and pressure carriers to transition a portion of their PPX3 and PPX4 fleet to slightly less efficient routes (e.g., Transpacific routes). The study team estimates that approximately 2% of PPX3 and PPX4 vessels in the world fleet will operate on services calling Tacoma Harbor.

Over the study period, the study team anticipates that vessels with 12,000 to 16,000 TEU capacity will become the workhorses of Transpacific routes over the study period. Table 4-7 presents the initial forecast of containerized vessel calls through the year 2035. The analysis holds the fleet and commodity forecast constant after 2035 through the end of the period of analysis. The analysis uses the fleet forecast as an input to the Corps-certified planning model, HarborSym, to estimate benefits for each alternative. Appendix A, Section 3, describes the fleet forecast methodology and future fleet forecast.

[4] This forecast was approved for use on Tacoma Harbor by the Deep Draft Navigation Planning Center of Expertise on November 30, 2018.

Table 4-7. Baseline Forecast of Vessel Calls for Tacoma Harbor by Year.

Vessel Class	2030	2035
PX	-	-
PPX1	49	81
PPX2	155	132
PPX3	229	189
PPX4	116	189
Total	**549**	**591**

4.3.3.3 Transportation Costs

The study team estimated transportation costs and benefits of each alternative plan using the HarborSym Modeling Suite of Tools. The final output of the model includes an estimate of Average Annual Equivalent (AAEQ) benefits.

The study estimates transportation costs for a 50-year period of analysis for the years 2030 through 2079. The study team estimated detailed transportation costs for the years 2030 and 2035. The HarborSym model interpolates transportation costs between 2030 and 2035 based on a constant rate of change. The study estimates that Tacoma Harbor will reach capacity in 2035. As a result, transportation costs remain constant after 2035 to simulate Blair Waterway terminals operating at or near capacity through the end of the study period. The study estimates AAEQ costs and benefits by discounting the cost stream to the project base year (2030) using the Fiscal Year 2020 Federal Discount rate of 2.75%.

The study estimates transportation costs for the future without-project condition to be $657,998,000 with a standard deviation of $7,471,000. Approximately 93-95% of all transportation costs result from a vessel's transit time at sea. This study only focuses on cost savings at Tacoma Harbor and limits the impact area to this geographic region. The study estimates the percent of total service costs for each vessel call and attributes a percentage of the total cost of a trip based on Tacoma Harbor's cargo share of total laden commodity tonnage to account for at-sea costs (Economic Appendix, Section 4.1). The remaining costs represent in-port costs, which are fully attributable to Tacoma Harbor. Future without-project costs serve as the baseline for comparison for cost savings afforded by each alternative.

4.3.4 Alternative 2 – Blair Waterway Deepening to -58 MLLW

Alternative 2 (Blair Waterway Deepening) includes channel deepening up to -58 MLLW. The transportation cost savings analysis assumes the same commodity throughput for this alternative as the future without-project conditions. However, Alternative 2 allows vessels to load to their full draft in order to carry more cargo in each transit. When vessels load more cargo, services require fewer total transits to ship the same commodity throughput, leading to a reduction in transportation costs. Table 4-8 compares the future without-project (-51 MLLW) calls to the estimated calls for each depth through -58 MLLW (Alternative 2). The analysis assumes that with a channel depth of -58 MLLW, Tacoma Harbor will require 150 and 162 fewer calls in 2030 and 2035, respectively. The analysis attributes 100% of in-port cost savings to the project and a portion of at-sea transportation cost savings based on Tacoma Harbor's estimated percentage of total cargo carried on each vessel (Appendix A).

Table 4-8. Vessel Calls by Year, Class, and Depth.

Vessel Class	-51 MLLW	-52 MLLW	-53 MLLW	-54 MLLW	-55 MLLW	-56 MLLW	-57 MLLW	-58 MLLW
2030								
SPX	0	0	0	0	0	0	0	0
PX	0	0	0	0	0	0	0	0
PPX1	49	25	4	0	0	0	0	0
PPX2	155	155	155	132	107	80	54	54
PPX3	229	229	229	229	229	229	229	229
PPX4	116	116	116	116	116	116	116	116
Total	**549**	**525**	**502**	**477**	**452**	**425**	**399**	**399**
2035								
PX	0	0	0	0	0	0	0	0
PPX1	81	55	29	5	0	0	0	0
PPX2	132	132	132	130	107	79	50	50
PPX3	189	189	189	189	189	189	189	189
PPX4	189	189	189	189	189	189	189	189
Total	**590**	**565**	**539**	**513**	**485**	**457**	**428**	**428**

Net AAEQ transportation costs for Alternative 2 are maximized at -57 MLLW. Approximately 94% of transportation costs are for the time at sea, and the remainder is for in-port costs at Tacoma Harbor. Benefits are a result of the reduction in vessel calls required to transport the forecasted commodity throughput. The benefit cost summary for each alternative and channel depth is available in Table 3-6.

Based on the ship simulation results, the study team includes turning basin design with capacity for PPX4 vessels as part of Alternative 2. While pilots may continue “back-out” practices with PPX3 and PPX4 vessels berthed at WUT under good weather conditions, strong Southwest winds and low visibility conditions could create higher incident risk for “back-out” transits. NOAA gage 9446482 contains wind records spanning the years 2007 through 2018. Wind speeds exceeding 10 knots are present about 10% of the time, with more severe winds exceeding 20 knots 2% of the time. The inclusion of the turning basin improves the pilot’s ability to manage environmental risk.

The use of a PPX4 instead of a PPX3 design vessel is not likely to change the horizontal footprint of the recommended turning basin design. Ship simulation revealed the need for consistent depth across the turning basin to avoid grounding risk due to “dead water,” or areas shallower than the navigable depth, which pilots identified as high risk for turning. Therefore, the incremental costs between turning basin design for a PPX4 over a PPX3 vessel equals the incremental dredging costs of a -57 MLLW over a -56 MLLW turning basin depth. The study team estimates a maximum incremental turning basin cost of $5.85 million, or 2.6% of the total project cost[5].

[5]Estimate assumes -56 MLLW depth up to WUT South Berth and fully bears incremental special equipment and turbidity monitoring costs. If a lower depth increment was recommended at the Turning Basin, the -57 MLLW depth would need to extend past WUT South Berth as a buffer for vessel maneuvering.

Adequate turning basin capacity for PPX4 vessel ensures that safety concerns will not create operational restrictions that limit PPX4 vessel berthing at WUT. Such restrictions would reduce project benefits and could impact plan selection if restrictions made PPX4 transits to WUT cost prohibitive. Based on a $5.85 million incremental cost, the turning basin would be incrementally justified if it alleviated approximately 150 hours of PPX4 dockside wait time per year. This amounts to approximately 0.9% of the anticipated total PPX4 in-port time in 2035. This estimate is meant to provide context for the incremental costs and is not a robust incremental justification. The study team believes the incremental turning basin costs are a necessary safety feature of the Recommended Plan. Without appropriate turning basin capacity, the project is unlikely to realize the full economic benefits of project implementation.

Slope stabilization may be necessary at four locations, as outlined in Section 3.3.4, to prevent material sloughing into the channel footprint. Navigation is not expected to be impacted by these measures.

4.3.5 Alternative 2a – Blair Waterway Deepening through Husky Terminal to -58 MLLW

Alternative 2a analysis assumes that vessels will take advantage of additional channel depth and require fewer overall transits to transport the same amount of cargo. Alternative 2a differs from Alternative 2 in that it only proposes deepening to Husky Terminal. As a result, fewer vessels take advantage of the additional channel depth, and the alternative realizes lower total transportation cost savings. Consistent with the percent cargo share and fleet calling Husky Terminal, AAEQ benefits amount to approximately 37% of total channel benefits that would occur under Alternative 2. Total transportation costs for Alternative 2a are approximately $607,606,000, which equates to AAEQ transportation cost savings of $32,411,000 and AAEQ net benefits equals $29,091,000.

4.3.6 Alternative 2b – Blair Waterway Deepening to -57 MLLW (NED Plan/Preferred Alternative)

Alternative 2b includes Blair Waterway Deepening and turning basin deepening and expansion through the turning basin for the reasons outlined in Section 4.3.4. The NED Plan applies the same commodity and fleet forecast as Alternative 1. However, vessels would transport the forecasted throughput tonnage more efficiently with fewer vessel calls and increased loading of the future fleet. The NED Plan will require 150 and 162 fewer vessel calls in 2030 and 2035, respectively, Table 4-8..

The analysis assumes AAEQ transportation costs for the NED Plan of $521,803,000. The analysis attributes approximately 94% of transportation cost to time at sea and the remainder to time in port. Alternative 2b provides approximately the same AAEQ benefits as Alternative 2 at -58 MLLW ($136,195,000); however, Alternative 2b maximizes AAEQ benefits over AAEQ costs compared to all other alternatives, with $122,561,000 in AAEQ net benefits for transportation cost savings.

Alternative 2b includes beneficial placement of dredged material along the northwest shoreline of Commencement Bay to build Saltchuk. In order to be implemented, Saltchuck must be designed to avoid impacts to navigation. Potential navigation impacts resulting from this placement would be evaluated in PED as explained in Section 5.9.3 (Pre-Construction, Engineering, and Design (PED) Activities). Physical changes due to material placement at Saltchuk would be built into the bathymetry to ensure an accurate representation of bathymetric conditions and to fully evaluate potential effects to navigation.

4.3.7 Cumulative Effects on Navigation and Economic Conditions

Each alternative generates cumulative benefit for navigation and economic conditions when compared to the future without-project condition. Channel deepening and associated optimized vessel loading reduces the number of vessel calls required at Tacoma Harbor. Any reduction in the number of annual calls can lead to lower congestion in and around Blair Waterway. Lower congestion results in lower vessel wait times and overall efficiency gains to the navigation system. All alternatives have a net cumulative benefit when a reduction in vessel calls is considered in conjunction with Tacoma Harbor improvements to water quality and air emissions (Section 4).

As outlined in Section 3.3.4 and mentioned again in Section 4.3.4, slope stabilization may be necessary at four locations along the shoreline. No cumulative effects on navigation are expected from these measures.

4.4 Hydraulics and Geomorphology

Commencement Bay is an approximately 7.72 square miles (20 square kilometers) bay on the north end of Tacoma, between Point Defiance and Brown's point, into which the Puyallup River drains. The Puyallup discharges sediment into Commencement Bay at an estimated rate of 1,000,000 tons per year (Czuba et al. 2010). Water depths in Commencement Bay can reach over 600 feet.

Table 4-9. Tidal Data at Tacoma NOAA Station 9446484 (1983-2001 tidal epoch).

Datum	Water Level (feet)
Highest Observed Water Level	14.87
Mean Higher-High Water (MHHW)	11.78
Mean High Water (MHW)	10.9
Mean Tide Level (MTL)	6.87
Mean Low Water (MLW)	2.84
North American Vertical Datum 88 (NAVD88)	2.39
Mean Lower-Low Water (MLLW)	0
Lowest Observed Water Level	-4.73

Tides in Commencement Bay are the mixed semidiurnal type (i.e., tides occur twice a day and are different sizes). The mean diurnal tidal range for Tacoma published by the National Ocean Survey is 8.06 feet. The great diurnal tidal range for Tacoma is 11.77 feet. Other relevant elevations appear in Table 4-9.

Blair Waterway has no substantial water inflow/outflow other than tidal influence. As such, currents in the area are generally less than 0.5 knots (0.82 feet per second) during all tidal phases. The stronger currents occur at the mouth of the Puyallup River and Hylebos Waterway. At the Blair Waterway, the currents move parallel to the waterway, with the stronger currents being around 0.1 knot (0.16 feet per second) at the channel's mouth and around 0 knots (0.32 feet per second) at the head near PCT.

Saltchuk lies within the southeast quadrant of Commencement Bay. Currents move along this shoreline at the lower speeds of the 0-0.5 knot range.

4.4.1 Alternative 1 – No-Action Alternative/Future Without-Project Conditions

The No-Action Alternative would maintain the currently authorized channel footprint and depth at -51 MLLW. Recent bathymetry indicates this channel width and depth will not accommodate the larger proposed vessels. The evidence is scour marks along the channel's center from the bigger and heavier vessels' prop-wash at these spots. Puget Sound Pilots confirm that the bigger and heavier vessels' propeller wash will sometimes scour the centerline of the waterway as they transit the waterway. Furthermore, upon utilizing the turning basin, fully loaded ships can cause scouring of this part of the waterway from propeller wash as well.

4.4.2 Alternative 2 – Blair Waterway Deepening to -58 MLLW

Deepening the channel to -58 MLLW with associated widening would allow the design vessel to transit more efficiently through the channel. A freshly dredged channel bottom composed entirely of native material would serve as a baseline for future O&M dredging, but geomorphology would remain otherwise unchanged. The tidal prism (i.e., the amount of water flowing in and out of Blair Waterway) would increase. However, this increase is not expected to result in substantial changes to the current speed or direction.

Current and wave analysis will occur in PED to examine the effects of hydraulics and geomorphology at Saltchuk. However, preliminary analysis of the small proportion of Saltchuk that modifies the shoreline (approximately 7%) is not likely to have a measurable impact on tidal currents in comparison to Commencement Bay. Sediment migration will depend on several factors, including sediment particle size, current speed, and site configuration. For example, island creation in Scenario E may further decrease already low current speeds. If any sediment migration occurs, it can be expected to occur alongshore towards the existing marina or towards the Hylebos Waterway's mouth. Based on the preliminary sediment characterization, material placed at Saltchuk would consist of a large proportion of native material. This would cover the wood waste that is not a natural component of the geomorphology. Overall, the construction of Scenario E at Saltchuk is not expected to cause substantial changes to hydraulics or geomorphology of Commencement Bay.

Channel deepening may result in the need for side slope stabilization at four sites, as discussed in Section 3.3.4. Stabilization measures are not expected to change hydraulics or geomorphology in the study area and may be required to deepen the Blair Waterway to achieve anticipated economic benefits. Based on the analysis above, deepening, material placement at Saltchuk, and potential stabilization measures are not expected to have more than a minor impact on hydraulic or geomorphological characteristics of the study area.

4.4.3 Alternative 2a – Blair Waterway Deepening Through Husky Terminal to -58 MLLW

Deepening the channel to -58 MLLW with associated widening up to Husky Terminals would allow the design vessel to more efficiently transit and dock at Husky. As with Alternative 2, the channel bottom up to Husky would be composed of newly exposed native material, and the tidal prism would increase slightly but would not be enough to substantially impact current speed or direction.

Only 697,000 CY of material suitable for open-water disposal would be dredged under Alternative 2a; it is likely slightly less would be suitable for beneficial use, which would not be enough material to build

Scenario E, a best buy scenario (Section 3.6.1.1). Placing no material at Saltchuk would have no effect on hydraulics or geomorphology.

As described in Section 4.4.2 Alternative 2, deepening and potential side slope stabilization measures are expected to have only a minor impact on the hydraulic or geomorphological characteristics of the study area.

4.4.4 Alternative 2b – Blair Waterway Deepening to -57 MLLW (NED Plan/Preferred Alternative)

The NED Plan considers a deepening and associated widening of the entire channel to -57 MLLW. This alternative is very similar to Alternative 2, but the channel is just one foot shallower. Alternative 2b would have the same effects from material placement at Saltchuk as described for Alternative 2. As in previous cases, deepening and potential side slope stabilization measures are not expected to considerably impact the area's hydraulic or geomorphological characteristics.

As described in Section 4.4.2 Alternative 2, deepening, material placement at Saltchuk, and potential side slope stabilization measures would only have a minor impact on the area's hydraulic or geomorphological characteristics.

4.4.5 Cumulative Effects to Hydraulics and Geomorphology

The previous discussion leads to the reasonable conclusion that, regardless of the selected alternative, no substantial changes to Blair Waterway's hydraulics and geomorphology are expected to occur from the deepening, aquatic material placement, or the potential side slope stabilization. Saltchuk is less than about 0.5 miles along the shoreline. When compared to the approximately seven miles of shoreline around Commencement Bay, modification to Saltchuk using mostly native material from the Blair Waterway will not have more t than a minor change to Commencement Bay hydraulics and geomorphology.

4.5 Geotechnical

The side slopes of the Blair Waterway are uniform among most areas. As-built drawings from previous wharf projects reveal a combination of 2H:1V slopes near the toe of the slope and steeper 1.5H:1H slopes closer to the surface with additional seismic slope stability provided by the structural piers upon which the wharf was built, as well as the use of Improved Ground (Stone Columns), in some cases (e.g., Pier 4).

Side slopes were identified as having an equilibrium slope of 2H:1V, based upon recent bathymetric survey data indicating that slopes without structures are approximately 2H:1V. These slopes have been established since the last channel deepening/dredging in 2001. The proposed channel has been designed with this consideration in mind. Preliminary geotechnical modeling validates this observation and can be found in more detail in Appendix B (Engineering) and Section 3.3.4 (Side Slope Stability).

4.5.1 Alternative 1 – No-Action Alternative/Future Without-Project Conditions

The No-Action Alternative would maintain the current depth for Blair Waterway and would limit access for proposed larger vessels in the future. Channel slopes are 2H:1V or shallower in many areas. The maximum proposed vessel anticipated to use the Blair Waterway would require a deeper channel, which would, in turn, require steeper side slopes or an expansion of the waterway footprint. The No-Action Alternative would have a minimal effect on the geotechnical conditions of the study area.

4.5.2 Alternative 2 – Blair Waterway Deepening to -58 MLLW

Deepening and widening the traffic channel in Blair Waterway and turning basin would likely impact the side slopes of the channel. Proposed channel modeling indicates that side slopes could be steepened to 1.5H:1V so as to not impact upland areas adjacent to the channel in four locations (Table 3-3). Concerns regarding the slopes' stability without piles or other stabilization methods were preliminarily analyzed and modeled with SlopeW (slope stability analysis software) using data from existing geotechnical reports (Appendix B, Annex 6 and 7) for similar projects constructed in the harbor. These models revealed the potential for slope failures without further stabilization, such as the potential stabilization methods in Table 3-3. Previous wharf designs with steeper slopes used piles and riprap to provide slope stability. Additionally, the stability of three culvert outfalls may be impacted in areas where channel side slope will be steepened. The culvert at Site 3 was originally installed in support of a now completed remediation effort. The culvert is currently owned by Stevedoring Services of America (SSA). With completion of remediation, the remediation easement associated with the culvert was scheduled to end in June 2020. After that, SSA is responsible for the removal of the culvert outfall, and the removal of any associated contamination (i.e., contaminated soils). Two other culvert outfalls may need to be modified or relocated to accommodate the proposed channel deepening and associated widening, pending detailed design information to be developed in PED (see Section 5.9.3). One outfall is adjacent to Site 1 and one outfall is within Site 2. If further design indicates this area will be part of the Federal project's footprint, the Port of Tacoma would be solely responsible for removing or relocating these outfalls and conducting any associated remediation of Sites 2 and 3 before construction. Further modeling and analysis in PED will inform dredging and construction extents and methodologies for stabilization. Potential impacts on wharves and berths should be evaluated by others prior to the deepening of the berthing areas, as this would occur outside of the proposed Federal project. Based on the features present and this analysis, there will be minimal effects to geotechnical characteristics of side slopes. As listed in Section 4.6.2 (Water Quality), the navigation channel would be dredged to allow the side slopes to come to stable equilibrium and avoid sloughing later. An environmental bucket would be used to remove unsuitable material. Bathymetric surveys during and after construction would show whether sloughing has occurred.

4.5.3 Alternative 2a – Blair Waterway Deepening Through Husky Terminal to -58 MLLW

Assuming existing slopes in the Blair Waterway are stable at 2H:1V or greater, no substantial impacts are anticipated from widening and deepening the channel from the entrance to Husky Terminal. This reach of the waterway is wider than the rest of the waterway; therefore, the channel can be expanded to accommodate a 2H:1V slope without the need for slope stabilization measures. This will be confirmed in PED. In comparison, Alternatives 2 and 2b have the potential for slope stabilization measures, which are summarized in Table 3-3. Based on the features present and this analysis, there will be only minor effects to geotechnical characteristics of side slopes in the study area.

4.5.4 Alternative 2b – Blair Waterway Deepening to -57 MLLW (NED Plan/Preferred Alternative)

With a difference of proposed dredge depth of one foot, Alternative 2 and Alternative 2b will have approximately the same impacts as described for Alternative 2. Based on the features present and this analysis, there will be minimal effects to geotechnical characteristics of side slopes.

4.5.5 Cumulative Effects to Geotechnical

Post-construction impacts may include erosion and turbidity due to previously unexposed soil now being exposed to tidal currents, as well as currents generated by ship propellers. Engineered solutions to achieve stable side slopes steeper than the angle of repose (i.e., about 2H:1V) may need to be removed for future development within the waterway and would cause impacts similar to their construction. These effects are not expected to rise to the level of significance.

4.6 Water Quality

Under the Clean Water Act, Ecology establishes standards for physical parameters of water, such as temperature, pH level, dissolved oxygen (DO), and chemical concentrations. Waters that do not meet standards are considered "polluted waters." Polluted waters are placed on a 303(d) list that Ecology regularly publishes (in reference to Section 303(d) of the Clean Water Act). Waters with signs of diminished health but still meet standards are "waters of concern" on the 303(d) list (see Appendix C for a map of 303(d) listed waters in the study area). The Corps completed a Section 404(b)(1) evaluation to address the substantive compliance issues of the Clean Water Act 404(b)(1) Guidelines [40 CFR §230.12(a)]; 33 CFR § 336.1(a).).

Portions of Commencement Bay are on Ecology's 303(d) list of threatened and impaired waters, listed as "polluted" for specific parameters. Inner Commencement Bay is listed for Bis(2-Ethylhexyl) phthalate and polychlorinated biphenyls (PCBs). Within the inner bay, Thea Foss Waterway is listed for PCBs, and Hylebos Waterway is listed for dieldrin, PCBs, chlorinated pesticides, dichlorodiphenyltrichloroethane (DDT), and high molecular weight PAHs. The Blair Waterway is not on the 303(d) list, but it is listed under "waters of concern" for benzene, tetrachloroethylene, and trichloroethylene. Outer Commencement Bay, which includes Saltchuk and the Commencement Bay open-water disposal site, is listed for bacteria, DO, PCBs, and Bis(2-Ethylhexyl) phthalate. This section of the report covers the parameters of turbidity, DO, and temperature, while issues related to sediment contaminants are covered in Section 4.10, Section 4.17, and Section 5.3.

Turbidity refers to the clarity or clearness of the water. The greater the amount of total suspended solids in the water, the murkier it appears, and the higher the measured turbidity. Turbidity is regulated because it relates to healthy habitat for fish, invertebrates, and aquatic plants. Turbidity is created when large ships enter the Blair Waterway due to the propellers' proximity to the bottom of the waterway. Sediment can be disturbed and suspended, temporarily creating a plume of turbidity. Another source includes glaciers on Mount Rainier that feed the Puyallup River and its tributaries. Glacial meltwater and high loads of fluvial (from the river) material generate turbidity in the Puyallup River and into Commencement Bay during peak flows, typically during spring melt and fall-winter rains (Puyallup River Watershed Council 2014).

DO in marine waters is essential for aquatic life. If levels are too low, it can be a sign of human-induced impacts such as excessive runoff of nutrients or of natural causes such as seasonal variations. Conditions for aquatic life are healthy when DO is above 5.0 milligrams per liter (mg/L). Concentrations between 5.0 mg/L and 3.5 mg/L are acceptable, except for the most sensitive species. When concentrations fall below 3.5 mg/L, conditions become unhealthy. DO in December 1980 was about 6.4 to 7.7 mg/L in the Blair Waterway (Dames and Moore 1981). Outer Commencement Bay is recognized as impaired for DO because samples taken 1993-2008 were below 6 mg/L (Ecology 2018). Commencement Bay is part of the Puget Sound Nutrient Source Reduction Project to address human sources of nutrients that may lower DO (Ecology 2019).

The temperature has a strong influence on the aquatic organisms that can survive and thrive in any particular habitat and can affect numbers, sizes, and distributions of biota. Temperatures in October 1980 in the Blair Waterway were about 15°C at the surface to 12°C at the bottom, while temperatures in December were about 10°C throughout the water column (Dames and Moore 1981). Long-term temperature data are not available for Puget Sound specifically; however, other Pacific Northwest locations indicate a long-term warming trend with an increase of 1°C from 1950 to 2005 (Snover et al. 2005).

4.6.1 Alternative 1 – No-Action Alternative/Future Without-Project Conditions

Global climate change and associated sea-level change (SLC) may affect the water quality parameters of temperature, turbidity, and DO over the 50-year period of analysis (Khangaonkar et al. 2019). The amount of DO in water is partly related to water temperature; as water temperature increases, less total DO can be concentrated within a given volume of water. Water temperatures are predicted to increase with climate change. Turbidity trends within the study area may change over the 50-year study period. The trends could change primarily because conditions of the contributing water body, the glacially fed Puyallup River, may become more turbid with increased scour events. The predicted rate of SLC for Puget Sound is expected to be a sea-level rise between 0.5 and 2.8 feet by 2080. The No-Action Alternative would have no effect on the long-term levels of temperature, turbidity, salinity, dissolved oxygen, or recreational use. O&M dredging to maintain authorized depths is expected to be limited to approximately 30,000 CY every 25 years, which would have an associated negligible amount of turbidity in each event.

4.6.2 Alternative 2 – Blair Waterway Deepening to -58 MLLW

The work duration may be the entire six-month work window for four consecutive years to accomplish the channel deepening. Some dredged material may contain sediment with biological and chemical oxygen demand that could temporarily lower local DO levels during dredging. The upper portion of sediment is sand with some silt. Infaunal and benthic organisms inhabit the upper sediment. Thus, the likelihood of finding much anaerobic sediment in this stratum of sediment is low. Deeper sediment within the dredge prism is more likely to have anoxic conditions. The current velocities are 0.16 feet per second at the mouth to 0.32 feet per second at the head of the waterway during all tidal phases (Appendix B). Water quality standards were maintained during several recent dredging projects in the Blair Waterway. Within the construction footprint, there is limited stagnation of water due to a wide tidal range. BMPs would be employed to avoid or minimize water quality impacts (Section 4.6); therefore, the Corps anticipates a temporary or minimal reduction in local DO during dredging and one-time material placement at Saltchuk. Long-term water quality benefits at Saltchuk in the immediate vicinity of the sediment due to covering wood waste is described in Section 4.11.2 (Benthic Organisms).

Channel deepening in systems with freshwater inflow, such as estuaries and rivers, may result in a greater excursion of saltwater into these systems. However, salinity is not anticipated to be substantially affected in the Blair Waterway because it is an artificial channel without any significant freshwater input (Appendix B Engineering). Blair Waterway is tidally influenced and adjacent to a much deeper channel; therefore, dredging is not anticipated to alter the temperature or DO of the channel substantially. Saltchuk is not confined from the wider Commencement Bay area and does not have any major freshwater input, so material placement is not anticipated to alter the temperature or DO of the site substantially.

Dredging causes short-term increases in turbidity in a linear plume down current from the dredging and material placement activity. Turbidity would be monitored during dredging and material placement at Saltchuk to adhere to State water quality requirements as provided by the project's Clean Water Act Section 401 Individual Water Quality Certification (WQC). A WQC would be sought from Ecology prior to construction. The Corps will seek a WQC from the Puyallup Tribe of Indians if further analysis in PED determining the design of the navigation channel indicates that there will be CWA Section 404 jurisdictional activity within their CWA Section 401 jurisdiction. No long-term changes to any water quality parameters would result from construction. The potential for resuspension of material unsuitable for in-water disposal is discussed in Sections 4.11 (Benthic Organisms), 4.12 (Fish) and 4.17 (Public Health and Safety). The Corps would employ BMPs and WQC requirements to minimize re-suspension during dredging, especially in areas where sediments are determined unsuitable for aquatic disposal. BMPs include the following:

- Comply with all necessary and appropriate water quality standards and conditions issued in a WQC and adhere to monitoring protocols in the approved water quality monitoring plan, as applicable, and in a manner consistent with the Clean Water Act and its implementing regulations
- Dredge only within the designated work window of August 16 through February 15 for material disposal at the Commencement Bay open-water disposal site. In-water work for other locations of Commencement Bay, including dredging, is July 16 through February 15 (WAC 220-660-330; Corps 2017b), but the Corps plans to delay the start of the in-water work window to August 16 to further reduce potential effects to late-migrating smolts.
- The entire footprint of the area to be dredged would undergo comprehensive sediment testing to determine suitability for aquatic disposal, and all material determined unsuitable would be transported for upland disposal at an appropriate facility.
- A closed-type (environmental) clamshell bucket would be used in all areas in which sediment has been determined unsuitable for aquatic disposal to minimize resuspension of unsuitable sediment.
- With the exception of side slopes that may require stabilization, the side slopes of the navigation channel would be graded (i.e., the navigation channel would be dredged to allow the side slopes to come to a stable equilibrium) to avoid sloughing later. An environmental bucket would be used to remove unsuitable material. Bathymetric surveys during and after construction would show whether sloughing has occurred.
- A spill response plan would be developed by the contractor with inspection requirements, spill response measures, and spill notification requirements. All equipment would be inspected daily to ensure that it is in proper working condition and have no leaks of fuel or hydraulic fluids. Each vessel would have a spill-control kit on board at all times.

The 1988 NEPA review of PSDDA sites included all activities related to the use and management of the Commencement Bay site, which is therefore not included in the scope of this analysis. Water quality monitoring is not required for disposal at the Commencement Bay open-water disposal site. According to the June 1988 PSDDA Management Plan Report, disposal at the unconfined open-water sites will be limited to dredged material that meets specific management conditions, will have a minimal loss of fines to the water column, and site monitoring will be conducted in accordance with the program document (PSDDA 1988). Reauthorization of the Dredged Material Management Program disposal site in Commencement Bay occurred in 2009 via a supplemental EIS (DMMP 2009).

Side slope stabilization is not expected to have a long-term effect on water quality. During construction, water quality monitoring would occur for riprap and other measures such as auguring for a secant pile wall that could generate turbidity. Once any potential side slope stabilization is in place, it would not generate turbidity or impede water circulation.

Short-term effects would occur for each O&M dredging event anticipated to be required about every 25 years for each waterway with a quantity of approximately 30,000 CY in the Blair Waterway. No long-term changes to water quality parameters would result from construction.

4.6.3 Alternative 2a – Blair Waterway Deepening Through Husky Terminal to -58 MLLW

The work duration is about 4.5 months within approximately one year to accomplish the channel deepening to -58 MLLW up to about 11th Street. Similar to Alternative 2, the Corps anticipates little or no reduction in local DO during dredging. No aspects of the project could change the temperature regime in the waterways or the estuary. Although temporary increases in turbidity would occur, no long-term changes to any water quality parameters would result from construction. Potential impacts to the groundwater flow regime as a result of deepening will be further assessed and confirmed during later stages of design but are assumed negligible based on current information and level of design. There would be no effects on water quality at Saltchuk from material placement because sufficient material would not be dredged under Alternative 2a. Localized water quality impacts from the presence of wood waste at Saltchuk would persist. The effects of O&M for Alternative 2a would be the same as for Alternative 2 to dredge the quantities that accumulate between O&M dredging events. Initial construction for Alternative 2a would take less time than Alternative 2, and O&M dredging would have a shorter duration due to the expectation of a smaller quantity of sediment accumulation for Alternative 2a. Based on the above analysis, only minor effects to water quality would occur under Alternative 2a. A WQC would be sought from Ecology prior to construction. The Corps will seek a WQC from the Puyallup Tribe of Indians if further analysis in PED determining the design of the navigation channel indicates that there will be CWA Section 404 jurisdictional activity within their CWA Section 401 jurisdiction. The Corps would employ BMPs and WQC requirements as described in Section 4.6.2.

4.6.4 Alternative 2b – Blair Waterway Deepening to -57 MLLW (NED Plan/Preferred Alternative)

The work duration would most likely be the entire six-month in-water work window in up to four consecutive years to accomplish the channel deepening. Similar to Alternative 2, the Corps anticipates little or no reduction in local DO during dredging and Saltchuk construction. No aspects of the project could change the temperature regime in the waterways, estuary, or at Saltchuk. Although temporary increases in turbidity would occur, no long-term changes to any water quality parameters would result from construction or material placement at Saltchuk. The effects of O&M for Alternative 2b would be the same as for Alternative 2 to dredge the quantities that accumulate between O&M dredging events. Initial construction for Alternative 2b would take slightly less time than Alternative 2, and O&M dredging would have the same duration due to the expectation of a similar quantity of sediment accumulation for both alternatives. Sediment accumulation is expected to occur over the entire length of the channel. A WQC would be sought from Ecology prior to construction. The Corps will seek a WQC from the Puyallup Tribe of Indians if further analysis in PED determining the design of the navigation channel indicates that there will be CWA Section 404 jurisdictional activity within their CWA Section 401 jurisdiction. The Corps would employ BMPs and WQC requirements as described in Section 4.6.2.

4.6.5 Cumulative Effects to Water Quality

Long-term changes to water quality in Puget Sound due to global climate change and human nutrient input are expected in the nearshore estuarine environment (Khangaonkar et al. 2019). Anticipated changes include increased temperature, lower DO, and lower pH by 2095. Because water quality impacts from the project would be temporary, cumulative impacts would occur only if other construction activities occur at the same time as the proposed dredging and disposal and do not adhere to water quality standards. This is possible but not likely due to the project location, water quality regulations, and duration of the in-water work window. In addition, BMPs such as those proposed for the project are expected to be implemented for other construction activities, which reduce the risk of substantial cumulative effects to water quality because all projects would be required to adhere to water quality standards. The majority of water quality issues in Commencement Bay stem from land-use practices and past industrial uses, not from in-water construction. Therefore, cumulative impacts to water quality would be minor for all alternatives and Saltchuk construction. See Section 6.3 for compliance with the Clean Water Act.

4.7 Air Quality

The agencies with jurisdiction over ambient air quality in the study area are the EPA, Ecology, and the Puget Sound Clean Air Agency. EPA is responsible for establishing the National Ambient Air Quality Standards (NAAQS). The NAAQS criteria pollutants of concern in the study area are carbon monoxide (CO), ozone, reactive organic gases (ROGs), volatile organic compounds (VOCs), lead, nitrogen oxides (NOx), sulfur oxides (SOx), and particulate matter (PM). PM is classified by size: PM_{10} refers to all PM 10 microns in diameter or smaller, and $PM_{2.5}$ refers to all PM 2.5 microns in diameter or smaller. Ambient air quality standards, as adopted by the State of Washington (WAC 173-476), are in Appendix C.

Human exposure to diesel exhaust (a component of this project) can contribute to an increased risk of negative health effects such as lung cancer, chronic respiratory problems, and cardiovascular disease. Diesel emissions are associated with impaired visibility, acid deposition, and climate change.

Where air quality does not meet NAAQS, the area is designated as a Non-Attainment Area. Areas that meet NAAQS are designated as Attainment Areas or unclassifiable. Areas without sufficient data to designate are unclassifiable. At areas previously designated as Non-Attainment, and where air quality has improved above NAAQS, the area is designated as a Maintenance Area. The site is located in Maintenance Areas for $PM_{2.5}$ and PM_{10} but is no longer a maintenance area for carbon monoxide or ozone as of 2016 (Table 4-10).

Table 4-10 Recent Clean Air Act Maintenance Area Information for Tacoma Harbor.

Chemical	NAAQS	End Date of 20-Year Maintenance Area Period

$PM_{2.5}$	35µg/m^3/24-hour period	March 2035
PM_{10}	150 µg/m^3/24-hour period	May 2021
Carbon Monoxide	9 ppm/8-hour period	October 2016
Ozone	0.070 ppm/h-hour period	November 2016

Since 2007, the Port has jointly developed and carried out the Northwest Ports Clean Air Strategy (NWPCAS). In 2013, the Ports of Seattle, Tacoma, and Vancouver collaborated to create an updated NWPCAS with three objectives: reducing port-related air quality impacts of diesel particulate matter (DPM), reducing greenhouse gas (GHG) emissions, and helping meet air quality standards and objectives for the airshed. Emission reduction programs have included a voluntary At Berth Clean Fuels program for 2007 to 2014, which has eliminated over 850 metric tons of sulfur emissions (and associated PM). In 2015, At Berth Clean Fuels was replaced by the North American Emissions Control Area (ECA) standard of 0.1% low sulfur fuel within 200 miles of the coast. The Clean Truck Program initiative has replaced over 410 trucks within the NWSA to maintain current standards (2007 engine or equivalent). Sources of air pollution during dredging projects would include the dredge vessel, tugboat, derrick machinery, and scow. For the alternative's analysis in this section, the quantity of potential air emissions was estimated using the following emissions factors:

- Non-road diesel equipment: emissions factors from the South Coast Air Quality Management District (SCAQMD). SCAQMD is the regulatory authority over air emissions in the south coast air basin in southern California and provides the best model for calculating potential emissions.
- Harbor craft: emissions factors from the Harborcraft, Dredge, and Barge Emission Factor Calculator from the Sacramento Metropolitan Air Quality Management District (SMAQMD 2017). The SMAQMD is responsible for monitoring air pollution within the Sacramento Basin.

The emissions estimate accounts for emissions associated with the operation of vessels and machinery with diesel engines used during dredging and material placement activities. These estimates are not intended as an exact calculation of the emissions associated with this project but rather as a means for comparison among the alternatives. Tons of CO, ROGs (ozone precursors), NOx, and PM were estimated and are reported below. Details about emission estimates and emissions factors appear in Appendix C.

Ocean-going vessels (OGV) that call at Tacoma Harbor typically use large Category 3 marine diesel engines. Emissions from these vessels relevant to this discussion are quantified and reported as DPM tons per year, and goals are set to reduce total DPM output. These large ships contribute 33% of DPM emissions in Puget Sound, with an output of 1.69 tons of DPM associated with OGV activities at Tacoma Harbor in 2016 (Starcrest 2018). The NWPCAS goal for DPM is to reduce emissions per ton of cargo by 80% from 2005 levels by 2020. Emissions from ships are expected to decrease significantly since the establishment of the North American ECA. In 2010, the International Maritime Organization designated the North American ECA, including waters 200 nautical miles or less from the coast. All vessels within the ECA must burn lower-sulfur fuel or achieve an equivalent emission reduction. The maximum allowable fuel sulfur limit was decreased to 1% in August 2012 and further decreased to 0.1% in January 2015.

4.7.1 Alternative 1 – No-Action Alternative/Future Without-Project Conditions

The area of analysis for this section is limited to the greater Puget Sound airshed, which contains the U.S. portions of the Georgia Basin/Puget Sound international airshed. This area was chosen because it is the same geographical boundary used by the Puget Sound Maritime Emissions Inventory (2018) and allows for comparisons with past emissions inventories. In addition, this area of analysis is more closely aligned with the economic analysis, which accounts for at-sea transportation cost savings but on the portion of costs as determined by Tacoma Harbor's total cargo share on each vessel. There would potentially be long-term air quality benefits beyond the Tacoma Harbor study area; however, this would only be a percentage due to actions taken by other Ports that are not within the scope of this study. Taking no action would mean no short-term effects on the output of diesel exhaust from project construction equipment. However, there could be greater long-term negative effects on air quality if the transit efficiency of the channel is not improved compared to the action alternatives. Much of the existing containership fleet consists of Panamax or greater size vessels, with a shift to even larger vessels in the future. Under the No-Action Alternative, these larger, deeper draft ships will have a narrower range of depths available through tidal restrictions for entry into the waterways. Therefore, ships may idle offshore from the harbor while waiting for tidal conditions that allow depth for entry into the harbor. Under the No-Action Alternative, 590 vessel calls are expected per year, which means more vessels would be required to transport the same amount of cargo compared to the other action alternatives. DPM emission reductions would be expected through strategies such as technology advancements and regulatory requirements. To meet targeted reductions in DPM emissions, the economic cost of achieving reductions may be shifted to expensive upgrades in infrastructure or land-based equipment. The No-Action Alternative is unlikely to have an effect on air quality because no construction would take place.

4.7.2 Alternative 2 – Blair Waterway Deepening to -58 MLLW

To analyze the short-term construction effects of dredging on air quality, the Corps estimated dredging equipment emissions for each action alternative. The emissions estimate assumed one dredge operating with its associated tugboat, scow, skiff, and survey boat running up to 24 hours per day for 19 months over four years in the Blair Waterway to achieve the length, width, and depths proposed. It represents the most likely scenario for estimated material to achieve the goal in this alternative and is based on the same conservative assumptions and quantities used for the cost analysis.

$PM_{2.5}$ enters the air through direct emissions and precursors. The precursors include SOx, NOx, ROGs, and ammonia. The EPA established 100 tons per year (TPY) as the *de minimis* emission level for NAAQS pollutants; the 100 TPY threshold applies separately to each pollutant (40 CFR 93.153). The EPA established threshold levels of pollutants of concern for non-attainment or maintenance areas; Tacoma Harbor is not located in a non-attainment area because the air quality in Pierce County does not have air quality worse than the NAAQS (EPA 2018). Ammonia is excluded from analysis, as it is not an expected emission in this project. Construction was sequenced to occur over four years to ensure emissions remain under 100 TPY. Emissions include numbers from open-water disposal and upland disposal, along with a comparison of emissions when building Saltchuk under this Alternative.

Table 4-11 Estimated annual emissions associated with the construction of the Blair Waterway Deepening.

Air Pollutant	Estimated annual emissions in tons (with full Saltchuk build out)	Estimated annual emissions in tons (without full Saltchuk build out)
Reactive Organic Gasses (ROGs)	7.6	6.3
Carbon Monoxide (CO)	30.6	26.0
Nitrogen Oxides (NOx)	98.0	82.4
Sulfur Dioxide (SOx)	0.1	0.1
Particulate Matter (PM2.5)	3.9	3.2

Operation of the dredge and associated support vessels would emit GHGs, primarily carbon monoxide and nitrous oxides, but also the criteria pollutants CO and NOx from the combustion of diesel. During the annual dredging episodes, including building Saltchuk, approximately 31 metric tons of carbon monoxide and 98 metric tons of nitrogen oxides would be produced (Table 4-11). Portions of each dredging event will occur in the fall and winter months when the typical weather of wind and rain would be expected to disperse air pollutants. Emissions are not expected to cause adverse health effects or result in the violation of applicable air quality standards; therefore, impacts will be inconsequential and result in no more than a *de minimis* increase in criteria pollutant emissions over no-action conditions.

Under Alternative 2, the number of vessel calls would decrease from 590 (No-Action Alternative) to 428 vessels per year and result in a long-term reduction in air pollutants emitted from ocean-going vessels (OGV; Table 4-8). This reduction is not a 1:1 reduction in air pollutants because the smaller size class vessels would drop from the fleet but results in an overall drop in air pollutant-emitting machinery. Therefore, temporary emissions during construction and long-term emissions reduction by 2035 would not constitute a measurable effect among the impacts of climate change and sea level rise, and is therefore considered a minor impact.

4.7.3 Alternative 2a – Blair Waterway Deepening Through Husky Terminal

The emissions estimate for this alternative assumed one dredge operating with its associated tugboat, scow, and survey boat running up to 24 hours per day for 4.5 months over about one year in the Blair Waterway to achieve the length, width, and depths proposed. It represents the most likely scenario for estimated material to achieve the goal in this alternative and is based on the same conservative assumptions and quantities used for the cost analysis.

Table 4-12 Estimated annual construction emissions for the Blair Waterway Deepening through Husky Terminal.

Air Pollutant	Estimated annual emissions in tons (without full Saltchuk build out)
Reactive Organic Gasses (ROGs)	5.2
Carbon Monoxide (CO)	21.6
Nitrogen Oxides (NOx)	68.2
Sulfur Dioxide (SOx)	0.1
Particulate Matter (PM2.5)	2.6

The effects of Alternative 2a are similar to Alternative 2 but to a lesser degree. The full Saltchuk build out (Scenario E in Section 3.6.1.1) would not be possible if dredging only occurred just past Husky Terminal due to a lack of dredged material. Alternative 2a does not provide enough dredged material for a best buy scenario that accomplishes beneficial use. Only 697,000 CY of material suitable for open-water disposal would be dredged; it is likely slightly less would be suitable for beneficial use and would not be enough material to build the first bench (Scenario B, [about 850,000 CY] or up to Scenario E, a best buy scenario [Section 3.6.1.1]). The long-term reduction of emissions from OGV would still occur but would not be as great as in Alternative 2. Alternative 2a would not result in a measurable effect among the impacts of climate change and sea level rise.

4.7.4 Alternative 2b – Blair Waterway Deepening to -57 MLLW (NED Plan/Preferred Alternative)

The emissions estimate for this alternative assumed one dredge operating with its associated tugboat, scow, and survey boat running up to 24 hours per day for 19 months over four years in the Blair Waterway to achieve the length, width, and depths proposed. It represents the most likely scenario for estimated material to achieve the goal in this alternative and is based on the same assumptions and quantities used for the cost analysis. Construction was sequenced to occur over four years to ensure emissions remain under 100 TPYs.

Table 4-13 Estimated annual emissions associated with the construction of the NED Plan.

Air Pollutant	Estimated annual emissions in tons (with full Saltchuk build out)	Estimated annual emissions in tons (without full Saltchuk build out)
Reactive Organic Gasses (ROGs)	6.9	5.5
Carbon Monoxide (CO)	27.7	22.9
Nitrogen Oxides (NOx)	92.1	72.4
Sulfur Dioxide (SOx)	0.1	0.1
Particulate Matter (PM2.5)	3.5	2.8

Alternative 2b differs from Alternative 2 by only one foot of depth and has nearly identical effects to air quality. Emissions are not expected to cause adverse health effects or result in the violation of applicable air quality standards listed in Section 4.7 (Air Quality); therefore, impacts will be negligible and have no more than a *de minimis* increase in criteria pollutant emissions over No-Action Alternative conditions. A long-term reduction in emissions from OGV is expected because the total number of annual vessel calls would drop from 590 to 428.

4.7.5 Cumulative Effects to Air Quality

The long-term effects of improving navigation efficiency would mean the reduction in DPM emissions as a cumulative total over the first 14 years following construction, which is when the project benefit of reducing the total number of vessels using Blair Waterway is fully realized (Section 4.3). The long-term effects have incorporated growth as described in Section 4.3. Criteria pollutants will not rise above the 100 TPY threshold and are not expected to contribute measurably to local air quality or climate change.

4.8 Greenhouse Gas Emissions

The Earth's atmosphere is changing, the climate system is warming, and the changes are likely due in part to human activities that produce GHGs. GHGs include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone (O_3), and some hydrocarbons and chlorofluorocarbons. These compounds create a greenhouse effect when they accumulate in the Earth's atmosphere. They act as a layer of insulation, retaining some of the thermal radiation that originated from the sun within the Earth's atmosphere. GHGs can have natural and human sources from activities such as the combustion of fossil fuels and cement production. CO_2 is naturally absorbed during some physiochemical and biological processes, but human activities can affect these processes. Projections for future emissions vary greatly based on the assumptions made about trends in human activities related to CO_2 production and absorption. However, the scientific community agrees without significant changes to current policies and practices; CO_2 concentrations in the atmosphere will continue to increase. Concern regarding the implications of global climate change is increasing across the public and private sectors and within Federal, state, and local governments. The concern for Federal projects is the contribution of GHGs to the atmosphere in such large quantities to outweigh the benefit of executing the proposed action. The most common source of anthropogenic GHG emissions is the burning of fossil fuels either by vehicles/equipment (e.g., vessels used to accomplish dredging and disposal of dredged material) or to generate heat and power for buildings. In 2013, the largest contributor of GHGs in Washington was the transportation sector when fuel is used in cars, trucks, ships, trains, and planes (42.8%; Sandlin 2016).

Sources of GHGs among the action alternatives include mechanical bucket dredge, dump truck, excavator, bulldozer, tugboat, and locomotive. Emissions estimates of total GHG emissions, expressed in tons CO_2 equivalent, were analyzed for each alternative and estimated based on emissions generated during total equipment running times needed to accomplish each alternative. Equipment running time is related to sediment volume because removing larger amounts of sediment takes longer than removing less sediment. The estimates are not intended as a precise calculation of the emissions associated with this project because the full design and contracting information is not available at the feasibility phase, and therefore precise data inputs (such as the number of pieces of equipment and final sediment volumes) are not available. This assessment serves as a means for reasonably comparing the alternatives based on estimated data and experience from previous dredging projects. The area of analysis for this section is limited to the greater Puget Sound airshed, which contains the U.S. portions of the Georgia Basin/Puget Sound international airshed. This area was chosen because it is the same geographical boundary used by the Puget Sound Maritime Emissions Inventory (2018) and allows for comparisons with past emissions inventories. In addition, this area of analysis is more closely aligned with the economic analysis, which accounts for at-sea transportation cost savings but on the portion of costs as determined by Tacoma Harbor's total cargo share on each vessel. There would potentially be greenhouse gas emission reductions beyond the Tacoma Harbor study area; however, this would only be a percentage due to actions taken by other Ports that are not within the scope of this study.

Some Federal agencies have proposed GHG emission thresholds; for example, the Federal Energy Regulatory Commission proposed a threshold of 100,000 metric tons per year of CO_2 equivalent for projects. However, there are currently no Federal GHG emission thresholds that apply to the proposed project. Therefore, the USACE has analyzed anticipated direct and indirect GHG emissions for each alternative.

4.8.1 Alternative 1 – No-Action Alternative/Future Without-Project Conditions

Under the No-Action Alternative, the Corps would undertake no deepening activities; O&M dredging would continue as usual in the Blair Waterway on a very infrequent basis, and the Port would continue to maintain its berths and areas adjacent to the Federal navigation channel. No effects from deepening construction would occur under the No-Action Alternative.

4.8.2 Alternative 2 – Blair Waterway Deepening to -58 MLLW

A short-term impact of dredging the Blair Waterway to -58 MLLW with associated widening would be the generation of 29,335 tons of CO_2 equivalent total if all suitable material is taken to the Commencement Bay open-water disposal site (Table 4-14). Building the full Saltchuk design in addition to deepening the Blair Waterway to -58 MLLW with associated widening would generate 34,458 tons of CO_2 equivalent during construction over four work seasons. Methane (39.7 tons) is also produced, and although fewer tons of methane are generated and it is a shorter-lived GHG than CO_2, it has a greater warming influence than CO_2. Statewide GHG emissions produced from fossil fuel combustion in Washington's transportation sector in 2018 were estimated at 44.73 million metric tons CO_2 equivalent (Ecology 2021). Assuming statewide GHG emissions are constant in the near future, the direct annual GHG emissions from Alternative 2 (with Saltchuk) would be approximately 0.069% of the total statewide annual GHG emissions in the transportation sector. In addition, long-term GHG emissions in Washington State would be reduced based on the reduction in total vessel calls as a result of the alternative.

Table 4-14 Total Greenhouse Gas Emissions to Construct Alternative 2.

Greenhouse Gas	Estimated emissions in tons CO_2 equivalent **without** Saltchuk	Estimated emissions in tons CO_2 equivalent **with** Saltchuk
*Carbon Dioxide (CO_2)	29,294	34,410.9
**Methane (CH_4)	39.7	47.4
TOTAL GHG Emissions	29,334.7	34,458.3

*Estimate for CO_2 includes emissions for all work elements (dredge, tug, and upland disposal)

**Estimate for CH_4 includes emissions for dredge and associated equipment only.

GHG emissions due to O&M activities were not estimated because they are constant among all alternatives. Dredging events associated with O&M are estimated to be needed once per 25 years. The volume of dredged material generated during O&M dredging under the NED would be similar to the No-Action Alternative. Associated O&M GHG emissions would likewise be similar. The magnitude of GHG emissions associated with O&M activities is likely much smaller than emissions associated with regularly occurring port activities. In the long-term (after 2035), GHG emissions reductions achieved under the NED (inclusive of both dredging, placement in Saltchuk, and ongoing maintenance) would most likely result in a net GHG emission reduction when compared with the GHG emissions produced by the No-Action Alternative (inclusive of emissions associated with maintenance activities only) due to the 27% reduction in vessel traffic by 2035; this is considered a countervailing effect in the analysis of cumulative effects. Compared to the total GHG emissions in the Washington State transportation sector and global emissions, the minor contribution of the proposed dredging and Saltchuk construction would not constitute a measurable or meaningful effect to GHG emissions contributing to anthropogenic causes of climate change and sea level rise.

4.8.3 Alternative 2a – Blair Waterway Deepening through Husky Terminal to -58 MLLW

A direct impact of dredging the Blair Waterway through Husky Terminal would be the generation of 6,670 tons of CO_2 equivalent if all suitable material is taken to the Commencement Bay open-water disposal site (Table 4-15). There is not enough material to build the full Saltchuk design, so less than approximately 5,000 tons of CO2 equivalent would be generated to build only the three Saltchuk benches.

Table 4-15 Greenhouse Gas Emissions to Construct Alternative 2a.

Greenhouse Gas	Estimated emissions in tons CO_2 equivalent **without** Saltchuk
Carbon Dioxide (CO_{2e})	6,660.2
Methane (CH_4)	8.8
TOTAL GHG Emissions	6,670.1

Assuming statewide GHG emissions are constant in the near future, the direct annual GHG emissions from Alternative 2a would be approximately 0.01% of the total statewide annual GHG emissions in the transportation sector. Compared to the global emissions measured at nearly 7,000 million metric tons in 2014 (EPA 2016), the proposed dredging is a minor contribution. The number of vessels each year would be reduced, although to a lesser degree compared to Alternative 2.

4.8.4 Alternative 2b – Blair Waterway Deepening to -57 MLLW (NED Plan/Preferred Alternative)

A direct impact of dredging the Blair Waterway to -58 MLLW with associated widening would be the generation of 25,865 tons of CO_2 equivalent if all suitable material is taken to the Commencement Bay open-water disposal site (Table 4-14). Building the full Saltchuk design would generate 31,232 tons of CO_2 equivalent.

Table 4-16 Greenhouse Gas Emissions to Construct the NED Alternative.

Greenhouse Gas	Estimated emissions in tons CO_2 equivalent **without** Saltchuk	Estimated emissions in tons CO_2 equivalent **with** Saltchuk
Carbon Dioxide (CO_{2e})	25,829.4	31,188.8
Methane (CH_4)	35.8	43
TOTAL GHG Emissions	25,864.6	31,231.8

Assuming statewide GHG emissions are constant in the near future, the direct annual GHG emissions from Alternative 2b would be approximately 0.06% of the total statewide annual GHG emissions in the transportation sector. Compared to the global emissions measured at nearly 7,000 million metric tons in 2014 (EPA 2016), the proposed dredging's minor contribution would not constitute a measurable or substantial effect among the impacts of climate change and sea level rise and is considered a minor impact. In addition, long-term GHG emissions would decline because annual vessels are projected to change from 590 to 428.

Compared to the total GHG emissions in Washington State and global emissions, the minor contribution of the proposed dredging and full placement of material in Saltchuk would not constitute a measurable or meaningful effect to GHG emissions contributing to anthropogenic causes of climate change and sea level rise.

4.8.5 Cumulative Effects to Greenhouse Gas Emissions

A long-term net reduction in greenhouse gas emissions is expected by 2035, which is when the project benefit of reducing the total number of vessels using Blair Waterway is fully realized (Section 4.3).

4.9 Sea Level Change

Sea level change (SLC) is an uncertainty, with the potential for increasing the frequency of extreme water levels. Planning guidance in ER 1100-2-8162 (USACE 2013) incorporates new information, including projections by the Intergovernmental Panel on Climate Change and the National Research Council (IPCC 2007; NRC 2012). The ER (USACE 2013) requires that projects be evaluated to determine how sensitive they are to SLC's various scenarios. Because predictions of SLC have uncertainty, the risks associated with three SLC scenarios are addressed. These scenarios are termed low, intermediate, and high, and they correspond to different rates of global sea level acceleration starting from the year 1992. Historically, this global (eustatic) sea level rise rate has been approximately 0.07 inches per year.

Table 4-17 Predicted Sea level change in feet. Base Year and Economic Life Cycle Year Are in Bold.

Year	Low	Int	High
1992	0	0	0
2027	0.24	0.35	0.69
2030	0.26	0.39	0.79
2035	0.29	0.46	0.98
2040	0.32	0.53	1.18
2045	0.36	0.61	1.4
2050	0.39	0.69	1.64
2055	0.43	0.78	1.9
2060	0.46	0.87	2.17
2065	0.49	0.97	2.47
2070	0.53	1.07	2.78
2075	0.56	1.17	3.12

Year	Low	Int	High
2077	0.57	1.22	3.25
2080	0.6	1.28	3.47
2085	0.63	1.4	3.84
2090	0.66	1.52	4.22
2095	0.7	1.64	4.63
2100	0.73	1.77	5.05
2105	0.76	1.9	5.5
2110	0.8	2.04	5.96
2115	0.83	2.18	6.44
2120	0.87	2.32	6.94
2125	0.9	2.47	7.46
2127	0.91	2.53	7.67

Locally, SLC varies geographically as it is the difference between the global SLC (0.067 inches/year according to IPCC 2007) and local vertical land movement. The accuracy of local mean sea level rates is a function of the period of record of the water level time series. ER 1100-2-8162 recommends that a NOAA water level station should be used with a period of record of at least 40 years. At 50 years, the predicted sea level rise at the project ranges from 0.6 to 3.47 feet.

The project footprint of Blair Waterway contains no crossing bridges; thus, clearances are not a concern. The biggest potential risk associated with SLC is inundation to LSFs, including piers, sea cranes, and utilities serving the berthing areas. All LSFs will be impacted by SLC equally for each alternative. Impacts are assessed using statistics from historical water levels combined with the predicted SLC scenarios. The 99% annual exceedance probability (AEP; or 1-year return period) of the measured total water level (TWL) at the Seattle tide gauge is added to each SLC scenario. If SLC, coupled with the 99% AEP total water level exceeds the deck height for any given terminal, it is assumed to be in a condition that would require significant structural modifications. Table 4-18 indicates the deck height of the terminals is high enough to avoid inundation for all scenarios with the exception of the 2127 High SLC scenario. This indicates a low overall risk to the LSF at the project over the 50-year economic horizon but moderate risk over the 100-year planning horizon. Major structural and utility modifications or relocations would be required to minimize these vulnerabilities. According to data presented in Table 4-17 and Table 4-18, the point where these consequences may begin to be felt is the year 2100, when the high SLC plus TWL would be 17.87 MLLW, exceeding TOTE Maritime's terminal deck height of 17.5 MLLW.

Table 4-18 Deck Height of Terminals with Inundation Scenarios.

Deck height of each	**Deck Height (feet, MLLW)**	**2077 Low/High SLC + 1-year TWL[1] (feet MLLW)**	**2127 Low/High SLC + 1-year TWL[1] (feet MLLW)**
HUSKY	18.0		
TOTE	17.5		
WUT	21.0	13.4 / 16.1	13.7 / 20.5
PCT	22.0		
EB1	21.5		

[1] 1-year TWL (99% Annual Exceedance Probability) is 12.82 MLLW (NOAA 2015)

Independent shoaling and SLC analysis was performed to validate the Recommended Plan as presented in Section 5 and to determine the need and frequency of maintenance dredging. Per Corps guidance, three SLC scenarios, low, intermediate, and high, are considered when projecting into the future. These levels were compared to the expected shoaling, and a net depth gain or loss is established (details on the SLC and shoaling calculations can be found in Appendix B, Engineering). The analysis resulted in SLC slightly outpacing shoaling, which translates into the channel increasing in depth in all but the low SLC scenarios. However, the increase in channel depth is minimal and negates the possibility of dredging to a shallower depth while still realizing the necessary navigation benefits. Given these results and the uncertainties in projecting future conditions, maintenance dredging is included every 25 years as part of this project.

4.9.1 Alternative 1 – No-Action Alternative/Future Without-Project Conditions

The shoaling analysis revealed the sedimentation rate in the waterway to be minimal; SLC is expected to increase the navigable depth over time and reduce the amount of O&M dredging required to maintain the authorized depths. Appendix B (Engineering) describes the predicted shoaling rate in the waterway in more detail. However, the SLC amount would not significantly improve the conditions enough to achieve project objectives under Alternative 1. The limiting depth in the Blair Waterway is currently -51 MLLW. The predicted rates anticipated the average infill over the 50-year project life in the waterway to be less than the predicted SLC, even the 'low' scenario. This increase in navigable depth would range between approximately 0 and 3 feet over the 50-year project life cycle and would have no effect on maintenance of the navigation channel under the No-Action alternative.

4.9.2 Alternative 2 – Blair Waterway Deepening to -58 MLLW

SLC and the shoaling analysis in Appendix B suggest that O&M dredging frequency could be reduced under Alternative 2 (deepening to -58 MLLW). As sea level rises at a faster rate than shoaling occurs, navigable depths will be maintained longer. In addition, although slope stabilization measures may be necessary for four locations, as outlined in Section 3.3.4, no effects from SLC are expected with these measures. Therefore, minimal impacts from SLC are expected under Alternative 2.

4.9.3 Alternative 2a – Blair Waterway Deepening through Husky Terminal to -58 MLLW

As described in Alternative 2, SLC and the shoaling analysis in Appendix B suggest that O&M dredging frequency could be reduced under Alternative 2a. As sea level rises at a faster rate than shoaling occurs, navigable depths will be maintained longer. Therefore, minor impacts from SLC are expected under Alternative 2a.

4.9.4 Alternative 2b – Blair Waterway Deepening to -57 MLLW (NED Plan/Preferred Alternative)

As described in Alternative 2, SLC and the shoaling analysis in Appendix B suggest that O&M dredging frequency could be reduced. As sea level rises at a faster rate than shoaling occurs, navigable depths will be maintained longer. In addition, although slope stabilization measures may be necessary for four locations, as outlined in Section 3.3.4, no effects from SLC are expected from these measures. Therefore, minor impacts from SLC are expected under Alternative 2b.

4.9.5 Cumulative Effects to Sea Level Change

The Corps has not identified any cumulative effects associated with SLC in the implementation of these alternatives. SLC will affect mainly those LSFs whose deck height lies below the predicted SLC elevations, with issues being forecast to start occurring around the year 2100.

4.10 Hazardous, Toxic, and Radioactive Waste

This section summarizes areas of known or suspected contamination in the study area. Given the highly industrialized nature of Commencement Bay and Blair Waterway, numerous cleanup sites under state and Federal oversight lie immediately adjacent to Blair Waterway. There are 43 MTCA sites surrounding Blair Waterway, along with 6 RCRA sites, 4 NPL sites, and 4 CERCLA sites (a subset of NPL). Fifteen of these sites have known contaminated groundwater and are located immediately next to Blair Waterway. An additional five sites are located one block further away from Blair. Two of the NPL sites listed, Commencement Bay Nearshore Tideflats and Glenn Springs Holdings, are among the contaminated groundwater sites immediately next to, but not overlapping, Blair Waterway.

The most notable HTRW site within the study boundary is the Commencement Bay Nearshore Tideflats Superfund Site, placed on the NPL in 1981. The ROD for the site was issued in September 1989. Blair Waterway was originally included as a component of the Superfund Site. The Operable Units (OUs) associated with Blair Waterway include the Commencement Bay/Nearshore Tideflats Sediments OU (OU1) and the Commencement Bay/Nearshore Tideflats Source OU (OU5). The EPA issued a partial deletion in 1996 pertaining to the portions of the two separate OUs addressing sediments contained in and certain properties draining to the Blair Waterway (EPA 2014). As such, no further Federal action is required for remediation of sediments or associated sources to Blair Waterway. Coordination with the EPA during the feasibility study has confirmed that disposal of dredged materials with known low levels of contamination within the Blair Waterway can be appropriately managed through the standard best management practices for navigation dredging with unsuitable material (see Appendix D for compliance documentation). Additional HTRW sites are discussed in Section 4.10.2 due to their proximity or overlap with the footprint for Alternative 2 (see Appendix H for maps of identified HTRW sites). There are no HTRW sites that overlap with Saltchuk.

Under all alternatives, during the Preconstruction Engineering and Design Phase of the project, USACE will conduct a full sampling and characterization of the project footprint. The DMMP will review the sediment sampling following DMMP guidelines for a suitability determination associated with disposal of dredged material. Given the current numerous state and Federal cleanup sites and current remedies in place, the sampling plan will have an independent review conducted by the Environmental and Munitions Center of Expertise (CEHNC) to advise that the plan is adequate and accounts for potential sources of environmental risk or liability from areas impacted by the project footprint. Upon receipt of the sampling data, and prior to a determination by the DMMP, USACE will engage EPA Region 10 and the Toxics Cleanup Program at Washington Department of Ecology to review the sampling results and the Commencement Bay Nearshore Tideflats Superfund project and other areas impacted by the footprint of the project. If the regulatory agencies determine that these results warrant further investigation or remedial response under CERCLA or other applicable Federal or State environmental laws, those activities would be a responsibility of the non-Federal sponsor and would be coordinated with, and subject to the approval of, EPA or other regulatory agency. Should a regulatory agency make such a decision, the non-Federal sponsor will be fully responsible for coordinating those efforts prior to USACE proceeding with the navigation project.

4.10.1 Alternative 1 – No-Action Alternative/Future Without-Project Conditions

In the future without-project condition where no action is taken, sites surrounding the Blair Waterway and under Washington State cleanup programs designation will likely proceed. Blair Waterway has no anticipated future Federal cleanup actions.

4.10.2 Alternative 2 – Blair Waterway Deepening to -58 MLLW

A Phase I Environmental Site Assessment documents potential impacts to known or suspected sources of environmental risk or liability on the proposed project site, and in the surrounding areas in accordance with ASTM Standard D6008, Standard Practice for Conducting Environmental Baseline Surveys (2014; see Appendix H). To inform potential impacts of alternatives, the maximum proposed dimension of channel improvements (Alternative 2) was evaluated as a conservative scenario to identify the maximum potential for any conflict between the project footprint and HTRW.

Separate from the Commencement Bay/Nearshore Tideflats Superfund action, an EPA regulated Time Critical Removal Action at Pier 4 (aka Husky Terminal) occurred in 2015 to remove TBT contaminated sediments. The Port dredged approximately 71,000 CY of TBT contaminated sediment from the site under the EPA's direction. Construction was completed in 2016. All contaminated sediments were removed, and no additional action was required (Floyd Snider 2016).

Other cleanup actions in the uplands have occurred adjacent to the waterway (Figure 4.4), including the Occidental Chemical Corporation Site, a historic chemical manufacturing facility. The site is managed under RCRA by both the Washington Department of Ecology and EPA. Chlorinated VOCs, hexachlorobenzene, PCBs, and metals in soil and groundwater contaminate the site. Ecology manages the site, and in October 2018, finalized a Feasibility Study. While impacted soils and groundwater do not directly overlap with the Blair Waterway project footprint, the cleanup site is notable given its size and the degree of contamination (Ecology 2019c). Additional evaluation will be conducted during PED to confirm the assessment based on the feasibility level design that the proposed Federal action in the Blair Waterway will not affect the existing preferential flow of the contaminated groundwater plume (Section **5.9.3.**). Should potential impacts to groundwater be elucidated, or potential impacts to the project be identified from the Occidental Chemical Corporation Site, additional Phase II investigations may be necessary and additional engineering analysis and coordination with the regulatory agencies and non-Federal sponsor will be needed in PED phase to address the concern.

TruGrit Abrasives Incorporated is another site located along Blair Waterway and managed by the Department of Ecology under the MTCA program for upland soils and sediment contaminated with metals. The study is in the feasibility phase. The shoreline bounds the metal contamination in the sediment and does not overlap with the proposed navigation channel. During PED, further analysis and confirmation of the design will be conducted to ensure that any proposed side slope stabilization measures do not intersect with the site (Ecology 2019c). If potential impacts to the deepening project are identified from the TruGrit Abrasives Site, additional Phase II investigations may be necessary.

Additional coordination with Washington Department of Ecology and the EPA is needed for the Occidental Chemical Corporation site (RCRA) and TruGrit Abrasives site (MTCA) to ensure there is no overlap or associated impacts at these HTRW sites resulting from the implementation of the Recommended Plan. At this time, preliminary investigations suggest these two HTRW sites will not be of concern but should be confirmed as the design progresses. If it is determined that these sites are of concern, supplemental investigation (separate from an Environmental Site Assessment and including a Phase II assessment if needed), in this area may be warranted.

Remediation at the Former Lincoln Avenue Ditch site occurred between 1992 and 1994 under the EPA's Puyallup Land Transfer Consent Decree (see Appendix H for map). As part of that remediation, institutional controls are in place due to contamination remaining in place along the shoreline below elevation +12 MLLW and extending approximately 30 feet water-ward from the bank's top. These institutional controls set limitations on any future construction and uncontrolled release of contaminated materials resulting from the construction. Soil and sediments contaminated with arsenic, dioxin, and PCBs above relevant MTCA thresholds are present. This location overlaps with areas identified as potentially needing additional side slope stabilization associated with the proposed navigation channel. This location corresponds to Site 2 (STA 74+50.00 to STA 82+00.00) as described in Section 3.3.4. Given this overlap and institutional controls' presence, further coordination with the EPA will be required during PED (Ecology 2019c). Per ER 1165-2-132, Hazardous, Toxic, and Radioactive Waste (HTRW) Guidance for Civil Works Projects, "construction of Civil Works projects in HTRW-contaminated areas should be avoided where practicable…Where HTRW contaminated areas or impacts cannot be avoided, response actions must be acceptable to EPA and the applicable state regulatory agencies." The potential for additional slope stability measures is identified at the Lincoln Avenue Ditch as the result of the feasibility-level ship simulation investigation and associated geotechnical evaluations. Design compatibility needs additional consideration in PED after full ship simulation, to ensure the identified engineering solution for slope stability measures also ensure complete avoidance of disturbing HTRW material. The design for additional side slope stabilization measures at this location will also have to consider potential groundwater impacts, particularly related to any changes in the flow regime. Additional investigations conducted under a Phase II Environmental Site Assessment are needed to delineate the nature and extent of contamination at the Former Lincoln Ave Ditch Site as it relates to the deepening study. Given the length of time since completion of the remedial action in this area, contamination remaining in place, and uncertainty related to nature and extent, a Phase II assessment is considered necessary. These investigations are needed for both sediment and groundwater. Sediment testing may also confirm if contamination has the potential for migration. Should additional coordination during PED with EPA include availability of new data or design modifications that fully avoid Lincoln Avenue Ditch, a Phase II may not be warranted.

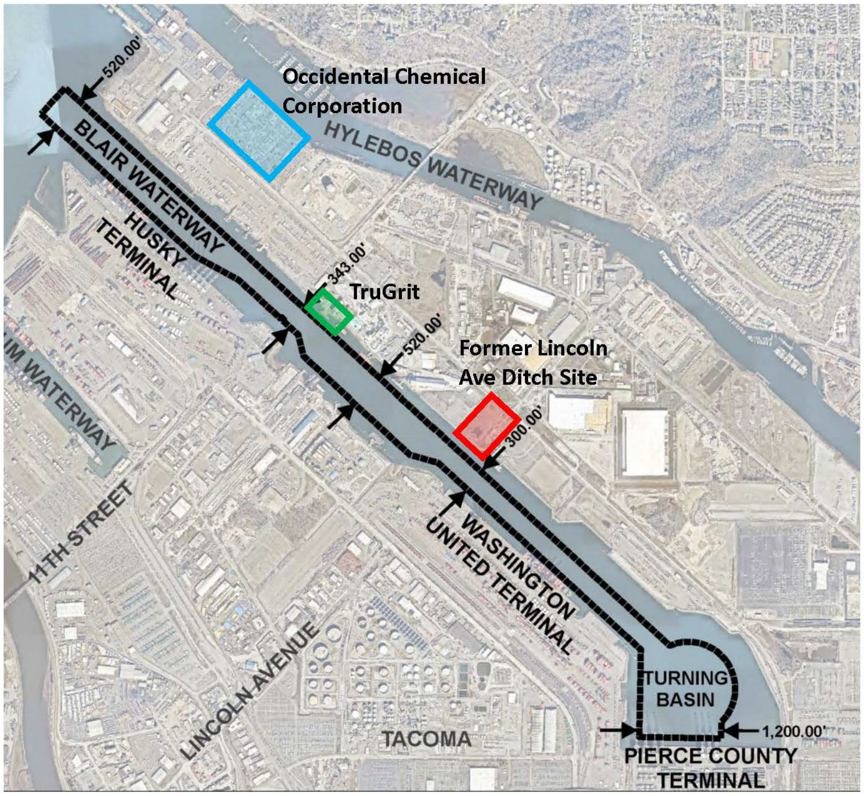


Figure 4.4. General Location for Occidental, TruGrit, and Lincoln Avenue Adjacent to Blair Waterway.

For disposal of dredged material, sediment suitable for open-water disposal can go to the Commencement Bay Unconfined Open-Water Disposal Site or the Saltchuk Beneficial Use Site. Costs for upland disposal of contaminated sediments at a permitted waste disposal facility would be a non-Federal expense. An analysis of HTRW did not occur because pre-established programs regulate and manage the Commencement Bay Disposal Site and upland facility. For the Saltchuk Beneficial Use Site, a Phase I Environmental Site Assessment did not identify any known or suspected areas of contamination immediately within the project footprint. Crow's Nest Marina, immediately west of the project site, is undergoing a State-led MTCA cleanup for contaminated soil and groundwater, but the extent of contamination does not overlap with the study area (Ecology 2019c). While the Saltchuk Beneficial Use Site is within the Nearshore Area Boundary of the NPL, there is no Superfund action in or around the Saltchuk site because there is no identified presence of contaminants that pose a risk to human health or the environment.

As it relates to HTRW, slope stabilization at Site 2 (see Section 3.3.4.) has the most potential to overlap with existing contamination that remains in place as part of the remedial action efforts conducted at the Former Lincoln Avenue Ditch site. As such, the Phase I Environmental Site Assessment (Appendix H) recommends a Phase II Environmental Site Assessment be conducted during PED to better understand the potential for overlap (Section 5.9.3). Should contamination overlap with the footprint for slope stabilization in this area, the non-Federal sponsor will be responsible for remediation of the contamination prior to construction. Experts from the Environmental and Munitions Center of Expertise will be engaged to advise on site assessments and sampling during PED that is carried out to determine the extent of contamination or the potential for impact to existing CERCLA remedies, including the coordination with US EPA regarding the DMMP sampling data and any Phase II site assessments.

4.10.3 Alternative 2a – Blair Waterway Deepening through Husky Terminal to -58 MLLW

For Alternative 2a, one former HTRW site within the project footprint is the Time Critical Removal Action at Pier 4 (aka Husky Terminal) conducted in 2015 to remove TBT contaminated sediments. This action is complete, and no remaining HTRW is present in the study area (Floyd Snider 2016). As mentioned previously for Alternative 2, Occidental Chemical Corporation is also adjacent to the study area but does not overlap with the navigation deepening.

Disposal options for this alternative are the same as for Alternative 2 but would have less total quantity of material available for beneficial use if that measure were implemented.

4.10.4 Alternative 2b – Blair Waterway Deepening to -57 MLLW (NED Plan/Preferred Alternative)

For purposes of HTRW, the NED Plan does not vary notably from Alternative 2 at -58 MLLW as it relates to potential impacts to areas of known or suspected contamination. As such, the impacts described for Alternative 2 at -58 MLLW are similar to the NED Plan at -57 MLLW. The same considerations for design, specifically side slopes associated with the Former Lincoln Avenue Ditch site, will need to be incorporated in future design phases of the NED Plan.

For disposal, the base plan for material suitable for open-water disposal is Commencement Bay Unconfined Open-Water Disposal Site. An analysis of HTRW did not occur for the Commencement Bay Unconfined Open-Water Disposal Site because this area is managed and monitoring through the Dredged Material Management Program (DMMP) with an existing programmatic EIS and 2015 Biological Evaluation. Any materials not suitable for open-water disposal will go to a regulated upland facility.

4.10.5 Cumulative Effects to Hazardous, Toxic, and Radioactive Waste

Previous efforts through Federal and State cleanup actions have managed a majority of known contaminants in the immediate project footprint. While dredging does cause temporary re-suspension of sediments with associated contaminants, sediments in the study area will be evaluated during PED to ensure they do not have chemical concentrations warranting federal or state regulatory action. Results of the DMMP suitability sampling will be coordinated through EPA Region 10 and the Toxics Cleanup Program at Washington Department of Ecology to determine if any results warrant regulatory action. Dredging Best Management Practices, including required water quality monitoring, help to manage the magnitude and extent of sediment re-suspension. Any sediments that are dredged and contain contamination that is determined unsuitable for open water disposal under DMMP guidelines will be disposed at an appropriate upland disposal facility. Costs for upland disposal of contaminated sediments at a permitted waste disposal facility would be a non-federal expense.

4.11 Benthic Organisms

Several factors determine the benthic invertebrate community, including small animals such as crustaceans, shellfish, worms, and insects that dwell in the sediment of estuarine and marine habitats. Factors that influence this community are primarily the substrate, period of inundation, salinity, and energy in the form of currents and wave action. The area where work is proposed, also known as the affected environment, is at the bottom of the Blair Waterway channel. The habitat classification is estuarine intertidal (Dethier 2014). Due to extensive dredging to create this navigable channel and Commencement Bay development, the estuarine habitat of the Blair Waterway is much deeper (-51 MLLW) than an average estuary. The average speed of water currents is 0.16 feet per second at the mouth to 0.32 feet per second at the head of the waterway during all tidal phases (Appendix B, Engineering). Within the Blair Waterway, the sediment in the top two feet of the substrate is 24-90% sand (median 72%), and fine material content was 3.8-76% (median 27.5%; DMMP 2019).

The benthic invertebrate community in Blair Waterway has a high proportion of pollution-tolerant species (Partridge et al. 2010). Since 1999, the Blair Waterway benthic community has been described as adversely affected by natural or human stressors compared to the greater Puget Sound due to extremely low arthropod abundance, low species diversity, and high numbers of mostly stress-tolerant polychaetes (marine worms; Partridge et al. 2010). Benthic samples collected in 1999, 2008, and 2014 all had mollusks and arthropods, but bivalves (clams) and polychaetes were most abundant (Weakland et al. 2016). One aspect of the Blair Waterway habitat that likely leads to lower population diversity of crabs and shellfish compared to other more natural estuaries is the frequent propeller wash of the large ships transiting the waterways. These ships often have little clearance beneath their hulls and propellers that cause frequent disturbance of the benthic sediments, as evidenced by turbidity generated as the largest ships transit the waterway.

Initial recommendations on the average percent likelihood of dredged material suitability for beneficial use at the Saltchuk site are included in the DMMP (2019) advisory memorandum (Appendix B Engineering). The purpose of beneficial use of dredged material is to create shallow, nearshore habitat suitable for close contact with sensitive species and with a healthy prey supply for juvenile salmonids. Therefore, the study team assumes that dredged material that is not appropriate for beneficial use is also not ideal for benthic invertebrates. The material was considered suitable for beneficial use if it was below Washington State's Sediment Quality Standards (WAC 173-204-320), had less than 2,000 µg/kg PAH (NMFS 2014) had dioxin less than four parts per trillion toxicity equivalence. According to advisory-level sampling in 2019, 85% of the mouth, 40% of the middle, 100% of the head, and 95% of native material (below approximately -53 MLLW) was estimated likely to be appropriate for beneficial use (DMMP 2019).

The epibenthic invertebrate community at the substrate's surface is mostly copepods and amphipods that feed on detritus and plants (Dames and Moore 1981). Browns Point had the highest number and diversity of epibenthic species in Commencement Bay compared to the waterways. Within the Blair Waterway, a seasonal shift in the number of epibenthic organisms has been observed where the highest abundance is in April, and the lowest is in November (Dames and Moore 1981).

Benthic invertebrates typically occupy the top few millimeters of sediment; therefore, differing dredging quantities among the alternatives do not make a substantial difference in the numbers of organisms lost to dredging. The total surface area of disturbance for each alternative provides the best parameter to compare the alternatives' environmental effects to benthic organisms. Benthic organisms are included in the Essential Fish Habitat (EFH) analysis in accordance with the Magnuson-Stevens Act (Section 6.9).

4.11.1 Alternative 1 – No-action Alternative/Future Without-Project Conditions

Under the No-Action Alternative, the benthic community would not be disturbed by dredging. However, turbidity can sometimes be seen when the largest ships transit Blair Waterway because strong prop wash (i.e., the turbidity of sediments stirred up from ship propellers) is generated when ships are maneuvered within the confines of the channel. Prop wash that disrupts the substrate likely disturbs the benthic community as well. This disturbance is likely to continue and could increase under the No-Action Alternative as more ships continue to use Blair Waterway. In addition, sediment that is unsuitable for open-water disposal would not be removed under the No-Action Alternative, so the current condition of minimum to low chemical exposure would continue (Weakland et al. 2016). Beneficial use of dredged material would not occur at the Saltchuk site under the No-Action Alternative, and wood waste would not be capped. Ecology (2013) describes three main issues that excess wood waste can have on the benthic environment: 1) the physical presence of wood waste, which prevents biota from thriving and recruiting in and on the native, healthy substrate; 2) decreased dissolved oxygen due to microbial decomposition, which can create an unhealthy or toxic environment for biota, and; 3) decomposition by-products such as sulfides, ammonia, and phenols, which can cause or contribute to toxicity. The current condition of wood waste deposits would persist at Saltchuk, but the Port may pursue similar restoration actions that would benefit juvenile salmonids. The No-Action Alternative would not constitute more than a minor impact to benthic invertebrates based on the above analysis.

4.11.2 Alternative 2 – Blair Waterway Deepening to -58 MLLW

Alternative 2 would disrupt the benthic community by dredging the full length and width of the Blair Waterway. Mortality and displacement of benthic invertebrates from the top few millimeters of sediment over 214.5 acres would be expected as sediment is removed from the waterway. The dredging would take about four years to complete. The project's duration is partly due to the limitation of the in-water work window of August 16 through February 15. Therefore, the areas in which the benthic organisms are eliminated would not be the total surface area in a single dredging event. In each year, approximately one quarter to one third of the total benthic area of similar habitat in the waterways would be dredged. This would allow organisms to migrate from undisturbed areas into the deepened segments after dredging. In addition, the resulting native material would likely have fewer contaminants and may result in a more diverse community after benthic organisms recolonize areas disturbed by dredging.

Mobile organisms such as crabs and shrimp would be able to move out of the way of the descending clamshell bucket and escape the area of active dredging. However, the more sessile (immobile) organisms such as bivalves would not survive due to lack of ability to escape. Juvenile crab stages would be unable to escape, but the non-native loam to silt-loam material is not their preferred substrate, and lack of submerged vegetation make it unlikely for the Blair Waterway to be a nursery area with juvenile crab. Clamshell dredges have been shown to have a 10% mortality rate of all crabs captured by the bucket during dredging in a study in Grays Harbor, Washington (Stevens 1981). The rate of entrainment for this method depends on the density of crabs present in the dredging area. Commercially important species such as Dungeness, red rock crabs, and shrimp are not harvested in the Blair Waterway itself, and only approximately one-third of the waterway would be dredged at a time. Local shellfish harvest schedules at the mouth of the Blair Waterway and Saltchuk would be considered by coordinating with the Puyallup Tribe when scheduling construction to avoid affecting fishers. Given the low mortality rate of entrained crab, the physical effects of dredging would not impact reproduction or harvest rates outside of the Blair Waterway.

While dredging typically causes short-term loss of non-mobile benthic invertebrates and a temporary reduction in abundance and diversity, many of these areas become recolonized by benthic fauna that moves in from neighboring habitat (McCauley et al. 1977; Richardson et al. 1977). Several studies have demonstrated that benthic organisms rapidly recolonize habitats disturbed by dredging and dredged materials disposal and return these habitats to reference conditions (Wilber and Clarke 2007; Ponti et al. 2009). Recovery begins with the early colonizers and takes less than a year for the short-lived organisms with rapid growth and re-population strategies, followed by the longer-lived species that grow larger but have a slower recovery time of two to three years (Newell et al. 1998). This suggests that full recovery of a site may take years; however, O&M dredging will only be necessary about every 25 years, so the community is expected to recover fully between these dredge events. The benthic assemblage's abundance and diversity are expected to recover and become similar to those of the nearby benthic community in approximately three to five years (Newell et al. 1998).

Placement of dredged material at the Saltchuk site would cause the mortality of invertebrates present where the bulk of material lands. Larger organisms, such as crabs, would generally be able to flee the area. Sediments would be a similar type and coarseness as some already present in the nearshore sites. Other areas with wood waste or fine material would be covered by native material. The depth of the total habitat area available would be reduced to provide shallow water habitat for juvenile salmonids. In a relatively short period, organisms would reestablish in the placement area due to recruitment from adjacent non-disturbed areas. Based on these factors, effects on benthic invertebrate populations and their habitat due to dredging and one-time material placement at Saltchuk would be minor.

Construction of Saltchuk would be an overall benefit to benthic organisms. Ecology (2013) describes three main issues that excess wood waste can have on the benthic environment: 1) the physical presence of wood waste, which prevents biota (i.e., benthic organisms) from thriving and recruiting in and on the native, healthy substrate; 2) decreased dissolved oxygen due to microbial decomposition, which can create an unhealthy or toxic environment for biota, and; 3) decomposition by-products such as sulfides, ammonia, and phenols, which can cause or contribute to toxicity. Capping the wood waste with native material may initially harm habitat during early consolidation because benthic invertebrates in and on the sediment would be exposed to the pore water forced upwards from the wood waste below. Depending on the capping material's nature and the wood waste being capped, this may be a transient, short-lived effect. Effects of pore water being forced upward are expected to be limited because about 90% of the wood waste is in the DZ, where a thicker layer of sediment (10 to 20 feet thick) would be placed. This is compared to the LSZ, which only has about 10% of the wood waste, and the dredged material would be 5 to 10 feet thick.

Because some of the dredged sediments are unsuitable for aquatic disposal, it is important to consider whether re-suspension of this material and its contaminants would cause biological effects to the benthic community. Assuming the standard 3% rate of re-suspension (AECOM 2012), approximately 13,000 CY of material would be re-suspended during construction. As stated above, different amounts of the mouth (85%), middle (40%), head (100%), and native material (all material below approximately -53 MLLW; 95% overall) are likely to be appropriate for beneficial use (DMMP 2019). Only a portion of this amount would consist of re-suspended material that is not suitable for beneficial use. While exact quantities are not available, the level of risk of harm to benthic invertebrates is estimated as low, given the low level of contamination in a minor fraction of the sediments to be dredged.

Side slopes that may have slope stabilization (Table 3-3) have existing riprap armoring in the intertidal and shallow subtidal areas (from about +10 to -3 MLLW), a slope of approximately 2H:1V, poor riparian vegetation conditions, and lack complex shoreline habitat. Construction of slope stabilization (Table 3-3) would cause mortality of benthic organisms in the immediate area and would result in temporary, localized turbidity increases when riprap or an engineered slope stabilization method such as a secant pile wall are placed. Mobile benthic organisms, such as crabs, would be able to move away from construction as each side slope section is stabilized. Slope stabilization measures in Table 3-3 would create a short-term loss of benthic organisms but would not substantially reduce long-term salmonid prey availability or composition due to existing slope stabilization and steep configuration that does not provide preferred foraging habitat for juvenile salmonids.

Fewer benthic invertebrates would be available as prey for other species such as fish and birds for about the first seven months after dredging, but this would be a short-term loss. It is unlikely that the temporary reduction in abundance and diversity would result in a measurable reduction in total prey items. In addition, the risk of re-suspended contaminants harming benthic invertebrates is low. Based on these factors, effects on benthic invertebrate populations and their habitat due to dredging and material placement would be minor.

4.11.3 Alternative 2a – Blair Waterway Deepening through Husky Terminal to -58 MLLW

Alternative 2a differs from Alternative 2 primarily by the area dredged. There would be 63.5 acres of the Blair Waterway dredged under Alternative 2a, compared to 214.5 acres dredged under Alternative 2. Slope stabilization measures would not be necessary. Mortality and displacement of benthic invertebrates would occur under Alternative 2a but to a lesser extent than Alternative 2. In addition, only 697,000 CY of dredged material (about 1,150,000 CY less than Alternative 2) would be available for beneficial use at Saltchuk, which does not provide enough dredged material for a best buy scenario that accomplishes beneficial use that could benefit benthic invertebrates. Given the benthic invertebrate community's ability to recover relatively quickly, it is unlikely that the reduction in abundance would result in a meaningful reduction in total prey items for birds and fish.

4.11.4 Alternative 2b – Blair Waterway Deepening to -57 MLLW (NED Plan/Preferred Alternative)

As stated above, surface area dredged is the key parameter to analyze rather than quantities for effect to benthic organisms. Alternative 2b will have similar effects as Alternative 2 because they differ primarily by dredging depth. Because mortality and displacement of benthic invertebrates are typically from the top few millimeters of sediment, the effects of Alternative 2 and Alternative 2b would be nearly indistinguishable, although the total area dredged would be slightly less. The effects of material placement at Saltchuk and potential slope stabilization measures would be the same as Alternative 2 for Alternative 2b. Based on the above analysis, this Alternative would not have a substantial effect on benthic invertebrates.

4.11.5 Cumulative Impacts on Benthic Organisms

The benthic community at the Blair Waterway depth range is not an important prey source to the federally protected species or other commercially important species present. Therefore, the effects on benthic organisms from dredging, which would only endure for up to three years after dredging is complete, are a minor impact on this ecosystem. Deepening may reduce disturbance to the benthic community that occurs when propellers of the largest ships move close to the substrate, but the deeper depths that are not the preferred feeding depths of juvenile salmonids will persist. Saltchuk construction would create a temporary and localized disturbance to the benthic community, which is expected to recover quickly and would not constitute a population-level effect. O&M dredging would likely occur on a 25-year cycle or less frequently as there is very little sediment input to the Blair Waterway. The benthic community would not be frequently disturbed. In addition, SLC may reduce the need for O&M dredging and would be much smaller than the area for deepening because the dredging would only target areas above the authorized depth; therefore, the benthic organisms would likely reach an equilibrium community condition between O&M dredging events. Because effects to benthic invertebrates would be minor and short-term, no cumulative effects would occur due to this proposed action.

4.12 Fish

The estuarine waters of Commencement Bay provide habitat for various fish species. For this analysis, fish are separated into two categories: resident marine/estuarine species and anadromous salmonid species.

Resident Marine/Estuarine Species

Marine and estuarine fishes in the area include three-spine stickleback, shiner perch, Pacific staghorn sculpin, Pacific tomcod, ratfish, copper rockfish, and snake prickleback and forage fish (Dames and Moore 1981). Flatfish such as sole species (English, rock, flathead, C-O, and sand sole), starry flounder, and speckled sanddab is very common throughout Commencement Bay in flat, sandy substrate. The most common waterways species are English sole, flathead sole, Pacific staghorn sculpin, Dover sole, ratfish, Pacific tomcod, and starry flounder (Dames and Moore 1981).

Forage fish present includes Pacific herring, surf smelt, and sand lance (Dames and Moore 1981). Pacific herring do not spawn in Commencement Bay. The closest pre-spawner holding area is outside of Commencement Bay at the south end of Vashon and Maury islands, but they are likely present within the Bay (Dames and Moore 1981; WDFW 2018). Forage fish are primarily pelagic and would be swimming through the area looking for food; sand lance burrows into the sandy substrate and remain from dusk to dawn. Forage fish larvae are ubiquitous in Puget Sound and are a common component of the nearshore plankton. There are limited spawning areas within Commencement Bay, but surf smelt spawning was observed in 2006 on either side of the Puyallup River and near Thea Foss waterway, while sand lance has spawned near the Puyallup River and the southwestern side of Commencement Bay (Figure 4-5). Spawning is much more extensive along Browns Point and outside the bay (Figure 4-5). Larvae and juveniles prey on epibenthic invertebrates and crustaceans and are themselves important prey for larger juvenile salmon and bull trout.

Eulachon are small fish that typically spend three to five years in offshore marine waters and return to glacial-fed rivers to spawn in late winter and early spring in tidal portions of the rivers. In Washington, they are present predominantly in the Columbia River. Eulachon is discussed in more detail in Section 4.14.

Forage Fish Spawning Map - Washington State

This map displays sand lance, smelt, herring spawning areas, herring pre-spawner holding areas, and the forage fish spawning survey beaches in Washington State.

Earthstar Geographics | Washington Department of Natural Resources, Aquatics Division | Washington Department of Fish and Wildlife | These data were collected by WDFW staff with contributions from the North Olympic Salmon Coalition and the Friends of the San Juans. | City of Tacoma CED, Esri, HERE, Garmin

Figure 4-4. Forage Fish Spawning Map within Commencement Bay (WDFW 2018).

Anadromous Salmonid Species to -58 MLLW

The Puyallup/White River watershed enters Puget Sound at Commencement Bay. Eight stocks of anadromous salmonids have been documented in the Puyallup River: winter steelhead, bull trout, coastal cutthroat trout, and spring/fall Chinook, fall chum, coho, sockeye, and odd-year pink salmon (Dames and Moore 1981; NWIFC 2019). These multiple migratory runs of native and hatchery-reared salmonid stocks occur seasonally in Commencement Bay. Rearing and foraging by juvenile salmonids occur along the limited shoreline areas that are shallow or retain natural structural diversity. Returning adult salmon congregate at the mouth of the Puyallup River prior to upstream migration. Juvenile salmonids may use the nearshore reaches in addition to Commencement Bay to transition into marine waters. Juvenile salmonids generally enter Commencement Bay January through August, with peak outmigration in May (Marks et al. 2018).

Feeding habitats of the juvenile salmon shift from the epibenthic zones to neritic (zooplankton) prey during downstream migration yet focus primarily on shallow-water habitats (Hiss and Boomer 1986). Juvenile Chinook, chum, and coho salmon in the Commencement Bay estuary feed primarily on epibenthic invertebrates such as copepods, amphipods, and aquatic insect larval and pupal stages. The juvenile salmon transition from epibenthic prey to pelagic prey (such as aquatic insects, chironomids, and planktonic prey) with growth (Meyer et al. 1981; Simenstad 2000). Steelhead diet contains more neomysid shrimp and transitions from insects to small fish with growth. Bull trout juveniles follow a similar feeding pattern on aquatic invertebrates such as stoneflies, caddisflies, and mayflies before transitioning primarily to fish (Marks et al. 2018).

At the head of the Blair Waterway, intermittent surveys from the 1970s to the 1990s found an extremely limited number of coho and fall chum salmon use and spawn in the lower reaches of Wapato Creek and its tributary, Simon’s Creek (E. Marks, PTI, pers. comm. 2019). In addition, although winter steelhead are thought to use Wapato Creek, data is limited (SalmonScape 2019). There is no documentation of the use of Wapato Creek by Chinook salmon or steelhead for at least twenty years, and NMFS does not believe Wapato Creek provides suitable habitat in present conditions (J. Fisher, NMFS, pers. comm. 2013). Surveys of Wapato Creek have been inconsistent and low priority due to low salmon production and use and limited accessibility (E. Marks, PTI, pers. comm. 2019).

Habitat Conditions

Fish habitat along the shorelines of the study area is limited by shoreline armoring and overwater structures. Commencement Bay has been highly modified by industrial development (Section 1.5) with large areas of fill, dredging, stabilization, and infrastructure (Simenstad 2000). Overwater structures in the form of piers for ship loading are prevalent along the study area's shorelines. This shading affects the community of the subtidal organisms that serve as fish food or habitat structure in the form of eelgrass and kelp (Nightingale and Simenstad 2001). Piers and other overwater structures can inhibit juvenile salmon migration as physical barriers, shading that causes avoidance, and increased susceptibility to predation (Simenstad et al. 1982). The study area within the Blair Waterway contains no kelp or eelgrass patches, but there is some eelgrass near the mouth of the Hylebos Waterway and near the Thea Foss and Middle waterways. The depth of sea floor in most of Commencement Bay (30-100 meters) and the depth of Blair Waterway (-51 MLLW) is not the habitat that salmonids select for feeding. Additionally, the invertebrates inhabiting the Blair Waterway substrate, such as polychaete and nematode worms, do not contribute significantly to the salmonid food chain (Hiss and Boomer 1986).

Wapato Creek salmonid habitat is limited due to extremely low summer and fall flows, poor water quality, and heavy siltation due to residential and commercial development, agricultural and storm runoff, and heavy industry discharge.

Habitat at the Saltchuk site is degraded due to previous log raft storage at the site. The existing conditions of the substrate of the intertidal zone (0 to -5 MLLW) consist of sand and silt substrate with some gravel and relatively uniform wood debris accumulations overlain across the entire site. The shallow subtidal zone habitat (-5 to -15 MLLW) is composed of sand and silt substrate with wood debris accumulations. Based on previous wood debris studies, wood debris accumulation observed in the intertidal zone appears to extend through the mapped wood debris concentration in the shallow subtidal zone and deep subtidal zone to a depth of approximately -30 MLLW and includes three concentrated areas of wood debris with up to 90% coverage. Macroalgae in the LSZ is largely composed of sea lettuce (Ulva ssp.). No eelgrass was observed within the Saltchuk site, but one patch of eelgrass was identified southeast of the study area at depths of approximately -6 to -10 MLLW (Section 1.5.2.6).

Section 4.10 discusses contaminants in the sediments of the study area. PCBs' effects on salmon include impaired growth and increased mortality after disease (Varanasi et al. 1993, Arkoosh et al. 1998). PAHs and PCBs occur in fish from Commencement Bay, and these are correlated to sub-lethal health effects in fish, including reproductive impairment and liver tumors (Malins et al. 1984, Stein et al. 1992).

Baseline conditions include regular maintenance projects and other planned infrastructure upgrades by the Port (Section 1.5). Dredging and in-water work can cause fish to avoid areas due to the noise of machinery or dredges and associated vessels. To minimize impacts to salmonids, dredging schedules and in-water work observe fish work windows. The work windows allow work during times of the year when juvenile salmonids are least likely to be present. The in-water work window for protection of salmonids in the Blair Waterway is July 15 through February 15 (WAC 220-660-330), and the work window for dredged material disposal at the Commencement Bay open-water site is August 16 through February 15 (WAC 220-660-330; Corps 2017b). However, the Corps would delay the start of the in-water work window for all work (including in the Blair Waterway) to August 16 to further reduce potential effects to late-migrating salmon smolts. Other minor disturbances in the fish migration corridor occur when large shipping vessels transit the channel and displace fish due to underwater noise and physical presence.

4.12.1 Alternative 1 – No-Action Alternative/Future Without-Project Conditions

Under the No-Action Alternative, the existing conditions, as described in Section 4.11, would continue for all fish species that use the study area. The area would remain as an industrial waterway with minimal habitat appropriate for the species using the estuary. No slope stabilization would be necessary. Intermittent O&M dredging is not expected to measurably affect fish species.

4.12.2 Alternative 2 – Blair Waterway Deepening

Dredging for deepening and Saltchuk construction are expected to temporarily displace the bottom-dwelling resident fishes such as flounder, sole, and sculpins. Dredging activity affects only a small area at any given time of the total construction project. The benthic fish are expected to return to the area as the dredge moves to each of the channel's sequential portions. The dredge equipment operates in a small footprint compared to the 214.5 acres of the Blair Waterway channel. Therefore, the mobile and migratory fish that may enter the waterway have a broad area for avoiding the dredge equipment. The construction duration would be four construction seasons using only the allowable in-water work windows to avoid disturbance effects to the most sensitive species.

Most forage fish do not occur in the benthic areas of the water column of navigation channels and thus are not affected by dredging. Those that might be transiting navigation channels or Saltchuk are not associated with one location, are highly mobile, and can avoid dredging activities. For this reason, clamshell dredges have a low risk of entrainment. Although sand lance burrows into sandy substrates, they would not likely select an area of active dredging or material placement at Saltchuk because of the disturbance of the clamshell removing the substrate that would host the sand lance or disturbance during material placement. If dredging commenced where sand lance were present, they are at low risk of entrainment by clamshell dredges. The effect on schools of forage fish would be discountable. The Corps does not anticipate any detectable effect of dredging on forage fish or their food sources (Section 4.10.2).

Effects of dredging and Saltchuk construction on the anadromous salmonids are short-term noise, visual disturbance from the dredging activities, and increased turbidity during dredging or material placement that may cause a minor delay of adults during upstream spawning migration. However, adult migrating salmonids are unlikely to be delayed or diverted by an active dredge because the adults can easily swim around a barge transiting to the dredged material disposal location without any delay in their migration in a study area of this size. The Blair Waterway is not on their path to the Puyallup River. Any turbidity plume would be localized and of short duration as the sand settles quickly through the water column. A plume would not be expected to extend more than several hundred feet from the dredge or Saltchuk into Commencement Bay. Juvenile salmonids move downstream in spring and follow the shoreline past the waterways' mouths away from dredge equipment. The in-water work closures substantially protect juvenile salmon if they enter the Blair Waterway or Saltchuk. Therefore, they are unlikely to be affected by dredge and disposal operations. The same is true for the O&M dredging that would be required on a very infrequent basis. The effects of the project on threatened and endangered species are discussed in more detail in Section 4.14.

The temporary increases in suspended solids could affect juvenile salmon in the immediate dredging or placement area through decreased visibility for foraging activities and impaired oxygen exchange due to clogged or lacerated gills. However, the available evidence indicates that total suspended solids (TSS) levels sufficient to cause such effects would be limited in extent. LeGore and Des Voigne (1973) conducted 96-hour bioassays on juvenile coho salmon using re-suspended Duwamish River sediments from five locations. Up to 5% sediment in suspension (28,800 mg/l dry weight), well above levels expected to be suspended during dredging, had no acute effects. Salo et al. (1979) reported a maximum of only 94 mg/l of sediment in solution in the immediate vicinity of a working dredge in the Hood Canal. This indicates that turbidity would be elevated on a temporary and localized basis by dredging, but that TSS levels sufficient to cause adverse effects on salmon would be very limited in extent. Any turbidity would primarily be at the bottom of the water column in the center of the channel, and juvenile salmon are surface-oriented in shallow water near the shoreline.

Any sediments determined to be unsuitable for aquatic disposal would be taken off-site to an upland disposal site. The upland disposal site would be certified to receive the material and have met all Federal and state environmental compliance requirements. While this removes unsuitable sediment from the aquatic environment, some re-suspension would occur during the dredging process, estimated at approximately 3% or 13,000 CY for the proposed action (Section 4.17.2 discusses re-suspension). Bioaccumulative toxins appear in fish tissues collected throughout the Puget Sound region, especially in urban areas (Puget Sound Action Team 2007). Concentrations of PCBs and other bioavailable contaminants in biota, including edible species, would have a minor increase during dredging. The increase in contamination concentrations in biota is a temporary effect that would persist in the food chain for approximately two to three years following the cessation of dredging. One study, which examined PCB concentrations in fish tissue following environmental remediation in Commencement Bay, estimated that concentrations of PCBs in fish tissue remain elevated for two to three years after completion of construction (AECOM 2012; Patmont et al. 2018). A key difference to note between this study and the Blair Waterway deepening is that the study looked at environmental remediation, which removes sediment with higher concentrations of PCBs when compared to removal of sediment that is mostly suitable for open-water disposal. A similar duration could be expected for other persistent organic compounds, although likely to a lesser degree for the proposed action, because the bulk of the material that would be dredged is suitable for open-water disposal. As discussed in Section 4.17, the quantity of contaminants that may become re-suspended from the additional sediment is small. Different amounts of the mouth (85%), middle (40%), head (100%), and native material (all material below approximately -53 MLLW; 95% overall) are likely to be appropriate for beneficial use (DMMP 2019). Only a portion of this amount would consist of re-suspended material that is not suitable for beneficial use. While exact quantities are not available, the level of risk of substantial bioaccumulation in fish is estimated as low, given the low level of contamination in a minor fraction of the sediments to be dredged. Within that sediment quantity estimate, there is uncertainty regarding the degree to which contaminants could be suspended in the water, the influence of environmental conditions, and the potential exposure level to fish. Ultimately, the resulting removal of sediment that is unsuitable for open-water disposal would be a net long-term benefit to the aquatic environment in the Blair Waterway, especially for bottom-dwelling fish that often test positive for contaminants in Puget Sound.

Slope strengthening among four locations in Blair Waterway may be necessary (Section 3.5). The installation of slope strengthening would create a temporary disturbance but would not substantially degrade the already highly industrial waterfront habitat quality. This habitat is not high-quality aquatic habitat for juvenile salmonids or benthic invertebrates due to existing stabilization such as riprap from about +10 MLLW to -2 MLLW and built structures such as docks. The greatest extent of slope stabilization would be riprap from +10 MLLW to -58 MLLW with a secant pile wall. The presence of engineered slope strengthening along about 8% (762 linear meters total) of the approximately 8,700 linear meters of overall Blair Waterway shoreline in areas of similar, existing development would not substantially degrade the habitat quality of this highly industrial and stabilized waterway. Economic forecasting has identified a substantial long-term benefit for the aquatic habitat. By the year 2035, navigation improvement is expected to reduce the number of vessel calls from 590 per year to 428 per year compared to the No-Action Alternative. This 27% reduction in vessel calls would reduce disturbance to fish in the waterway and throughout Commencement Bay and the shipping channel in Puget Sound. (Section 6.8 discusses compliance with the Fish and Wildlife Coordination Act [FWCA], and Section 6.9 discusses compliance with the Magnuson-Stevens Fishery Conservation and Management Act).

Beneficial use of dredged material at Saltchuk would potentially improve the quality of salmonid feeding and refuge habitat in the Commencement Bay area (Pierce County 2012) by increasing the amount of shallower nearshore habitat through the placement of dredged material. Shallow water along natural shorelines in the upper shore zone provides refuge from predators and a migratory corridor. Chinook salmon smolts use the shallow nearshore to avoid predation by piscivorous predators, such as staghorn sculpin and larger salmon. Willette (2001) found that juvenile pink salmon in Prince William Sound leave the shallow nearshore zone when the biomass of large copepods, their food, declined. With the juvenile pink salmon foraging in deeper water, the mean daily individual predator consumption of salmon increased by a factor of five.

4.12.3 Alternative 2a – Blair Waterway Deepening through Husky Terminal to -58 MLLW

All short-term and long-term effects described for Alternative 2 are the same for Alternative 2a but to a lesser degree. The main difference is that Alternative 2a (63.5 acres) covers less area than Alternative 2 (214.5 acres) and would take less time to complete, so it would have less impact on fish species and their habitat. The sediment at the mouth of the waterway where the Husky Terminal is located has a high chance (90%) of being suitable for open-water disposal. However, only 697,000 CY of material suitable for open-water disposal would be dredged; it is likely slightly less of this material would be suitable for beneficial use and would not be enough material to build Scenario B (about 850,000 CY) or up to Scenario E, a best buy scenario (Section 3.6.1.1). Dredging here would contribute a smaller amount to the quantity of contaminants that may be suspended. No side slope stabilization would be necessary. Less terminal slope strengthening by the Port may be needed (approximately 1,140 feet) compared to Alternative 2 (approximately 5,240 feet; Section 5.1.2). The need for infrequent O&M dredging would be the same cycle as for Alternatives 2 and 2b.

4.12.4 Alternative 2b – Blair Waterway Deepening to -57 MLLW (NED Plan/Preferred Alternative)

All short-term and long-term effects described for Alternative 2 are the same for the NED Plan. Dredging to a shallower depth would have no discernible difference for bottom-dwelling fish, forage fish, or salmonids as they migrate through the area. The only difference would be that the NED Plan's construction would take slightly less time to remove the sediment. As discussed in Section 4.18, the sediment would contribute a smaller amount to the quantity of contaminants that may become re-suspended. As in Alternative 2, there is uncertainty regarding the degree to which contaminants could be suspended in the water, the influence of environmental conditions, and the potential exposure level to fish. However, the resulting removal of sediment that is unsuitable for open-water disposal would be a net long-term benefit. A similar amount of slope strengthening, as described in Alternative 2, may be necessary (Section 3.5). The need for infrequent O&M dredging would be the same cycle as for Alternatives 2 and 2a. The NED Plan would achieve the same long-term benefit as Alternative 2 (27% reduction in forecasted vessel calls), which could not be achieved by the No-Action Alternative.

4.12.5 Cumulative Effects to Fish

The negative effect to fish from the proposed action would be the underwater noise, a temporary effect discussed in Section 4.15. This is considered a short-term effect and is not a change to the habitat type under the piers because the area is already armored with overwater structures. Berth deepening or pier stabilization (LSFs) that require additional dredging, riprap, sheet piles, or other in-water work could occur in Blair Waterway. Although it is not part of the Federal action, it is included here as a cumulative effect because this work is reasonably certain to occur and could be necessary to different degrees as slope stabilization under Alternatives 2, 2a, and 2b (Section 5.1.2). Migratory salmonids may encounter re-suspended contaminants on their outward migration if they are in the study area during cleanup activities elsewhere in Commencement Bay, planned upgrade construction, or the proposed Federal navigation improvement. These fish may then encounter underwater noise or turbidity disturbance during any of these same activities as they may occur during the homeward migration when the fish are adults. All effects are expected to be short-term and sub-lethal but could affect the overall level of success in growth and reproduction. Long-term effects from global climate change (increased water temperatures, lower DO, and lower pH) could also affect overall fitness. However, the combined effect is not anticipated to be a measurable cumulative effect on fish populations.

4.13 Wildlife

The study area is primarily the high-use Blair Waterway aquatic habitat surrounded by the industrial port infrastructure and activities. The marine mammals most likely to be present in Commencement Bay include harbor seals, Steller sea lion, harbor porpoise, California sea lions, gray whales, and rarely humpback whales, Bigg's (transient) killer whales, and Southern Resident killer whales (Dames and Moore 1981). River otters, an aquatic-oriented mammal, also frequent the study area but are not often seen in the heavily trafficked Blair Waterway. A family of otters has inhabited the Saltchuk site and resided behind the Port administrative building for about a decade.

A variety of marine birds typical of developed areas in Western Washington occur within the study area, including osprey (*Pandion haliaetus*), glaucous-winged gull (*Larus glaucescens*), pigeon guillemonts, Caspian tern (*Hydroprogne caspia*), double-crested cormorant (*Phalacrocorax auritus*), and great blue heron (*Ardea herodias*). Commencement Bay is along the Pacific Flyway, which stretches south from Alaska to Mexico and east, past Utah. Migratory birds that may be in the study area include the bald eagle (*Haliaeetus leucocephalus*), black oystercatcher (*Haematopus bachmani*), black turnstone (*Arenaria melanocephala*), Clark's grebe (*Aechmophorus clarkii*), great blue heron, lesser yellowlegs (*Tringa flavipes*), olive-sided flycatcher (*Contopus cooperi*), red-throated loon (*Gavia stellate*), rufous hummingbird (*Selasphorus rufus*), semipalmated sandpiper (*Calidris pusilla*), short-billed dowitcher (*Limnodromus griseus*) and western screech-owl (*Megascops kennicottii kennicottii;* IPAC 2019). The black turnstone, olive-sided flycatcher, lesser yellowlegs, are likely to be present during the in-water work window, and the great blue heron and bald eagle may be present and breeding during the in-water work window (IPAC 2019). Nesting sites for great blue heron and bald eagle are not documented in the study area (iNaturalist.org and ebird.org). Birds and marine mammals in the study area are assumed to be habituated to the industrial port activities (Section 6.8 discusses compliance with the FWCA, and Section 6.12 discusses the Migratory Bird Treaty Act).

4.13.1 Alternative 1 – No-Action Alternative/Future Without-Project Conditions

Under the No-Action Alternative, no dredging for deepening the Blair Waterway would occur, and little to no O&M would continue as needed to maintain the currently authorized channel depths. The baseline conditions are expected to continue and are therefore expected to continue to support the same levels of wildlife that currently use the study area.

4.13.2 Alternative 2 – Blair Waterway Deepening to -58 MLLW

Noise effects of dredging for deepening may temporarily displace a small number of marine mammals and birds from the immediate area surrounding the dredge. The effects would not be widespread to the rest of Commencement Bay (see Section 4.15 for discussion of underwater noise). The minor amount of turbidity would have a discountable effect on foraging opportunities for diving birds and marine mammals. Implementation of Alternative 2 would not have any negative effects on migratory bird habitat and would only have minor and temporary effects on a small number of individual birds that may be present in the study area. Concentrations of PCBs and other bioavailable contaminants in biota may increase during dredging. The increase in contamination concentrations in biota is a temporary effect, which would persist for a number of years following cessation of dredging. The resulting removal of sediment that is not suitable for open-water disposal and construction of Saltchuk would be a net long-term benefit to the aquatic environment in the Blair Waterway and Commencement Bay overall. The beneficial use of dredged material at Saltchuk would improve habitat for wildlife and their prey species. Slope strengthening among four locations in Blair Waterway may be necessary (Section 3.3.4). The installation of slope strengthening would create a temporary disturbance but would not substantially degrade the already highly industrial waterfront habitat quality. This habitat is not high-quality aquatic habitat for juvenile salmonid, benthic invertebrates, or wildlife due to existing stabilization such as riprap from about +10 MLLW to -2 MLLW and built structures such as docks. Therefore, a measurable reduction in wildlife, their prey species, or interruption to migration is not expected. For Alternative 2, no long-term change to wildlife use of the study area is anticipated.

4.13.3 Alternative 2a – Blair Waterway Deepening through Husky Terminal to -58 MLLW

The effects described in Alternative 2 would be the same for dredging through Husky Terminal but to a lesser extent. The smaller amount of material would take less time to dredge and has a higher probability of being suitable for open-water disposal. However, only 697,000 CY of material suitable for open-water disposal would be dredged; it is likely slightly less of this material would be suitable for beneficial use and would not be enough material to build Scenario B (about 850,000 CY) or up to Scenario E, a best buy scenario (Section 3.6.2.2 and Appendix C). No long-term change to wildlife use of the study area is anticipated under Alternative 2a, and the degraded condition of Saltchuk would persist.

4.13.4 Alternative 2b – Blair Waterway Deepening to -57 MLLW (NED Plan/Preferred Alternative)

The effects described for Alternative 2b would be the same for Alternative 2. The smaller quantity of material would take slightly less time to dredge. For Alternative 2b, no long-term change to wildlife use of the study area is anticipated.

4.13.5 Cumulative Effects to Wildlife

Although it is not part of the Federal action, planned upgrades (Section 1.5) are included as a cumulative effect because this work is reasonably certain to occur. The only potential cumulative effect identified for wildlife is for migratory birds that may encounter re-suspended contaminants on their outward migration if they are in the study area during cleanup activities elsewhere in Commencement Bay, planned upgrade construction, or unsuitable material during the proposed Federal navigation improvement. These birds may then encounter underwater noise or turbidity disturbance during any of these same activities as they may occur during the return migration. All effects are expected to be sub-lethal but could affect the overall level of success in growth and reproduction (Section 6.8 discusses compliance with the FWCA). These effects are temporary and not expected to rise to a measurable level when combined with the effects of global climate change (increased water temperatures, lower DO, and lower pH).

4.14 Threatened and Endangered Species

Nine species or distinct population segments (DPS), listed as threatened or endangered under the ESA may occur in the study area (Table 4-19).

The proposed Federal action considered under NEPA includes dredging in the waterway with associated potential slope strengthening, aquatic, nearshore beneficial use, or upland disposal. Under ESA, the future capital improvement projects such as berth deepening or slope stabilization are not considered part of this Federal action for consultation because this work does not depend on the Federal action for its justification and because it has independent utility apart from the Federal action. Future improvements would be executed by the Port or NWSA and would undergo their own ESA consultation. Disposal of material at the Commencement Bay open-water disposal site has already undergone ESA Section 7 consultation as well as full NEPA evaluation. Therefore, it is not included in the ESA effects determination or environmental impacts analysis under NEPA for the proposed deepening. Therefore, only the effects of Federal navigation channel dredging, upland disposal, potential slope stabilization, and Saltchuk construction are analyzed for an effects determination under ESA and NEPA.

To evaluate effects of potential slope strengthening under ESA, NMFS and USFWS (the Services) required a single slope stabilization measure be provided for each location rather than the range of slope strengthening measures evaluated in this IFR/EA (Section 3.3.4 Side Slope Stability). At Areas 1 and 4, the Services assume a 1.5H:1V slope with riprap would be constructed. At Areas 2 and 3, the Services assume a secant wall with a 2H:1V slope would be used. In addition, the Services assume the proposed method for secant pile installation is augering and vibratory pile driving. Vibratory pile driving may be used to install steel casings prior to drilling. Vibratory driving may also be used to install temporary sheetpile cofferdams prior to pouring concrete. Impact pile driving would not be used at any point in the secant wall installation process. Dredging may occur before or after shoreline stabilization measures are installed.

The Corps will finalize slope stabilization needs at these four locations and determine if reinitiation of ESA Section 7 consultation is warranted in PED. A change from these slope stability measures as analyzed by the Services would require reinitiation, if there were adverse effects to ESA listed species or their designated critical habitat that were not previously considered in the ESA consultation. If the Corps determines that no slope stabilization is required at any of these four sites (i.e., no riprap or secant pile walls), then reinitiation would not be necessary.

Table 4-19. ESA Listed Species That May Occur in the Study area According To USFWS and NMFS.

Species	Listing Status	Critical Habitat	
		Designated	Located in the Study area
Coastal/Puget Sound bull trout	Threatened	Yes	Yes
Puget Sound Chinook salmon	Threatened	Yes	Yes
Puget Sound steelhead	Threatened	Yes	Yes
Bocaccio rockfish	Endangered	Yes	No
Yelloweye rockfish	Threatened	Yes	No
Green sturgeon (southern DPS)	Threatened	Yes	No
Southern DPS Pacific eulachon	Threatened	Yes	No
Marbled murrelet	Threatened	Yes	No
Southern Resident killer whale	Endangered	Yes	Yes

Other ESA-listed species may occur within Commencement Bay and Puget Sound but are not expected to occur in the study area (Table 4-20). The Corps found no records of sightings of leatherback sea turtles in Puget Sound, and there are no breeding beaches in Washington. Habitat requirements of the remaining species exclude them from the study area. The Corps has determined there will be no effect on these species due primarily to the low likelihood of their occurrence. The effects of the project would not extend to the species or harm their prey items or habitat in any measurable way.

Table 4-20. ESA Listed Species Highly Unlikely to Occur in the Study area.

Species	Listing Status
Humpback whale *Megaptera novaeangliae*	Endangered
Leatherback sea turtle *Dermochelys coriacea*	Endangered
Streaked horned lark *Eremophila alpestris strigata*	Threatened
Yellow-billed cuckoo *Coccyzus americanus*	Threatened
Oregon spotted frog *Rana pretiosa*	Threatened
Marsh sandwort *Arenaria paludicola* (historic)	Endangered
Water howellia *Howellia aquatilis*	Threatened

The action area (i.e., the area affected directly or indirectly by the dredging project) for evaluating effects to ESA-listed species is defined as the federally authorized navigation channel in the Blair Waterway and an approximately 3-mile radius surrounding the Blair Waterway (Figure 3). A 3-mile radius was chosen to fully capture effects within Commencement Bay and the lower Puyallup River (Appendix D). The lack of terrestrial species affected by the proposed project primarily limits the action area to the aquatic portions of the Blair Waterway, Saltchuk, and Commencement Bay; however, the action area also encompasses the intertidal portion of Saltchuk (Figure 3). The 3-mile radius encompasses the farthest extent of effects that could occur outside the project area, such as water quality impacts, noise and disturbance from vessel or equipment activity, potential entrainment, and transport of materials by boat to the transloading facility.

Figure 4-5. A three-mile radius (circle) around the Blair Waterway (noted by “x”) is the action area for evaluating effects to ESA-listed species.

Chinook salmon, steelhead, and bull trout use the action area as a migratory corridor. Bull trout may use the action area for foraging and overwintering as well. Juvenile Chinook and steelhead typically use shallow water habitat and distributary channels for rearing habitat. These components were mostly eliminated by industrial development and the use of the estuary. Juvenile salmonid trapping by the Puyallup Tribal Fisheries Department observed juvenile salmonids as early as January (Chinook salmon) and as late as August, although the peak outmigration for most species is May (Marks et al. 2018). As the juveniles grow and outmigrate to Commencement Bay to reside in the estuarine environment with higher salinities, this preference changes to pelagic items such as decapod larvae, larval and juvenile fish, drift insects, and euphausiids (Simenstad et al. 1982). It is assumed that by the time juvenile Chinook salmon reach Commencement Bay or shortly after, their diet preference has shifted to pelagic prey. Steelhead are typically age 2+ when emigrating from their natal watersheds, and seaward outmigration occurs in spring. Once they have reached the action area, they move through rapidly according to their life history (Marks et al. 2018).

Figure 4-6. Beach Seine Locations during 2004-2005 and 2016 Juvenile Fish Surveys (E. Marks, PTI, pers. comm. 2019).

Within the Blair Waterway, annual beach seine data consistently show juvenile Chinook, coho, and chum salmon use of the Fairliner site and near the mouth of the waterway (E. Marks, PTI, pers. comm. 2019). Beach seine data from sites around Commencement Bay (Figure 4-7) found juvenile Chinook, pink, and chum salmon February-March 2004 in the Fairliner Site and near the mouth of the waterway, and juvenile Chinook salmon in the Fairliner Site January-February 2005 (E. Marks, PTI, pers. comm. 2019). Beach seine data from sampling in April-June 2016 recorded Chinook, chum, coho, and pink salmon at the Fairliner Site and Squally Beach; cutthroat trout were also found at Squally Beach in May and June (E. Marks, PTI, pers. comm. 2019).

Bocaccio and yelloweye rockfish are large Pacific coast rockfish. Adult bocaccio are most common between 160 and 820 feet deep, with strong associations to rocky bottoms and outcrops. Adult yelloweye rockfish are found between 80 and 1,560 feet deep, also with strong associations to rocky bottoms and outcrops. Adults are highly unlikely to inhabit the Blair Waterway or Saltchuk site. Larval young are passively dispersed by currents and are pelagic until early June when they move toward the shore, so they may be pushed into the project site by the currents (Love et al. 2002). Juveniles and subadults of bocaccio may be more common in shallower waters and are associated with reefs, kelp beds, and artificial structures such as piers (NMFS 2013a; NMFS 2013b). Juvenile bocaccio settlement habitats located in the nearshore with substrates such as sand, rock, or cobble compositions that also support kelp are essential for conservation because these features enable forage opportunities and refuge from predators and enable behavioral and physiological changes needed for juveniles to occupy deeper adult habitats (79 FR 68041). Unlike bocaccio, juvenile yelloweye rockfish are not typically found in intertidal areas, instead of settling in waters deeper than 98 feet (NMFS 2013c).

Green sturgeon are rare in Puget Sound, including Commencement Bay, but tagged fish have been detected in summer as well as winter months in relatively low numbers (Lindley et al. 2011). No spawning occurs in Puget Sound, so the vulnerable larval and juvenile life stages would not be present.

Eulachon mostly spawn in major rivers such as the Columbia and larger tributaries to the Columbia in late winter and early spring. Eulachon are far less common in south Puget Sound drainages and are not considered to be established in the Puget Sound rivers (NMFS 2010). However, they have been reported sporadically; for example, one was caught in a Nisqually River smolt trap in 2013 (S. Hodgson, Nisqually Indian Tribe, pers. comm. 2014). In the study area, there were small numbers of adult eulachon captured in a salmon outmigrant screwtrap at river mile 10 in the Puyallup River (R. Ladley, PTI, pers. comm. 2013) and one adult female eulachon with eggs during beach seining at the Rhone-Poulenc restoration site in the Blair Waterway (A. Berger, PTI, pers. comm. 2019). Eulachon are considered to be present in the Puyallup River.

Humpback whales (*Megaptera novaeangliae*) have been sighted in south Puget Sound. The whales feed off the U.S. west coast, with a winter migratory destination in Mexico and Central America's coastal waters. In recent years, humpback whales have been sighted with increasing frequency in Washington's inland waters, including Puget Sound (primarily during the fall and spring). However, their occurrence is still relatively uncommon, and their DPS origin is unknown. Humpback whales more commonly occur in coastal waters and forage on a variety of crustaceans, other invertebrates, and forage fish. Although humpback whales occur along the Washington coast and in Puget Sound, they are extremely unlikely to occur in the Blair Waterway vicinity during construction.

The Southern Resident killer whales spend considerable time in the Salish Sea from late spring to early autumn, with concentrated activity in the inland waters of Washington around the San Juan Islands June-August, and then move south into Puget Sound September-January, and have extended excursions outside the Salish Sea February-May (Olson et al. 2018). Southern Resident killer whales are sighted annually at the mouth of Commencement Bay, and occasionally in the estuary from 1976-2014, there have been up to 250 sightings total in Commencement Bay (Olson et al. 2018). However, Southern Resident killer whales are not known to enter the navigation channels. Several factors affect the survival and well-being of killer whales. However, the main factors are the physical disturbance of behavior patterns by boat noise or intrusive boating activities, reduction of food sources (primarily adult resident Chinook salmon), and bioaccumulation of persistent, bioaccumulative toxins.

Marbled murrelets are permanent residents of Puget Sound, but the species is not abundant anywhere in Puget Sound (Speich and Wahl 1995). They are occasionally sighted in Commencement Bay, most often off Browns Point (Seattle Audubon Society 2019). The primary prey items for marbled murrelets in Puget Sound include Pacific sand lance, Pacific herring, and krill (euphausiids; Burkett 1995). Since marbled murrelets generally stay close to shore and away from populated and industrial areas, they are unlikely to be present in the waterway.

4.14.1 Alternative 1 – No-Action Alternative/Future Without-Project Conditions

Under the No-Action Alternative, no dredging for deepening the Blair Waterway would occur. The existing conditions for listed species and their habitats (as described in Sections 4.12 and 4.13) are expected to persist into the future, and the industrial seaport would maintain a similar level of effects to threatened and endangered species as current levels.

4.14.2 Alternative 2 – Blair Waterway Deepening to -58 MLLW

Dredging and disposal activities for the Blair Waterway Deepening are described in detail in Section3.5. ESA consultation has been concluded for material that is suitable for aquatic disposal and would be placed at the Commencement Bay Dredged Material Disposal site in Puget Sound (Figure 4-8). Material placed at Saltchuk for beneficial reuse would be suitable for aquatic disposal and has undergone ESA consultation. Any sediments determined unsuitable for aquatic disposal would be taken to an appropriate upland disposal site, which would have no effect on any ESA-listed species. O&M dredging of approximately 30,000 CY is expected approximately every 25 years after deepening.

Salmonid Species

Dredging and Saltchuk construction effects to Coastal/Puget Sound bull trout, Puget Sound steelhead, and Puget Sound Chinook salmon would be limited to short-term disturbance primarily during the adult migration period. Dredging via clamshell in Puget Sound is conducted mid-July or August to mid-February when bull trout are not expected to be present (Goetz et al. 2004). Summer-run steelhead immigration occurs from May to October, and winter-run steelhead immigration occurs from December through April. While construction overlaps each run, adult steelhead can easily avoid the dredging and material placement operation in the wide area of aquatic habitat available. Since juvenile steelhead typically emigrate in spring and move quickly through nearshore areas, they would not encounter dredge operations or Saltchuk construction due to the work window closure during their migration. Adult Chinook migrate through the study area in late July through September and are capable of avoiding dredging operations. Juvenile Chinook initiate their arrival in late January, but the majority of outmigrants arrive after the in-water work window has closed; therefore, few juveniles would experience the minor effects of elevated turbidity from the dredge within and immediately outside of the Blair Waterway within Commencement Bay or at the Saltchuk site. Clamshell dredge buckets have almost no risk for entrainment or other mortality for salmonids. Dredging the waterways would allow fish passage along either shoreline away from the dredge operation. Because of construction timing, dredge type, and location of dredges, there would be discountable effects to bull trout, steelhead, and Chinook.

Habitat limiting factors for salmonids in Commencement Bay are listed as dredging and filling that eliminated mudflats and emergent marsh habitats, reduced riparian function, and sediment contamination (Kerwin 1999). None of these factors would be affected by the proposed action. The Corps' analysis of effects on the primary biological factors of critical habitat for bull trout (USFWS 2005), Chinook (NMFS 2005), and steelhead (NMFS 2005) is dredging would have either no effect or discountable effects. The effects of beneficial use of dredged material at Saltchuk and side slope stabilization on salmonid habitat is discussed in Section 4.12.2.

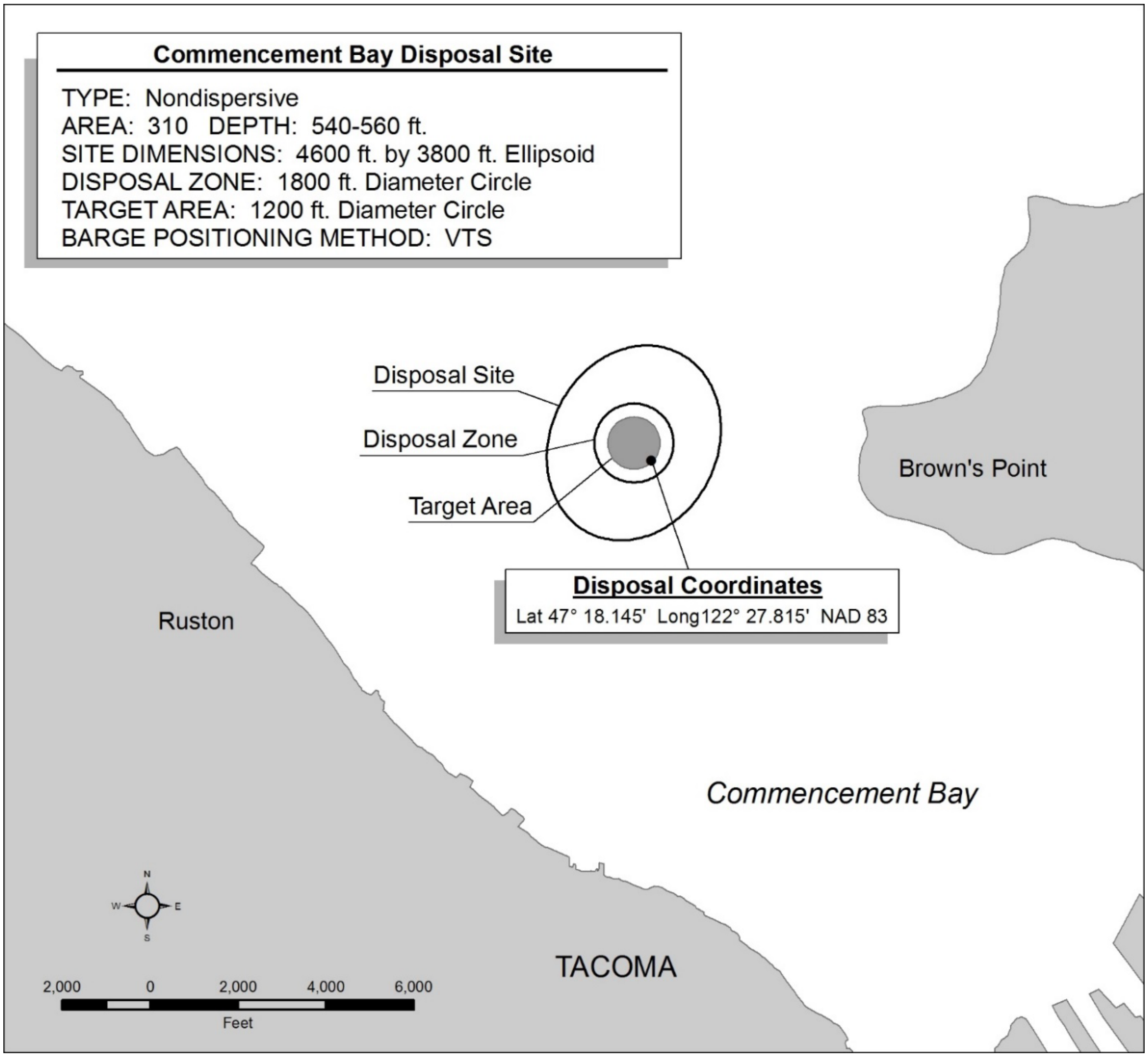


Figure 4-7. Commencement Bay Dredged Material Management Program Disposal Site.

Georgia Basin Rockfish Species

Three life stages are considered for Georgia Basin rockfish species: larvae are not able to swim directionally, juveniles are larger and able to swim to preferred habitats, and adults are strongly associated with rocky substrates deeper than 160 feet (Love et al. 2002). Adult rockfish are not expected to occur in navigation channels as the channels are in shallower water away from marine deep, rocky habitat and are not near typical spawning locations. Juveniles settle in nearshore rocky habitat or kelp forests (Love et al. 1991), but this habitat type is not associated with the proposed dredging in the Blair Waterway primarily because the nearshore zone is at least 2,000 feet away from the channels and has a variety of armoring types that are not suitable rocky habitat.

Larval rockfish are present in surface waters in central and south Puget Sound, apparently with two peaks of seasonal abundance that occur in early spring and late summer (Greene and Godersky 2012). According to Love et al. (2002), the ESA-listed rockfish species' larval stage does not occur in the intertidal, nearshore, or shallow shelf habitats of Puget Sound; therefore, dredging and work at the Saltchuk site would have no effect on larval rockfish unless currents carry larvae into the dredge or turbidity created during construction. Given the length of construction (four years) it is assumed that tides, currents, or wind could move a small number of larval rockfish into these habitats.. Blair Waterway has no substantial water inflow/outflow other than tidal influence. Rockfish larvae could be carried towards the Blair Waterway and Saltchuk by tidal currents, but circulated outward by Puyallup River flow; this also means larvae would be recirculated towards and away from construction at an approximately equal rate (Appendix B).

Effects of construction would primarily be due to suspended sediment within 150 feet of dredging or Saltchuk placement, which would probably kill or injure larval ESA-listed rockfish if they are present. However, if a conservative estimate of larvae present is double the average density of Central Puget Sound basin index sites (< 30 to 40 larvae in 1,000 m^3; Green and Godersky 2012), then it would be highly unlikely for rockfish larvae to be within 150 feet of active dredging in the Blair Waterway or material placement at Saltchuk. In addition, the baseline condition of Commencement Bay is a naturally sediment-laden basin due to glaciers on Mount Rainier that feed the Puyallup River and its tributaries. Glacial meltwater and high loads of sediment generate turbidity in the Puyallup River and into Commencement Bay during peak flows when rockfish larvae could be present, which then flows predominantly along the north shore (Puyallup River Watershed Council 2014). U.S. Geological Survey data show turbidity concentrations are greatest in the White River during summer months during expected periods of glacial meltwater.

The effects of the proposed action would be minimal and a change in population abundance is not likely to be appreciable because of the relatively small number of larvae that would be affected. The effects of suspended sediment on larval rockfish resulting from dredging and Saltchuk construction, when added to baseline Commencement Bay conditions, will be too small to be meaningfully measured or detected. The number of larval rockfish in inner Commencement Bay during dredging or Saltchuk construction are likewise too small to detect and unlikely to occur within 150 feet of construction, but nevertheless < 30 to 40 rockfish larvae per 1000 m^3 are assumed to be present in Commencement Bay for the month of August, then decline (Love et al. 2002). In addition, yelloweye rockfish produce between 1,200,000 and 2,700,000 larvae per year. Bocaccio produce between 201,000 and 2,298,000 eggs per year (Love et al. 2002). The amount of larval rockfish killed or injured for each listed species is well less than the equivalent of the amount for one mature female, and thus has nearly inconsequential impacts on abundance, productivity, diversity, and productivity for each species. Dredging in the navigation channels would have a minimal effect on rockfish due to the low likelihood of their presence. The Corps made an effects determination for larval yelloweye rockfish and bocaccio of may affect, likely to adversely affect, after additional coordination with NMFS and to be conservative given the four-year construction timeline. The Blair Waterway is excluded from rockfish critical habitat.

Green Sturgeon

Given the infrequent use of Puget Sound and, by extension, the study area (based on available tagging data), there is a low probability any adults would be present during dredging, and they would be able to avoid construction; therefore, impacts are discountable. Critical habitat does not include Puget Sound.

Southern Resident Killer Whale

Killer whales are not known to enter the waterways. Because the noise from dredging operations and transport to the Commencement Bay disposal site and Saltchuk would attenuate in a short distance, the Corps does not expect noise from construction, including slope stabilization, to cause harm (Section 4.15 Underwater Noise). Effects on prey species are negligible and would not reduce populations; therefore, there are no effects to killer whales from noise. Tugboats with barges are slow-moving, follow a predictable course, do not target whales, and should be easily detected by all marine mammals. Vessel strikes have a discountable probability. The re-suspension rate is estimated at 2-5% of PCBs by mass with increased bioavailability for approximately two years. This minor fraction would have a negligible effect on killer whale prey items and an undetectable contribution to the whales themselves. Section 4.12.2 contains additional discussion on the anticipated effects to fish from resuspension of sediment unsuitable for in-water disposal, a minor fraction (3%) of the unsuitable sediment estimated for removal (428,000 CY). Analysis for the ESA consultation on continued use of the DMMP disposal sites concluded effects of transport and disposal of dredged material containing biomagnifying substances to killer whales are discountable. A summary of the rationale provided is that the DMMP uses rigorous testing procedures to quantify effects, and disposal sites show similar or lower concentrations of contaminants compared to nearby locations. The complete analysis appears in the Corps (2015) Biological Assessment and the NMFS (2015) Biological Opinion, which are incorporated by reference. The NED Plan would result in 27% fewer vessel trips to transport the forecasted cargo; vessel transit is associated with several potential factors that may have caused or be limiting SRKW recovery. Fewer vessel trips would mean reduced underwater noise and vessel traffic (which is a potential risk factor for the decline of SRKW; 73 FR 4176) throughout the central and northern half of Puget Sound. Fewer vessels also reduces the chance of oil spills, another potential risk factor (73 FR 4176).

Critical habitat includes marine waters of Puget Sound; the mouth of the Blair Waterway overlaps the demarcation line of critical habitat, and the Commencement Bay disposal site is included. The proposed action may have negligible effects on Southern Resident killer whales and their critical habitat due to minor underwater noise from dredging. However, these effects would not be measurable or have a longer duration than the dredging operations.

Marbled Murrelet

The preference for forage fish, which tend to remain in nearshore environments, means marbled murrelet exposure to contaminants through the proposed dredging is discountable. The forage fish themselves have little chance to encounter contaminants through bioaccumulation because of dredging. Should a marbled murrelet be present in the construction area, potential take from collisions is unlikely as tugs and barges travel slowly, allowing marbled murrelets to flee from the approaching barge. Marbled murrelets would be expected to avoid any sediment plume while feeding, especially since their prey would likely avoid a sediment plume as well. Effects to marbled murrelets from dredging would be minor in intensity and brief duration.

Summary of Impact Assessment

Disturbances to ESA-listed species would be of minor intensity and short duration. The effects of underwater noise are described in Section 4.15 and have been determined to be insignificant. As stated in earlier sections, economic forecasting has identified a long-term benefit for the aquatic habitat: by the year 2035, navigation improvement to -58 MLLW is expected to reduce the number of vessel calls from 590 per year to 428 per year compared to the No-Action Alternative representing a 27% reduction in vessel calls. The combined effects of dredging, disposal, and slope stabilization would only have a minor impact the ESA-listed species in the study area. The cumulative effect identified for migratory salmonids described in Section 4.12.2 applies to the ESA-listed species as well.

4.14.3 Alternative 2a – Blair Waterway Deepening through Husky Terminal to -58 MLLW

Effects described for Alternative 2, Blair Waterway Deepening, are similar for dredging through Husky Terminal. The main difference is that Alternative 2a would have a smaller footprint, and it would take less time to remove the sediment. Only 697,000 CY of material suitable for open-water disposal would be dredged; it is likely slightly less of this material would be suitable for beneficial use and would not be enough material to build up to Scenario E, a best buy scenario (Section 3.6.1.1). Therefore, the nearshore habitat would not be improved for juvenile salmonids. O&M dredging would be needed on the same 25-year cycle as for Alternative 2.

4.14.4 Alternative 2b – Blair Waterway Deepening to -57 MLLW (NED Plan/Preferred Alternative)

Effects described for Alternative 2, Blair Waterway Deepening, are similar for the NED Plan. Dredging 1 foot less would have no discernible difference for ESA-listed species. The only difference would be construction for the NED would take slightly less time to remove the sediment. O&M dredging would be needed on the same 25-year cycle as for Alternative 2. Deepening the channel to -57 MLLW would achieve the same long-term benefit of a 27% reduction in forecasted vessel calls by 2035 compared to the No-Action Alternative. Based on the above analysis, this Alternative would not have a substantial effect on listed species or their habitats when compared to criteria in Section 4.14 (Threatened and Endangered Species).

Table 4-21 Effects Determinations for ESA-Listed Species and Their Critical Habitat.

Species	Effects Determination for Alternatives 2, 2a, and 2b	Critical Habitat Effect Determination
Coastal/Puget Sound bull trout	May Affect, Not Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect
Puget Sound Chinook salmon	May Affect, Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect
Puget Sound steelhead	May Affect, Not Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect
Bocaccio rockfish	May Affect, Likely to Adversely Affect	N/A
Yelloweye rockfish	May Affect, Likely to Adversely Affect	N/A
Southern DPS Pacific eulachon	May Affect, Not Likely to Adversely Affect	N/A
Green sturgeon	No effect	N/A
Marbled murrelet	May Affect, Not Likely to Adversely Affect	N/A
Southern Resident killer whale	May Affect, Not Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect

The Corps' effects determinations for the action alternatives appear in Table 4-21. As stated previously, the Federal action considered under ESA and NEPA is only the dredging. It does not include disposal that has already undergone ESA consultation and NEPA analysis or other future construction that would be executed by the Port because that will have a separate ESA consultation. The Corps' analysis concludes that the effects of the project on ESA listed species are minor (Section 6.2 discusses compliance with the Endangered Species Act).

4.14.5 Cumulative Effects to Threatened and Endangered Species

Various factors have contributed to low quality habitat in Commencement Bay waterfront. Those factors include shoreline fill, armoring and subsequent loss of wetlands, persistent contaminants from past industrial practices, periodic dredging, vessel traffic, and other ongoing and future construction related activities that may result in elevated turbidity and noise that affect the wildlife itself or their prey resources. Given the waterfront's degraded state, when combined with the proposed Blair Waterway deepening, cumulative impacts to ESA-listed species would be minor.

4.15 Underwater Noise

Ambient noise conditions underwater in Puget Sound have many contributors, including shipping traffic to the Ports of Everett, Seattle, Tacoma, U.S. Navy activities, the Washington State ferries, cruise ships, and commercial fishing vessels, and recreational boats. The mean ambient level in most marine waters is 80-100dB_{RMS} (Richardson et al. 1995). Data collected in Elliott Bay show background sound levels range from 105dB to 145dB with an average hourly mean of 128 dB_{RMS} (Laughlin 2015). Activities at Tacoma

Harbor that directly generate or contribute to underwater noise include container ships, tugboats, cargo handling equipment, and rail and truck traffic that cause ground vibrations around the study area.

The major groups of animals in Puget Sound that underwater noise can affect are fish, diving birds, pinnipeds (seals and sea lions), sea otters, and the two types of whales, mysticetes (baleen whales) and odontocetes (toothed whales). The species of focus for this analysis are the ESA-listed salmonids and rockfish, and the marine mammals most likely to occur in the study area, primarily harbor seals and sea lions, and rarely killer whales. Marbled murrelets are rarely present in the area, and other diving birds are assumed to flee the area at the onset of noise disturbance.

Intrusive noise levels can have behavioral and physiological effects on animals. Behavioral consequences are actions such as abandoning hunting, diving, or increasing swimming speed to flee the area, interrupted communication between individuals or pods, attempts to shield the young, and even panic and stranding (Richardson et al. 1995). Physiological consequences range from minor to lethal and can include temporary and permanent hearing loss, weight loss if prey cannot be captured, stress-induced health decline, and the lethal effect of hemorrhaging of the brain or other organs. Consequences from masked sounds can include other effects such as inability to avoid predators, separation from the pod, or missed opportunities for group hunting. Chronic noise pollution can affect not only individuals but also whole populations. Further information on the underwater noise analysis appears in Appendix C.

4.15.1 Alternative 1 – No-Action Alternative/Future Without-Project Conditions

Under the No-Action Alternative, no deepening of the Blair Waterway would occur. With the channel remaining at current depths, ships would continue to observe and increase their implementation of some of the non-structural measures identified in Section 3.1, such as tug assists, high tide transiting, and light loading. Shipping companies will be deploying larger ships on their shipping routes regardless of channel depths; therefore, it is reasonable to assume ships will use the non-structural management measures. The additional tug assists required would mean increased tugboat traffic associated with the overall higher number of vessels, which would increase underwater noise over the study period. Tugboats have a dominant frequency range of 100-500Hz with peak output at 170dB_{RMS} at 1 meter, which is above the threshold for Level B harassment for the species of concern in close proximity to the tug but attenuates quickly with distance from the vessel. High tide transiting would mean ships slow down as they navigate southward through Puget Sound to time their arrival at the Port of Tacoma, which would cause a longer duration of their underwater noise. Light loading would have the effect of causing a higher number of ships to transit Puget Sound to carry all the anticipated cargo. If no channel deepening occurs, according to economic forecasting through the year 2035, approximately 590 vessel calls would be required per year among the Panamax and Post-Panamax size classes, and each of these vessels uses tug assists.

4.15.2 Alternative 2 – Blair Waterway Deepening to -58 MLLW

As described in Section 3.5, several pieces of equipment would be operating and producing underwater noise for up to 24 hours per day. It is assumed only one dredge would be operating at a time and would be running nearly continuously. One tugboat for towing barges would be transiting between the waterways and the Commencement Bay open-water disposal site. A survey vessel would slowly transit the area to measure dredging progress while a water quality monitoring vessel would collect data periodically throughout each day. The duration of work would most likely be throughout the seven-month work window in four consecutive years. The installation of slope strengthening may create a temporary disturbance if strengthening includes pile driving. All these sound-producing vessels and actions would add to the waterways' ambient sound as a cumulative effect during construction. O&M dredging is anticipated to be needed every 25 years.

Tugboats have a dominant frequency range of 100-500Hz with peak output at 170dB_{RMS}, which is above the threshold for Level B harassment for the species of concern in close proximity to the tug but is expected to attenuate quickly with distance from the vessel. When in motion, the sound produced by the tugboats would be transient and expected to be at background levels a short distance from the moving vessel with no lasting effects, and therefore inconsequential. Measurements of sound levels generated by dredging in the Snohomish River (north of Seattle) were as high as 170dB_{RMS} for a clamshell dredge (SAIC and RPS Evans Hamilton 2011). However, this sound attenuated to the background within 150 meters. The substrate in the Blair Waterway is similar to that of the Snohomish River and is therefore likely to attenuate noise comparably. Since the aquatic habitat in the waterways is 200-250 meters wide, even when the dredge is in the center of the channel, there would be an area available for the avoidance of harassment noise levels.

Dredging and disposal at the Commencement Bay open-water disposal site would occur within the established work window of August 16 to February 15, which were set to avoid juvenile salmon outmigration, would avoid causing noise impacts. Material placed at Saltchuk for beneficial reuse would be placed during the same in-water work window and accomplished by barge-mounted excavator and bottom-dump barge. Any juveniles present in the Blair Waterway during the dredging months would likely be migrating along the shoreline, away from the dredge. Adult salmon may be present in the waterways during dredging since the work window overlaps with their entry into the estuary after returning from the ocean; however, the adult fish have ample space in the waterways to avoid noise from dredging operations, and they do not have to pass through the Blair Waterway to reach the Puyallup River.

Slope strengthening such as riprap, sheet piles, secant walls, or other vertical slope strengthening solutions at four locations in Blair Waterway may be necessary (Section 3.5) and would be determined in PED after additional information is collected by ship simulation. Likewise, the construction method has not been determined at this point in the feasibility phase, but typical construction methods for slope strengthening (e.g., an auger or vibratory hammer) could create a temporary disturbance to fish and wildlife in the area. Impacts due to potential construction methods would be temporary and spatially limited due to the Blair Waterway's confined nature that would reduce, but not eliminate, the noise transmission into inner Commencement Bay. In addition, potential slope strengthening locations within the Blair Waterway are away from areas that fish and wildlife utilize more frequently. Measures to minimize disturbance such as bubble curtains, in-water work windows, and construction techniques such as auguring may be implemented. However, the identification and feasibility of these measures would not be known until the type of slope strengthening and construction method is confirmed, and designs are available in PED. Engineered slope strengthening and construction methods have been coordinated with the Services for impacts to ESA-listed species (Section 6.2 and Appendix D) and will be verified as design progresses. Given the location, limited duration, and potential slope strengthening designs and measures available to minimize disturbance, slope strengthening is unlikely to cause more than a minor effect on fish and wildlife populations.

Diving bird species recorded during Seattle Audubon Society seabird surveys at Thea's Park, the closest shore site to the Blair Waterway along Commencement Bay, include grebe species, cormorant species, common and Barrow's goldeneyes, rhinoceros auklets, surf, and white-winged scoters, and pigeon guillemots (Seattle Audubon Society 2019). Common and red-throated loons and Caspian terns have been sighted around the study area. These birds forage closer to the shoreline and much less in the Blair Waterway or over the deep disposal site where the proposed dredging and disposal activities would occur. Marbled murrelets are occasionally sighted in Commencement Bay, most often off Browns Point; therefore, no substantial effects are anticipated (Seattle Audubon Society 2019). Given the lack of prime habitat for other types of seabirds in the waterways and at Saltchuk, their presence in the vicinity of construction is also rare. At any given time, the area of construction disturbance is only a small fraction of the area available for seabird use. Seabirds are likely to relocate away from construction when it occurs, with no substantial adverse effects anticipated from the work.

Marine mammals typically avoid the high-traffic area in the Blair Waterway. The nearest haul out sites are on navigational buoys and floats off the mouth of the Hylebos Waterway near the Saltchuk site (see Appendix C for more information); these are reported to host harbor seals and California sea lions only, not the ESA-listed western DPS Steller sea lions (Jeffries et al. 2000). A log boom in the same location was a popular haul out site but was removed in 2012. The buoys are about 1/2 mile away from where the dredging and open-water disposal activity would occur, which is beyond the noise attenuation distance. Material placed at Saltchuk would be approximately 150 meters from the buoys while the barge and tug transporting material could be closer. Marine mammals would be accustomed to this type of marine traffic coming from the mouth of the Hylebos Waterway and the marina nearby. The 300-500 California sea lions in Puget Sound, primarily present from fall to spring, are only males as females do not migrate from their breeding grounds in California and Mexico (Jeffries et al. 2000). Commencement Bay is not a major pupping and nursing site (Lambourn et al. 2010). Houghton et al. (2015) found that vessel speed is the greatest predictor of noise levels received by killer whales. Dredges and associated work vessels would be either stationary or traveling slowly to survey the bottom surface, maneuver the dredge and barge, or transiting the barge to the disposal site. The slow rate of travel should minimize sound emitted from each vessel.

Deepening the Blair Waterway to -58 MLLW would reduce the total number of vessel calls from 590 to 428 by 2035. Fewer vessels could reduce the number of tug assists and the overall number of vessels transiting Puget Sound and into Commencement Bay. A reduction in the number of vessels would reduce vessel noise that could disturb birds, fish, or marine mammals in the study area.

The dredges and associated work vessels have a short distance of sound attenuation. Additional factors considered in this analysis were the small number of marine mammals and diving birds and the use of the proscribed work window for ESA-listed species. Based on this analysis, the effects of underwater noise from dredging would be short duration, low intensity, and, therefore, inconsequential (Section 6.2 contains compliance with the ESA, and Section 6.10 has compliance with the Marine Mammal Protection Act).

4.15.3 Alternative 2a – Blair Waterway Deepening through Husky Terminal to -58 MLLW

All short-term and long-term effects described for Alternative 2, Blair Waterway Deepening, are the same for Alternative 2a, Blair Waterway Deepening through Husky Terminal. Alternative 2a would have a smaller footprint and take less time to complete, and would not be enough material to build any scenario at Saltchuk (Section 3.6.2.2). No slope strengthening would be required. The associated noise from the machinery and engines would have no discernible difference in the underwater noise impacts for diving birds, marine mammals, or salmonids compared to Alternative 2. The construction would not substantially contribute to the underwater noise generated in the industrial port environment.

4.15.4 Alternative 2b – Blair Waterway Deepening to -57 MLLW (NED Plan/Preferred Alternative)

Deepening the Blair Waterway to -57 MLLW under Alternative 2b would have the same short-term and long-term effects described in Alternative 2. The only difference would be construction for Alternative 2b would take slightly less time to remove the smaller amount of sediment. Alternative 2b provides enough material to build Scenario E, a best buy scenario (Section 3.6.2.2). The effects of underwater noise from dredging would be inconsequential.

4.15.5 Cumulative Effects of Underwater Noise

It is assumed that similar current and future work would have the same relative disturbance zone as deepening the Blair Waterway. Effects on diving birds and marine mammals are considered discountable due to their absence or ability to flee without injury. Effects on the ESA-listed salmonids would be negligible; adults would have substantial available aquatic habitat to avoid injury (Hart Crowser 2015). Effects to fish and wildlife from potential slope strengthening may occur and may require an IHA from NOAA and additional ESA coordination with the Services, but would not constitute a population-level effect and be discountable due to the strengthening locations, BMPs, and potential strengthening solutions that would avoid and minimize disturbance. Future non-Federal capital improvements would be conducted by the Port or NWSA and would undergo full environmental compliance prior to their construction action. A long-term reduction in vessel traffic would reduce underwater noise that could disturb birds, fish, or marine mammals in the study area.

4.16 Cultural Resources

Cultural resources are locations on the physical landscape that contain evidence of past human activity. These resources include archaeological sites such as lithic scatters, villages, procurement areas, resource extraction sites, rock shelters, rock images, or shell middens; submerged resources such as fish traps, weirs, or watercraft; historic era sites such as trash scatters, homesteads, railroads, ranches, or logging camps; and structures or buildings over 50 years old. Those cultural resources and related records, artifacts, and remains which are listed or considered eligible for inclusion on the National Register of Historic Places are known as historic properties (36 CFR § 800.16(l)(1)). They are protected under the National Historic Preservation Act (36 CFR § 800.1). Eligible properties must generally be at least 50 years old and possess integrity of physical characteristics, meaning it must "possess integrity of location, design, setting, materials, workmanship, feeling and association" (36 CFR § 60.4). Finally, a historic property must be significant under one or more of the following criteria:

- Criterion A. Be associated with events that have made a significant contribution to broad patterns of our history.
- Criterion B. Be associated with the lives of significant persons in our past.
- Criterion C. Embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction.
- Criterion D. Have yielded, or may be likely to yield, information important in prehistory or history (36 CFR 60.4).

An additional category of historic property is the traditional cultural property. Traditional cultural properties assist in the maintenance of a living community's cultural identity through association with practices or beliefs rooted in that community's history (Parker and King 1998).

The Corps conducted a review of the Washington Information System for Architectural and Archaeological Records Data for the proposed study area, including potential disposal areas. The potential disposal sites consist of an existing open-water disposal site, an existing upland disposal site, and the Saltchuk beneficial use zone. While numerous cultural resource surveys have occurred near the project within the past decade, none have included field investigations of the Blair Waterway or Saltchuk beneficial use zone. One archaeological site has been located within the area of potential effects (APE). Site 45PI47 (Wapato Creek Fish Weir) was found during dredging in October 1970. The site was hydraulically excavated, and the excavation uncovered a fish weir, netting, and a cedar bark hat, the latter of which "may be an innovative form not recorded in the ethnographic record, or […] of sufficient antiquity so that the form was not common or present in the ethnographic present" (Munsell 1975). Through radiometric analysis, the site dates to Common Era 1420-1640 (Cooper 2009) and was located in what was the Wapato Creek marsh zone (Berger et al. 2008). There are no known archaeological sites or submerged resources within the Blair Waterway.

Between 2007 and 2009, NOAA collected multibeam hydrography and side scan sonar data in the majority of Tacoma Harbor, including Blair Waterway. No shipwrecks were noted. Results indicated that the area near the Saltchuk beneficial use zone "is littered with debris and sunken wrecks (Simmons 2009)." However, no wrecks are located within the Saltchuk beneficial use zone, and the debris is wood waste piles from past logging operations.

The Corps reviewed historical maps to understand the development of the Blair Waterway over time. Prior to development by the Port of Tacoma, maps from the 19th century depict the area in which Tacoma Harbor now sits as tidal flats. Geotechnical borings taken immediately west of Blair Waterway bore peat layers at approximately 35 feet below the modern surface, potentially indicative of the past existence of a stable surface within the Tacoma tideflats (Dively and Martin 2010). A stable surface may have permitted habitation or other human activity. The harbor was established in 1918, and with its establishment fill from the construction of the harbor's numerous waterways was placed atop the Tacoma tideflats. This fill is believed to be 5 to 10 feet deep, upon which the harbor is built (Berger and Chambers 2006). The Blair Waterway, initially known as the Wapato, was extended to its current length between 1948 and 1960 with subsequent modifications to the mouth and turning basin apparent in maps from 2002, 2006, and 2009. The Blair Waterway has been repeatedly dredged for the duration of its existence.

Aerial photographs indicate Tyee Marina, adjacent to the Saltchuk beneficial use zone, was constructed between 1969 and 1980. Log storage in the Saltchuk beneficial use zone continued until approximately 2015, although storage appears to have dwindled in quantity beginning in approximately 2006.

In February 2019, sediment sampling was conducted in the Blair Waterway to characterize dredged material for suitability of disposal for either open-water or potential beneficial use. An archaeologist monitored the sediment sampling to determine whether any samples contained evidence of cultural material or artifacts. The archaeological monitor examined 25 cores; eight samples were selected for further analysis and screened through a 1/8-inch screen to detect the presence of any intact cultural resource material. No cultural material or artifacts were identified during the screening (Viloudaki and Amell 2019).

A determination and findings letter and modified APE was submitted to SHPO on November 6, 2019, requesting concurrence with the Corps' determination of finding no adverse effects to historic properties, under a condition of monitoring during sediment characterization during the PED phase. On November 07, 2019, the SHPO provided a concurrence of "no effect", and this response was further clarified by the SHPO on April 27, 2021 via email message as being "no adverse effect" to historic properties.

In November 2019, the Corps submitted a determinations and findings letter and modified APE to the Washington State Historic Preservation Officer requesting concurrence with the determination of no adverse effect on known historic properties, under the condition of monitoring during geotechnical testing of soils that will occur during the PED phase. The Corps received a letter from SHPO indicating a concurrence of no effect on November 7, 2019. Seeking clarification of the SHPO concurrence, the Corps contacted Rob Whitlam, State Archaeologist on April 27, 2021. SHPO issued its concurrence with the Corps determination of no adverse effect to historic properties via email on April 27, 2021.

4.16.1 Alternative 1 – No-Action Alternative/Future Without-Project Conditions

With no-action implemented from this feasibility study, no dredging would occur, and there would be little to no maintenance dredging to maintain the Federal navigation channel to its current depth. There would be no impacts to historic properties as none are known to exist within either Blair Waterway or the Saltchuk beneficial use zone according to the criteria listed in Section 4.16 (Cultural Resources). Based on the possible side slope stabilization techniques being considered and the results of previous archaeological testing work conducted, there will be no impacts to known intact cultural or historic resources.

4.16.2 Alternative 2 – Blair Waterway Deepening to -58 MLLW

Under the Blair Waterway Deepening to -58 MLLW Alternative, no impacts to cultural or historic resources are anticipated according to the criteria listed in Section 4.16 (Cultural Resources). Archaeological monitoring results of the sediment sampling cores were negative for cultural resources. Based on the possible side slope stabilization techniques being considered and the results of previous archaeological testing work conducted, there will be no impacts to known intact cultural or historic resources.

4.16.3 Alternative 2a – Blair Waterway Deepening through Husky Terminal to -58 MLLW

Under the Blair Waterway Deepening through Husky Terminal Alternative, no impacts to cultural or historic resources are anticipated according to the criteria listed in Section 4.16 (Cultural Resources). Archaeological monitoring results of the sediment sampling cores were negative for cultural resources. Based on the possible side slope stabilization techniques being considered and the results of previous archaeological testing work conducted, there will be no impacts.

4.16.4 Alternative 2b – Blair Waterway Deepening to -57 MLLW (NED Plan/Preferred Alternative)

Under the NED Plan, deepening to -57 MLLW, no impacts to cultural or historic resources are anticipated according to the criteria listed in Section 4.16 (Cultural Resources). Archaeological monitoring results of the sediment sampling cores were negative for cultural resources. Based on the possible side slope stabilization techniques being considered and the results of previous archaeological testing work conducted, there will be no impacts to known intact cultural or historic resources.

4.16.5 Cumulative Effects to Cultural Resources

Past actions, including the filling and subsequent industrialization of the estuary, have extensively altered the landscape. There are no known archaeological sites within the APE. While site 45PI47 (Wapato Creek Fish Weir) was identified in 1970 adjacent to the APE, it was hydraulically excavated. Subsequent monitoring in the area where site 45PI47 was located has not found additional artifacts or features. In addition, archaeological monitoring results of the sediment sampling cores were negative for cultural resources. No cumulative effects on cultural resources are expected.

4.17 Public Health and Safety

Regarding public health and safety, three factors affecting the local population were identified and considered. These factors are (a) risk of re-suspension of contaminants in the dredged sediment that would affect seafood species, (b) potential effects to commercial traffic patterns surrounding Tacoma Harbor, and (c) potential effects to navigation traffic patterns at the Hylebos Waterway.

Washington State Department of Health advises against eating any crab, shellfish, or bottom-feeding fish from the Commencement Bay waterways, including the Blair Waterway (WDOH 2016). Limits of flatfish such as English sole, starry flounder, and rock sole are set to two servings per month from inner Commencement Bay. In South Puget Sound, the recommended consumption for coho, chum, pink, and sockeye salmon is two to three servings per week, while Chinook salmon should not be consumed more than once per week. Resident Chinook (blackmouth) salmon is limited to two servings per month. The WDOH (2016) also recommends no more than four servings per month of Dungeness crab (without viscera) and spot prawns (without heads) from Commencement Bay.

The Dick Gilmur Memorial Shoreline Public Access and Kayak Launch provides public access to Commencement Bay. Placing any material at Saltchuck may temporarily interrupt public access at this site, and the Port would coordinate closure to prevent unsafe public access to the site during construction. Other access points are available around Commencement Bay.

Unsuitable Sediment Re-suspension during Dredging

Re-suspension of unsuitable sediments during dredging could affect the risk of bioaccumulation of toxicants in fish and benthic invertebrate tissues, which could then be consumed by humans. Re-suspension of unsuitable sediment is a well-documented, short-term impact during dredging. Coarser material settles closest to the activity while finer material may be transported beyond the operating area. Dredging may also release contaminants into the water column. These releases can be reduced by using BMPs such as reducing work speed and equipment selection, but not eliminated.

When analyzing potential impacts to humans through fish consumption, the spatial scope of analysis is broadened from the immediate study area in Blair Waterway to the entirety of Commencement Bay. This expanded range of the study area hosts several popular species of fish and crustaceans harvested for human consumption, and the home range of these species is unknown, so the greater area is analyzed. Public fishing access and tribal fishing occur at multiple points around the study area. The kinds of seafood of concern in human consumption from Commencement Bay include crab, shellfish, and bottom-feeding fish (EPA 2014). Salmon are not a significant concern for seafood consumption since very little of their time is spent in the study area relative to their total life span, and the majority of growth occurs in the ocean. The contaminants of interest that can occur in these seafood species are PCBs, dioxin, and mercury (EPA 2014), and PAHs, PBDEs, DDTs (Lanksbury et al. 2014).

Consumption of resident seafood that occurs during and immediately after construction operations such as dredging, despite the current Washington State Department of Health advisory against consuming any such seafood, presents short-term risks to the community. This is because contaminants in resident seafood are likely to be higher during and immediately after construction as a result of unsuitable sediment resuspension and biological uptake. Children can be at greater risk due to their developing bodily systems and greater consumption of food relative to body size. The increase in contamination concentrations in biota is a temporary effect that will persist for an estimate of two to three years following the cessation of dredging (AECOM 2012; Patmont et al. 2018). However, this reference to increased fish tissue contaminant concentrations for 2 to 3 years following dredging is specific to dredging of CERCLA regulated sediment during a remedial response action at a NPL site, which is not part of the proposed Federal project. While some degree of sediment resuspension is inevitable for navigation dredging, increased risk associated with contaminant body burden in fish is not anticipated. For this project, USACE will follow all necessary steps to ensure environmental impacts are minimized, including water quality monitoring requirements under Clean Water Act Section 401, dredging during designated in-water work windows, and thorough characterization of dredge material through the DMMP. The resulting removal of unsuitable sediment would be a net long-term benefit to public health.

Human health risk assessments conducted for Commencement Bay provide information on the existing conditions regarding the risk to humans from consumption of resident fish, shellfish, crabs, and spot prawn (Versar 1985, as cited in EPA 2014; WDOH 2016). Analysis of Commencement Bay and Tacoma Harbor waterways shows the concentrations of chemicals of concern in the tissue of crab, shellfish, and fish in the study area warrants consumption advisories. It is the intent of the consumption advisories to address these risks. However, recent fish tissue data for bioaccumulative chemicals are needed to determine if contaminant levels in fish tissues have been reduced since remediation of CERCLA sites around Commencement Bay has begun and if consumption advisories should be modified (EPA 2014). Per EPA's fifth Five Year Review, English Sole were collected in June of 2019 to evaluate potential reductions to contaminant body burden as a result of completed Superfund remedial actions (EPA 2020). This additional tissue data is anticipated to be taken into consideration as part of the existing CERCLA response action, outside of this proposed project. Currently, the fish advisory for this portion of Commencement Bay suggests no consumption of rockfish and only two meals per month for English Sole (DOH 2022).

Commercial Traffic around Tacoma Harbor

As described in Section 4.3, the Port will pursue and implement capital improvement projects, which may include berth deepening, slope stabilization, or other upgrades at their facilities. These activities will meet the changing commodity and vessel fleet demands to remain globally competitive. Upgrades will occur due to the recent trends in the global fleet of containerships, as well as a future fleet forecast that ultra-large containerships will regularly call at Tacoma Harbor, regardless of the proposed action. The berths will need to be sufficiently deep and cranes appropriately sized to accommodate these ships efficiently.

Although this IFR/EA will not include a detailed analysis of effects to land-based transportation and traffic, detailed transportation impact analysis is presented in the Blair-Hylebos Peninsula Terminal Redevelopment Project EIS (Port of Tacoma 2009), Land Use and Transportation Plan (Inova Planning and FEHR & PEERS 2014), and the Tideflats Area Transportation Study Final Report (FEHR PEERS 2011). The studies describe potential transportation impacts associated with truck and rail traffic (e.g., increased truck trips or delays at intersections) associated with the growth of the Port and City of Tacoma. The studies estimate the number of truck trips the Tacoma Harbor terminals could generate, including an evaluation of how projected container growth could affect truck volumes, the share of cargo expected to be transported through the terminal's on-dock intermodal rail yard, and the peak hours for truck movements. In addition to evaluating potential truck and transportation impacts, these studies identify several measures that could be implemented to mitigate the anticipated regional growth's long-term transportation impacts. These measures include infrastructure improvements (e.g., signal upgrades or road improvements) and operational protocols such as additional queuing space or notifications to truck drivers and dispatchers.

Marine Traffic around Tacoma Harbor

The Corps will work with the Port and the NWSA to minimize the impact of dredging in an active waterway, as well as any impacts to Hylebos Waterway traffic from the construction of the Recommended Plan. In order to be implemented, Saltchuck must be designed to avoid impacts to navigation. Potential navigation impacts resulting from this placement would be evaluated in PED as explained in Section 5.9.3 (Pre-Construction, Engineering, and Design (PED) Activities). Physical changes due to material placement at Saltchuk would be built into the bathymetry to ensure an accurate representation of bathymetric conditions and to fully evaluate potential effects to navigation.

4.17.1 Alternative 1 – No-Action Alternative/Future Without-Project Conditions

Under the No-Action Alternative, it is likely dredging would not proceed, and re-suspension of unsuitable sediments and a corresponding short-term increase of exposure to toxic substances related to dredging actions would not occur. However, sediment disturbance from the ships with low underkeel would continue without dredging. No disruption from material placement at Saltchuk would occur to public access at the Dick Gilmur Memorial Shoreline Public Access and Kayak Launch.

4.17.2 Alternative 2 – Blair Waterway Deepening to -58 MLLW

Sediment in the proposed footprint would undergo testing to determine the quantity suitable for aquatic disposal; unsuitable material must be removed for appropriate upland disposal. The Corps has estimated approximately 428,000 CY of the total volume dredged may be unsuitable for aquatic disposal. Dredging this material poses a risk of re-suspension of a fraction of those unsuitable sediments. Based on the conservative assumption described in Section 4.10, the anticipated quantity of re-suspension is 3% of sediment dredged with an environmental clamshell bucket and standard BMPs (e.g., debris sweep, controlled dredge rate, etc.); therefore, approximately 13,000 CY of material deemed unsuitable for aquatic disposal may be re-suspended under Alternative 2.

Dredging of unsuitable sediments poses a risk for elevated bioaccumulation of contaminants in fish tissues during construction. Concentrations of PCBs and other bioavailable contaminants in biota, including edible species, would increase during construction at Blair Waterway. The increase in contaminant concentrations in biota is a temporary effect but may persist for a number of years following cessation of dredging. The quantifiable health effects from re-suspension of unsuitable sediment are unknown. A health advisory is already in effect. Currently, the fish advisory for this portion of Commencement Bay suggests no consumption of rockfish and only two meals per month for English Sole (DOH 2022). Outside of the USACE proposed project and Blair Waterway, the US EPA continues to monitor contaminant levels in fish tissue and the potential changes resulting from previously completed remedial actions as part of the Commencement Bay Nearshore Tideflats Superfund project. Best management practices would be used to minimize sediment suspension during the construction of side slope stabilization if needed.

The proposed navigation improvement to deepen the Blair Waterway is not expected to increase the total number of containers moving through the region or have a substantial effect on long-term landside traffic associated with the port terminals as cargo throughput is a factor of market demand and port capacity more than channel depth. Construction of Alternative 2 would lead to a short-term increase in truck traffic in and around the study area due to the need to truck out the approximately 428,000 CY of material deemed unsuitable for aquatic disposal. The contractor would obtain the appropriate traffic control plan permits, oversized hauling permits, and general hauling permits for any equipment or material transported via roadways, as required. Alternative 2 does not change market demand or increase landside capacity. Therefore, the study does not assume a change in the volume of landside traffic resulting from the project.

Detailed Port capacity estimates are available in the Appendix A, Section 2.4. As shown, the landside constraints are the primary limitation on capacity at the Port of Tacoma. The main landside constraints appear to be container yard capacity, which is determined by yard acreage, container stack heights, and slot turnover. Additionally, The Port of Tacoma will receive calls from the design vessel in the Future Without-Project Condition (Section 4.3.3). The study assumes channel deepening will only increase the efficiency of these calls, not induce more calls from the design vessel class or increase port capacity. As a result, there is no change in cargo throughput (the number of containers moving through the Port) associated with Alternative 2.

Landside traffic is the responsibility of the Non-Federal Sponsor (Port of Tacoma). Actual truck/train congestion is primarily impacted by scheduling, slot turnover, seasonality, and other factors under the

Port's purview. Alternative 2 potentially increases the number of containers loaded or unloaded in one vessel call. However, it is not clear that this will lead to substantial impacts to congestion. Rail and road traffic improvements described in Section 4.17 (Public Health and Safety) are intended to accommodate Port and container growth, which would occur regardless of the proposed action, by reducing traffic impacts. Substantial effects to traffic due to the proposed action are not expected.

Slope stabilization may be needed at four locations in the Blair Waterway (Table 3-3) to maintain the navigation channel. Staging areas would be at existing developed locations provided by the Port and would not interfere with long-term use of recreation areas, marine traffic, or land-based vehicles. Coordination with the Port, contractor, and Seattle Department of Transportation would be necessary to minimize and avoid temporary disruption to traffic during construction.

Material placement at Saltchuk may temporarily interrupt public access at the Dick Gilmur Memorial Shoreline Public Access and Kayak Launch, and the Port would coordinate closure to prevent unsafe public access to the site during construction. Other access points are available around Commencement Bay.

4.17.3 Alternative 2a – Blair Waterway Deepening through Husky Terminal to -58 MLLW

The Corps has estimated there is 697,000 CY of material suitable for in-water disposal present in the Blair Waterway through Husky Terminal, and 83,000 CY of unsuitable material that would require upland disposal. Re-suspension of this material would have no effect on public health or safety because the majority (92%) is suitable for open-water disposal.

The evaluation of effects to traffic for Alternative 2 (Blair Waterway Deepening to -58 MLLW) applies for Alternative 2a, although to a lesser degree due to the limited deepening through Husky Terminal. The proposed navigation improvement to deepen the Blair Waterway would not increase the total number of containers moving through the region and would have no substantial effect on landside traffic associated with the port terminals according to criteria under Section 4.17 (Public Health and Safety).

No material would be placed at Saltchuk under this alternative, so no interruption to public access at the Dick Gilmur Memorial Shoreline Public Access and Kayak Launch would occur.

4.17.4 Alternative 2b – Blair Waterway Deepening to -57 MLLW (NED Plan/Preferred Alternative)

The Corps has estimated approximately 392,000 CY of the total dredged material in this alternative may be unsuitable for aquatic disposal. Dredging this material poses a risk of re-suspension of a fraction of those unsuitable sediments. The anticipated quantity of re-suspension is 3% of sediment dredged with a clamshell bucket; therefore, approximately 12,000 CY of material deemed unsuitable for aquatic disposal may be re-suspended. The public health risks due to re-suspension of unsuitable sediments under the NED, including re-suspension due to dredging at Blair Waterway, are similar to the impacts under Alternative 2. The dredging quantity is similar between the two plans, and unsuitable sediments are located in the uppermost layers of sediments in Blair Waterway. Dredging 1 foot less for this alternative in the relatively cleaner sediment at depth would not substantially reduce the exposure of downstream waterway users and organisms to contamination.

The evaluation of effects to traffic for Alternative 2 (Blair Waterway Deepening to -58 MLLW) applies for Alternative 2b (Blair Waterway Deepening to -57 MLLW). The proposed navigation improvement to deepen the Blair Waterway would not increase the total number of containers moving through the region and would have no substantial effect on landside traffic associated with the port terminals according to criteria under Section 4.17 (Public Health and Safety).

Material placement at Saltchuk may temporarily interrupt public access at the Dick Gilmur Memorial Shoreline Public Access and Kayak Launch, and the Port would coordinate closure to prevent unsafe public access to the site during construction. Other access points are available around Commencement Bay.

4.17.5 Cumulative Effects to Public Health and Safety

Given the setting of the highly developed industrial waterway with documented areas of unsuitable material, the minor fraction of re-suspended sediments would not constitute more than a minor effect on this heavily modified environment with multiple Superfund sites. The cumulative effects analysis indicates that removal of sediments with low levels of contaminants would have a net benefit to human health in the study area (see Section 6.16 for compliance with Executive Order 13045 Protection of Children from Environmental Health Risks and Safety Risks). A temporary interruption to public access during material placement at Saltchuk would not permanently reduce the overall public access around Commencement Bay.

5 Recommended Plan - Agency Preferred Alternative

This chapter describes the Recommended Plan advanced for design and implementation (Figure 5-1). As described in Chapter 3, Alternative 2b is the Recommended Plan. This comprehensive description of the Recommended Plan is intended to support a common vision of the final project and a defendable feasibility level cost estimate, to document feasibility level risks and uncertainties to be investigated further and resolved following feasibility during PED. This chapter discusses the material quantities and classifications, requirements for OMRR&R, dredged material disposal, cost and benefits, and risk and uncertainty. The navigation improvements respond to local needs and desires as well as the economic and environmental criteria used to screen, evaluate, select, and refine measures and alternatives.

5.1 Description of the Recommended Plan – Agency Preferred Alternative

The Recommended Plan is the NED Plan, which consists of deepening the entire Blair Waterway from -51 MLLW to -57 MLLW with associated channel widening for design vessel navigation (Figure 5-1). The Recommended Plan requires dredging approximately 2.8 million CY of material. While beneficial use of dredged material for environmental benefits is not the least cost disposal option (Base Plan), the Recommended Plan includes the Beneficial Use Plan for disposal. The Beneficial Use Plan includes dredged material disposal at the Saltchuk site (1,850,000 CY) based on analysis using an approved nearshore habitat valuation model described in Section 3.6.2.2 and Appendix D, Commencement Bay DMMP open-water site (562,000 CY), and upland placement (392,000 CY).

Beneficial use could restore up to 64 acres of nearshore intertidal and subtidal substrate conditions for fish and wildlife species at the Saltchuk site, including ESA-listed species, with the creation of nearly 38 LSZ acres. Full placement at Saltchuk would reduce the quantity of material going to the Commencement Bay open-water disposal site by approximately 1,850,000 CY of dredged material and would reduce the cost of monitoring and management of the disposal site. The incremental cost is reasonable in relation to the environmental benefits achieved and warrants additional evaluation.

5.1.1 General Navigation Features (GNF)

GNFs are for vessel maneuvering, turning, passing, mooring, and anchoring, disposal, and associated tipping fees, and side slope stability measures incidental to the transit of the channels. For the Recommended Plan, GNFs include the following:

- Channel deepening to -57 MLLW
- Selective channel widening from 450’ to 865’ (Figure 5-1)
- Turning Basin Expansion up to 1,935 feet in diameter and -57 MLLW depth
- Any side slope stability measures needed. Because the project is in the feasibility phase, the Corps does not want to prescribe any specific measures without the additional analysis to be completed in PED (Section 5.9.3). As a result, a conservative cost estimate is used for feasibility.

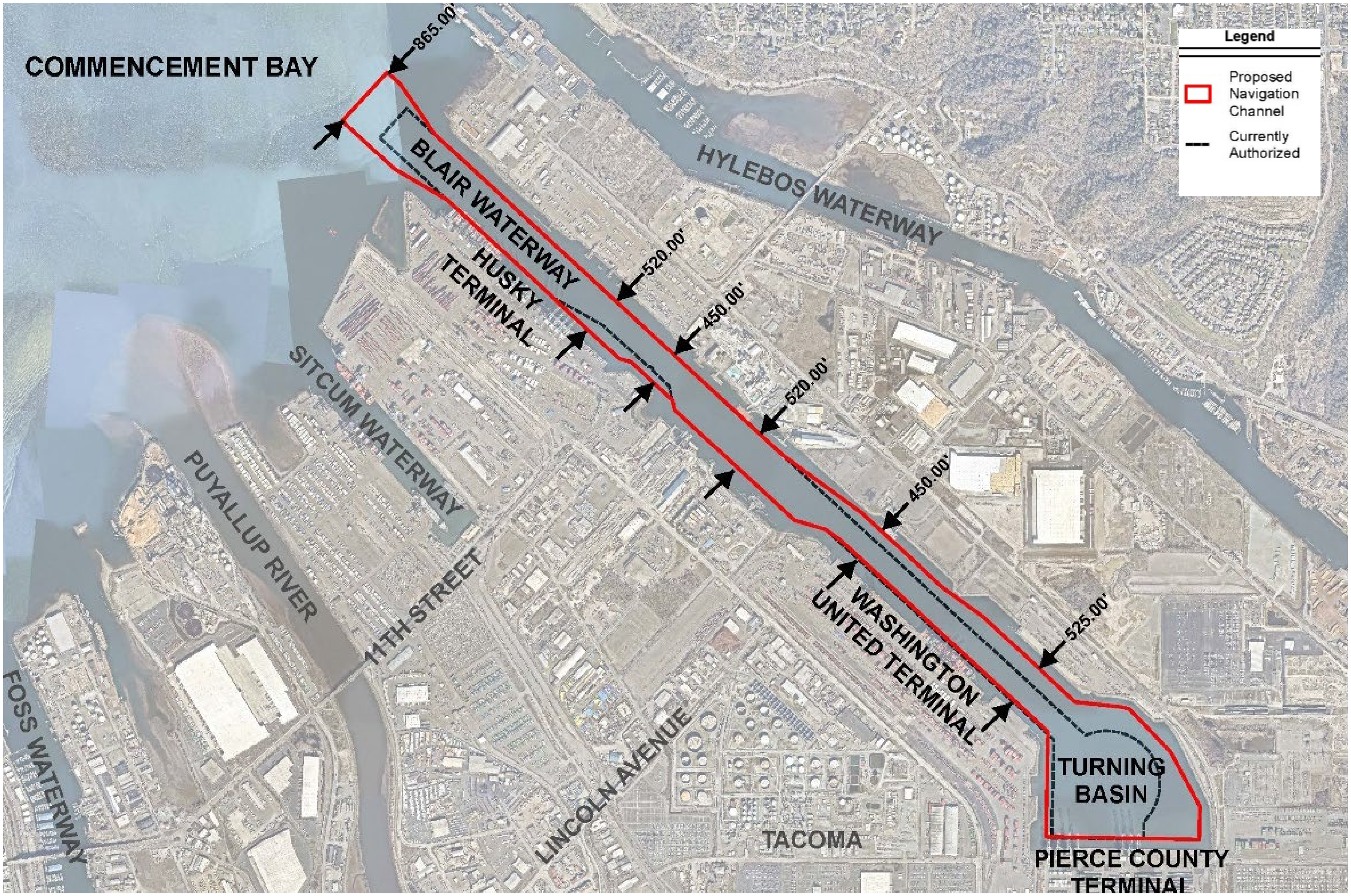


Figure 5-1. Recommended Plan.

5.1.2 Local Service Facilities

LSFs include terminals and transfer facilities, docks, berthing areas, and local access channels. The LSFs assumed for this project include berthing area deepening at Husky, WUT, and PCT for any depths below -54 MLLW. LSFs are 100% non-Federal costs (i.e., the responsibility of the Port of Tacoma) and considered economic costs in the benefit cost analysis in this study. The Port provided estimated lengths of slope strengthening required for each container facility (Figure 5-2). As shown, 1,140 feet, 2,010 feet, and 2,090 feet of slope strengthening are required for all depths below -54 MLLW at Husky, WUT, and PCT, respectively. Costs of these improvements include reinforcement of the slope, as well as the construction of a new toe wall at a cost approximated at $20,000 per linear foot. Figure 5-2 identifies locations where slope strengthening is required for consistent berth depth in red and portions that will not need strengthening in green.

Figure 5-2. Anticipated Slope Strengthening by Facility for Depth Below -54 MLLW.

5.2 Aids to Navigation

No new aids to navigation are proposed in the Recommended Plan for this project. The U.S. Coast Guard (USCG) provides the data for any aids to navigation costs, such as costs to relocate range markers due to a change in the channel's centerline with widening. The Corps has coordinated with the USCG to obtain data for any aids to navigation costs as well as initial feedback on the study and Recommended Plan. The USCG and Puget Sound Pilots have not identified specific aids to navigation needed for the Recommended Plan. The Corps has also not identified aids to navigation needed for implementing the recommended plan. The Corps will continue to coordinate with the USCG, Puget Sound Pilots, and the Port of Tacoma during PED to identify whether ATONs are required based on additional PED analysis. ATONs are typically a 100% Federal cost, paid by the USCG. For this project, the Port of Tacoma has indicated its willingness to pay for any new ATONs, if any, should be required, based on a more detailed analysis conducted in PED. For the purposes of this feasibility study, and based on analysis to date, the Corps included the potential for ATONS as part of the cost contingency since no specific aids to navigation were identified at this time. If ATONs are identified during PED, the Corps would finalize an estimated cost before construction.

5.3 Dredging and Dredged Material Management

Dredging would occur using a clamshell dredge. A digging bucket would remove the material suitable for aquatic disposal, while an environmental bucket would dredge the unsuitable material identified by a full sediment characterization in PED. If significant debris were encountered, the dredger would use a 1-foot-by-1-foot steel mesh grid that covers the scow barge to screen the material as it is loaded into the scow barge for open-water disposal. It is assumed that a 1,200-cy to 3,000-cy size bottom dump barge would be used to load, transport, and place dredged material suitable for open-water disposal. A contained, flat deck material barge would transport unsuitable material to a transloading facility where it would be dewatered and mechanically re-handled for disposal at a designated landfill site.

The production rates will depend on the dredging equipment used, nature of the dredged material, and environmental conditions. It is expected that suitable sediment production rates will be faster while dredging through non-native (upper layers) material compared to deeper native sediments. Native material is presumed to have never been disturbed and will be well consolidated, potentially decreasing production rates. Dredged material in the Blair Waterway is classified as loam to silt loam in non-native sediments and as sand to loamy sand in native sediments. Dredging operations would occur continuously with routine breaks for equipment maintenance, crew shifts, and barge repositioning. Production rate estimates range between 3,000 and 6,500 CY per day (see Appendix B for additional detail). Most of the material unsuitable for aquatic disposal is located in the side slopes and top 4 feet below the mudline. Thus, given the more complex disposal procedures of the unsuitable material, the operation will likely start slow and speed up as the project progresses. The dredging is estimated to take about four years to complete due to the volume of material being dredged and adhering to the in-water work windows to protect sensitive fish species.

5.3.1 Dredged Material Suitability Determination

The DMMP agencies determine what dredged material can be disposed of at open-water DMMP disposal sites. The DMMP does not manage contaminated sediment cleanups; those are managed by cleanup programs within Ecology and the EPA.

Sediment sampling and partial DMMP testing (including dioxin) were conducted in the Blair Waterway to estimate the volume of dredged material that would be suitable for aquatic disposal versus upland confined disposal. Due to time constraints on the acceptability of data for construction (three- to five-year limit for data acceptability under DMMP guidelines), a full DMMP suitability determination will be completed during PED. Based on the feasibility level advisory suitability determination, a percentage of the volume was assigned to each sample's likelihood of meeting open-water disposal criteria, and the average of all samples within designated areas of the waterway was calculated. These volume percentages were then used to develop quantities to inform cost estimates and associated cost contingencies for each alternative. This analysis found approximately 14% of the dredged material from the Blair Waterway would require upland disposal while 86% of the material is estimated to meet the suitability requirements of the DMMP and would be disposed of at the Commencement Bay open-water disposal site (Section 3.3.3; Appendix B) or the Saltchuk beneficial use site.

Table 5-1. Estimated Disposal Volumes for the Recommended Plan.

	Commencement Bay	Saltchuk	Upland disposal
-57 MLLW (+ 2 ft. overdepth)	562,000 CY	1,850,000 CY	392,000 CY

Recommendations and assumptions from the DMMP will be incorporated into the final design:

1. Conduct a full DMMP sediment characterization in PED.
2. Ensure that unsuitable material is separated from the suitable material during dredging by adding a minimum one-foot vertical buffer and an appropriate horizontal buffer to the unsuitable portions of the dredge prism. USACE planners will need to include the horizontal and vertical buffers in volume calculations for upland disposal.
3. Dredged material will likely be required to be screened to remove debris prior to disposal. Surface non-native sediments in areas with suitable material should be screened using a grid with a maximum opening size of 12 inches by 12 inches. Native material and material found unsuitable for open-water disposal will not need to be screened.
4. Physical monitoring of the Commencement Bay open-water disposal site before the start of the project to get a baseline and subsequent physical monitoring of the site after every 500,000 CY disposed or at the end of each dredging year, whichever is more frequent. Physical monitoring includes a multibeam bathymetric survey and Sediment Profile Imaging.

5.3.2 Beneficial Use of Dredged Material

The build-out of the Saltchuk disposal site with benches and intertidal islands is included in the Recommended Plan. The chosen Beneficial Use Plan is Scenario E (described in Appendix C and Section 3.6.2.2). Scenario E provides restoration of 64 acres of nearshore intertidal and subtidal substrate conditions for fish and wildlife species, including ESA-listed species, with the creation of nearly 38 LSZ acres at an average annual cost of $23,000 per AAHU or an average annual cost of $5,200 per acre. Placement at Saltchuk reduces the quantity of material going to the Commencement Bay open-water disposal site by approximately 1,850,000 CY of dredged material. The remaining capacity of the open-water disposal site (14,310,000 CY) can accommodate this material. However, the Commencement Bay open-water site's ESA conservation measures include evaluating dredged material for beneficial use, such as in-water habitat restoration projects as an alternative to disposal (NMFS 2015). Beneficial use of dredged material is a one-time placement of material at Saltchuk, and any O&M, while expected to be none or minimal, is the non-Federal sponsor’s responsibility. As described in Section 3.6 and Appendix C, the incremental cost is reasonable in relation to the environmental benefits achieved.

Implementation Guidance for Section 1161 of the WRDA 2016, which amends Section 2039 of WRDA 2007, directs the Secretary to ensure that, when conducting a feasibility study for a project (or component of a project) for ecosystem restoration, the recommended project includes a plan for monitoring the success of the ecosystem restoration. It also requires development of an adaptive management plan. The beneficial use of dredged material component of this project follows these requirements. The Corps developed a monitoring and adaptive management plan (Appendix C) to demonstrate the ecological success of the project. This success is determined by monitoring metrics that are specifically tied to project objectives and setting performance targets. This includes monitoring nearshore depths, wood waste coverage, and submerged aquatic vegetation. In addition, the plan identifies what adaptive management is proposed if the performance targets are not met after Saltchuk construction is complete. All post-construction monitoring will be cost shared between the Corps and the non-Federal sponsor for the first 10 years of monitoring. The non-Federal sponsor may choose to monitor beyond this ten-year period, although the cost would be a 100% non-Federal sponsor's responsibility. The Corps will perform monitoring at Saltchuk per the NMFS BiOp (Section 6.2). Adaptive management would be the responsibility of the non-Federal sponsor. Recommendations and assumptions from the DMMP advisory memo (2019; Appendix B) will be incorporated into the final design:

1. If material is unsuitable for the Commencement Bay open-water disposal site then it is also unsuitable for beneficial use.
2. NMFS' proposed PAH level for the protection of fish of 2,000 µg/kg is appropriate for aquatic beneficial use.
3. Only material with dioxin less than 4 parts per trillion toxicity equivalent is appropriate for beneficial use.

5.4 Real Estate Considerations

The Blair Waterway is an existing Federal project. In 1964 the Port of Tacoma granted two perpetual easements (Tracts 100E & 100E-2) to the Corps for this project. The Port will not receive LERRD credit for any lands previously provided for another Federal project.

The non-Federal sponsor (Port of Tacoma) is required to furnish all lands, easements, rights-of-way, relocations, and disposal (LERRD) for the proposed widening and deepening. The sponsor owns most of the channel in fee, except two parcels owned by the Puyallup Tribe of Indians. To address real estate interests, the sponsor will obtain a channel improvement easement over the lands the sponsor does not own in the proposed Federal channel south of the 11th Street right of way. The sponsor will receive LERRD credit for lands that are needed to expand the channel from the currently authorized footprint as summarized in Table 5-2 below.

Table 5-2 Lands Needed for NED Channel.

Tract	Interest	Owner	Acres
100E-3	Channel Improvement Easement	PORT OF TACOMA	146.5 (85.36 New Acres)
101E	Channel Improvement Easement	PUYALLUP TRIBE OF INDIANS FEE LANDS	2.22
A	Channel Improvement Easement	USA IN TRUST (PUYALLUP TRIBE OF INDIANS)	1.84

The Corps will exercise navigational servitude for the Commencement Bay open-water disposal site and the Saltchuk beneficial use site if utilized. The Corps will exercise navigational servitude north of the 11th Street bridge. Materials not suitable for open-water disposal will be transported off-site to an upland, licensed commercial disposal facility.

No utility relocations are identified at this time. The total project real estate costs (including administrative costs and land costs) is $307,000 including contingency at the April 2021 price level; this sum is included in the total project costs.

5.5 Benefits

Policy Directive – Comprehensive Documentation of Benefits in Decision Document (5 January 2021) requires the Corps to identify and analyze benefits in total and equally across a full array of benefit categories. This section summarizes the analysis of benefits across benefit categories for the recommended plan. References to detailed information in relevant sections of the IFR/EA are provided.

5.5.1 National Economic Development (NED) Benefits

The NED benefits of the recommended plan are expressed as transportation costs savings associated with the -57 feet MLLW alternative over the future without-project condition. At the October 2021 price level and fiscal year 2022 discount rate, average annual equivalent NED benefits of the recommended plan total $152,715,000[6]. Additional information on the national economic development benefits and costs of the recommended plan is provided in Section 5.6.

5.5.2 Regional Economic Development (RED) Benefits

The navigation construction expenditures associated with the Tacoma Harbor recommended alternative are $295,328,000. LSF is not included in the regional analysis as it is not a federally cost-shared feature and would have a unique regional economic impact compared to navigation construction expenditures. The RECONs model estimates that the local impact area captures $221,585,000 of the total expenditure. The state impact area (Washington State) captures $241,283,000 of the total expenditure including the local capture, and the nation captures $279,090,000 of the total expenditure including the local and state capture. Direct expenditures associated with the project also generate additional economic activity (secondary or multiplier effects). The RECONS model measures the direct and secondary impacts in output, jobs, labor income, and gross regional product (value added). RECONS measures jobs supported in full-time equivalent (FTE) jobs, defined as one full-time job for one year. Jobs supported by this project would only last over the construction period, and actual employment impact and duration will vary by function. The Civil Works expenditures of $295,328,000 support approximately 1,400 full-time equivalent jobs, $127,694,000 in labor income, $196,615,000 in value added to the local impact area. More broadly, these expenditures support 2,700 full-time equivalent jobs, $216,054,000 in labor income, $337,289,000 in value added to the economic output in the nation.

5.5.3 Environmental Quality (EQ)

Detailed descriptions of the analysis and impacts of the Recommended Plan appear in Chapter 4 of the IFR/EA. Table 4-1 in that chapter lists resources considered in the study and the rationale for inclusion or exclusion from detailed analysis. Section 5.8 below summarizes the environmental consequences of the Recommended Plan for each resource analyzed. Analysis shows no significant adverse effects to ESA-listed species, no significant negative impacts to commercially important species or protected marine mammals, no loss of wetlands, and no compensatory mitigation is proposed. Beneficial use of dredged material

[6] FY19 Vessel Operating Costs

would provide substantial long-term benefits to nearshore habitat in Commencement Bay and for ESA-listed species.

5.5.4 Other Social Effects (OSE)

Based on the absence of adverse impacts on human health and safety risk, the Recommended Plan would not have disproportionately high adverse impact(s) on human health and safety in any community, including environmental justice communities or children. See Appendix C and Section 6.14 for more detail.

5.6 Cost Estimate and Economic Summary

The Corps developed Class 3 level estimates for each alternative considered in the economic evaluation. Cost estimates for various depths were developed based on technical information provided for each alternative and from assumptions based on historical, similar work. This included quantities, type of material, disposal options, dredge plant, and other factors. A detailed "Basis of Cost Estimate" that outlines cost assumptions appears in Appendix F. Potential risk events were evaluated and incorporated into a risk model to determine contingency levels. As project plans were refined from the conceptual stage to the feasibility-level design stage, project costs were updated. This section presents the most recent available cost estimate for the Recommended Plan, which differs from preliminary estimates used for alternatives comparison and presented in Section 3.6. Costs of the NED Plan are presented assuming the Base Plan for disposal. Incremental costs of the Beneficial Use Plan are shown separately before presenting the total cost of the Recommended Plan with the Beneficial Use Plan for disposal.

The total project first cost for the NED Plan with the Base Plan for disposal is $285,786,000 at the October 2021 price level for GNFs and LERRs. Total First Cost of the Recommended Plan including incremental costs of $9,542,000 for beneficial use at Saltchuk is $295,328,000. The total economic cost of the Recommended Plan, including beneficial use and non-federal berth improvements is $420,684,000 (with contingency) at the October 2021 price level, which includes project first costs, IDC, LSFs, and aids to navigation. In accordance with the cost-share provisions in Section 101(a) of the WRDA of 1986, as amended {33 U.S.C. 2211(a)}, the estimated Federal share of the project first cost is $148,942,000. The estimated non-Federal share is $146,386,000, which includes a 50% Federal and 50% non-Federal cost share for GNF greater than -50 MLLW (as amended by Section 1111 of WRDA 2016). The estimated value of lands, easements, rights-of-way, and relocations (LERRs) is $307,000 and is 100% non-Federal. Costs reflect a non-Federal expense of 10% of GNF paid over 30 years for the NED Plan, less credit for LERR, or $28,241,000; this brings the cost share of the first costs to $120,701,000 Federal and $174,627,000 non-Federal.

Table 5-3 shows cost-sharing allocation for construction and OMRR&R costs.

Table 5-3. Cost Sharing Allocation for Navigation Construction and OMRR&R Costs.

Cost Category	Federal Cost Share	Non-Federal Cost Share
For Project Depths > -50 MLLW		
GNF Design and Construction	50%	50% + 10% (1)
LERR	0%	100%
Local Service Facilities (LSF)	0%	100%
OMRR&R of GNF	50%	50%
GNF in excess of NED Plan cost for Locally Preferred Plan (4)	0%	100%
Beneficial Use / Ecosystem Restoration	65%	35%
1 – 10% post-construction contribution less credit for LERR over 30 years 2 – LERR: Lands, easements, rights-of-way, and relocations 3 – OMRR&R: Operations, maintenance, relocations, rehabilitation, and replacements 4 – Cost share does not depend on project depth		

Table 5-4 outlines the project first costs, associated costs, and cost share of the Recommended Plan at the October 2021 price level. The cost share includes an incremental cost of $9,542,000 for beneficial use Scenario E, cost-shared at 65% Federal ($6,202,000) and 35% non-Federal ($3,340,000) per Section 2037 of WRDA 2007, where the beneficial use is cost shared based on ecosystem restoration. O&M of the beneficial use site is not anticipated at this time but is a non-Federal responsibility. Other associated non-Federal expenses include estimates for LSFs, including berth deepening outside of the Federal navigation channels and dock slope strengthening. ATONS are a Federal expense, but none have been identified at this time (Section 5.2). The Recommended Plan OMRR&R estimate is $4,755,000 per 25-year dredge cycle or $9,510,000 over the 50-year period of analysis. The cost share for the OMRR&R is based on the NED Plan depth of -57 MLLW with 50% Federal and 50% non-Federal cost share (as amended by Section 2102(b) of WRDA 2014), or $4,755,000 Federal and $4,755,000 non-Federal over 50 years, with costs split equally over two OMRR&R cycles in approximately years 25 and 50 after construction.

Table 5-4. Cost Share Summary for the Tacoma Harbor Recommended Plan (1,000s, Oct. 2021 Price Level).

Recommended Plan (-57 MLLW)	Total Cost[2]	Federal Share	Non-Federal Share
Cost Sharing for > -51 MLLW GNF to -57 MLLW 50% Federal / 50% Non-Federal			
General Navigation Features - Dredging[1]	$285,479	$142,740	$142,740
Lands, Easements, Rights-of-Way, and Relocations (LERR) 100% Non-Federal	$307	$-	$307
Beneficial Use, Incremental Cost (Ecosystem Restoration, 65% Federal / 35% Non-Federal)	$9,542	$6,202	$3,340
Project First Costs, Recommended Plan (rounded) [3]	$295,328	$148,942	$146,386
Additional 10% of GNF over 30 Years Less LERR 100% Non-Federal	$-	$(28,241)	$28,241
Project First Costs, Recommended Plan including 10% of Recommended Plan Plan GNF Adjustment over 30 Years (rounded)	$295,328	$120,701	$174,627
Non-Federal Local Service Facilities (LSF) 100% Non-Federal			
Berthing Area Dredging outside of Federal channel	$7,301	$-	$7,301
Dock Slope Strengthening	$104,800	$-	$104,800
Aids to Navigation (100% Federal Cost)[4]	$-	$-	$-
Total Project Costs - Recommended Plan including 10% of GNF Adjustment over 30 Years (rounded)	$407,429	$120,701	$286,729
Incremental OMRR&R over 50 years (GNF)	$9,510	$4,755	$4,755

1 Includes Preconstruction, Engineering & Design, Construction Management, and Federal Real Estate Labor Costs
2 Rows and columns may not add up due to rounding
3 Project First Costs account for monitoring of beneficial use. Monitoring cost is included in 'Planning During Construction' line item in the TPCS. Monitoring cost (approximately $142,000) is described in the Monitoring and Adaptive Management Plan (Appendix C). As this is a one-time placement for beneficial use, any future adaptive management is the non-Federal sponsor responsibility. Specific adaptive management measures will be identified in PED based on additional design.
4 Aids to Navigation have not yet been determined for the Recommended Plan

Table 5-5 summarizes the economic costs and benefits of the Recommended Plan presented at October 2021 price levels. IDC totals $13,255,000 and uses estimated construction first cost at the October 2021 price level, anticipated construction duration of 4 years, and the FY22 Federal discount rate (2.25%). Including IDC and estimated local service facility costs, total economic costs equal $420,684,000. The estimated total O&M over 50 years is $9,510,000 at the October 2021 price level. Average annual equivalent (AAEQ) costs at the October 2021 price level and FY22 discount rate are $14,259,000[7], which includes AAEQ O&M costs of $144,000. AAEQ benefits are approximately $152,715,000, resulting in total

[7] AAEQ costs for BCR calculation exclude incremental costs associated with Beneficial Use ($9,542,000)

net benefits of $138,456,000 (AAEQ benefits minus AAEQ costs) and a 10.7 BCR. The estimated first costs for authorization are $295,328,000[8] at the October 2021 price level.

Table 5-5 Average Annual Equivalent (AAEQ) Benefits and Costs of the Tacoma Harbor NED Plan.

Cost Item	Cost and Benefit Summary (October 2021 Price Level)
Interest Rate (Fiscal Year 2022)	2.25%
Construction Period, Years	4
Period of Analysis, Years	50
Estimated Construction Costs	$295,328,000
Interest During Construction (Construction only)	$13,255,000
Estimated Local Service Facilities	$112,101,000
Estimated Aids to Navigation	$0
Estimated Economic Costs	*$420,684,000*
AAEQ Costs	
AAEQ Construction Cost	$14,115,000
AAEQ OMRR&R	$144,000
Total AAEQ Costs	*$14,259,000*
AAEQ Benefits	*$152,715,000*
AAEQ Net Benefits (AAEQ Benefits – AAEQ Costs)	$138,456,000
Benefit-to-Cost Ratio (computed at 2.25%)[2]	10.7

[1]Benefits are computed using FY19 vessel operating costs from EGM 20-04 in coordination with the DDNPCX
[2]The BCR calculation includes the costs of Beneficial Use of Dredged Material ($9,542,000)

The incremental costs of the Beneficial Use Plan above the Base Plan are cost-shared with the Sponsor according to cost share for environmental restoration and consistent with Section 2037 of the WRDA of 2007, as amended, or 65% Federal and 35% non-Federal. Incremental cost for Scenario E beneficial use at Saltchuk is estimated at $9,542,000. The recommended Beneficial Use Plan of Scenario E, full build out, restores 64 acres of nearshore intertidal and subtidal substrate conditions for fish and wildlife species, including ESA-listed species, with a net increase of 14.5 AAHU over the No-Action Alternative. The recommended Beneficial Use Plan creates nearly 38 LSZ acres at an AAEQ cost of $23,000 per AAHU or an AAEQ cost of $5,200 per acre. Scenario E, full build-out at Saltchuk, reduces the quantity of material going to Commencement Bay open-water disposal site by approximately 1,850,000 CY of dredged material. Table 5-6 summarizes the beneficial use cost benefit analysis.

[8] Includes $9,542,000 for Beneficial Use of Dredged Material

Table 5-6 Beneficial Use Cost Benefit Summary.

Incremental BU Plan Placement Cost	Cost and Benefit Summary (Oct21 Price Level)
Construction	$9,542,000
Interest During Construction	$428,000
Total Investment Cost	$9,970,000
Amortized Construction Cost	$334,000
Incremental OMRR&R	$0
Total AAEQ Cost	$334,000
Net AAHU Gain (Benefits)	14.5
Acres Restored	64
AAEQ Cost/AAHU	$23,000
AAEQ Cost/Acre	$5,200

5.7 Fish and Wildlife Coordination Act (FWCA) Considerations*

The FWCA requires that fish and wildlife resources receive equal consideration to other project features in any Federal proposal for water resources development. Pursuant to Section 2(b) of FWCA, NMFS had the opportunity to provide input during the planning process and provided a Planning Aid Letter (PAL) that describes fish and wildlife resources in the study area, potential negative effects of the proposed project, and recommendations for mitigating the effects. The PAL appears in Appendix D. The potential negative effects identified in the PAL include the following:

- Increased turbidity from dredging that can cause lethal, sublethal, and behavioral effects to fish
- Potential resuspension of contaminants from dredged sediments
- Habitat disturbance for Essential Fish Habitat species (groundfish such as English sole) that forage in deep water
- Container ships are identified as having a potential effect on the feeding behavior of Southern Resident killer whales

Recommendations included the following:

- Work with NMFS, USFWS, Pierce County, Washington State Department of Fish and Wildlife (WDFW), EPA, and the Puyallup Tribe to determine restoration actions to mitigate for project impacts
- Coordinate with NMFS throughout the development of the alternatives and design of the project to expedite the ESA Section 7 consultation
- Develop a contingency plan to minimize water quality effects should contaminants be discovered during sediment sampling prior to dredging
- Provide a full characterization of sediment quality that will be used in nearshore placement
- Include an analysis of vessel effects on marine mammals
- Maximize habitat restoration in the nearshore
- Perform monitoring of habitat restoration site

After initial coordination and receipt of the PAL, the Corps considered the four key items identified as potential negative effects and incorporated analyses of these points into the environmental effects analysis in Chapter 4.

The Corps has coordinated closely with the natural resource agencies and Puyallup Tribe during the alternatives development phase. This coordination and consultation, including with the Muckleshoot Indian Tribe, will continue through design and implementation to avoid and minimize project impacts. Based on the Corps' determination that most project adverse effects would be short-term and temporary, and the only permanent adverse changes would have insignificant and discountable effects on environmental resources, the Corps has elected not to incorporate compensatory mitigation into the project design. In recognition of the identified potential negative effects listed in the PAL, the Corps will avoid and minimize effects by incorporating all applicable BMPs, as described in Section 4.6 Water Quality, Section 4.10 Hazardous, Toxic, and Radioactive Waste, and Section 4.17 Public Health and Safety. The Corps will continue to coordinate with NMFS throughout the study as part of the ESA Section 7 consultation. A full sediment characterization will be conducted for all dredged material in PED. Applicable BMPs would be implemented while dredging sediment unsuitable for open-water disposal to avoid and minimize the effects of unsuitable sediment. Vessel effects to marine mammals appear in Sections 4.13, 4.14, and 4.15. The beneficial use of dredged material at Saltchuk would maximize habitat restoration in the nearshore within the scope of this project and is included in the Recommended Plan. The Corps considered the PAL recommendation to perform monitoring at Saltchuk to confirm that fish use is established at baseline or improved levels, and at what time frame. The Corps will revise and update a monitoring and adaptive management plan in PED that follows Corps guidance and is applicable to the final design of Saltchuk (Appendix C).

5.8 Summary of Environmental Consequences and Cumulative Effects of the Recommended Plan (Agency Preferred Alternative)

The effects of an action can be additive, synergistic, or countervailing. After the Corps identified direct and indirect effects, it also evaluated the potential for cumulative impacts on resources as part of this study. According to the effects described for each resource in Chapter 4, the Corps determined that the incremental addition of the proposed action when added to other past, present, and reasonably foreseeable future actions will not substantially alter the context or intensity of effects on each resource category. Direct and indirect effects of the Recommended Plan, which are expected to be minor, and as a whole, would result in less than significant adverse effects, are summarized in Table 5-7 followed by a discussion of cumulative effects.

Table 5-7. Summary of Environmental Consequences of the Recommended Plan (Agency Preferred Alternative).

Resource	Short- and Long-term Consequences of the Recommended Plan
Navigation and Economic Conditions	Short-term: It helps the nation remain competitive in global commerce and boosts the regional economy. Long-term: National reduction in transportation costs and a 27% reduction in the number of vessel calls of the future fleet of containerships for the forecasted commodity demand.
Hydraulics and Geomorphology	Short-term: No short-term effects on hydraulics and geomorphology have been identified. Long-term: Deepening the Blair Waterway would cause a need for O&M dredging approximately every 25 years.
Geotechnical	Short-term: Deepening and widening would likely impact the side slopes of the channel. Additional slope stabilization may be necessary on over-steepened slopes, as determined by the slope stability modeling. Long-term: Potential effects may include erosion and turbidity due to previously unexposed soil now being exposed to tidal currents, as well as currents generated by ship propellers. Engineered solutions to achieve stable side slopes steeper than the angle of repose may need to be removed for future development within the waterway.
Water Quality	Short-term: Brief, minor pulses of turbidity and nearly undetectable decreases in DO may occur during dredging. Long-term: No long-term effects to water quality have been identified.
Air Quality	Short-term: Estimated air-pollutant concentrations from construction and O&M will stay below the threshold for NAAQS. Long-term: Potential changes in ship traffic emissions are predicted to result in a reduction in DPM emissions after construction.
Greenhouse Gas Emissions	Short-term: Construction and O&M would contribute a tiny fraction of statewide GHG emissions over the four construction seasons. Long-term: Changes in vessel traffic are predicted to result in a net reduction of CO_2 equivalent per year by 2035.
Sea Level Change	Short-term: Near future SLC would not affect the navigability of the waterways. Long-term: The intermediate and high level scenario predictions show a potential increase in navigable depth ranging between 0 and 2 feet in the next 50 years, which could reduce the need for O&M dredging if appropriate depths remain.
Underwater Noise	Short-term: Underwater noise from construction would occur when sensitive receptors may be present. These include marine mammals, fish, and diving birds. Long-term: Waterway improvements are predicted to result in a 27% reduction in annual vessel calls at Tacoma Harbor. This may reduce ambient underwater noise in Puget Sound, which would benefit the ESA-listed Southern Resident killer whales.
Hazardous, Toxic, and Radioactive Waste	<u>Non-HTRW Contamination</u> Short-term: Clamshell dredging causes re-suspension of sediments, and a minor fraction may have low levels of contamination (not at levels that constitute HTRW) that remain in the study area. Long-term: Removal of sediments that have low levels of contaminants (not at levels that constitute HTRW) would reduce contamination in the study area. <u>HTRW Contamination</u> Short-term: Corps regulations require avoidance of HTRW contaminated material, thus no short-term consequences

	Long-term: Corps regulations require avoidance of HTRW contaminated material, thus no long-term consequences
Benthic Organisms	Short-term: Dredging would cause mortality in the area being dredged. Long-term: Benthic macroinvertebrate populations are known to recover quickly from the type of action proposed, as in up to four years. No long-term change to the benthic community is predicted to occur. Removal of contaminants is a benefit.
Fish	Short-term: Construction would cause temporary displacement of bottom-dwelling fish and has the potential for minor re-suspension of some bioaccumulative toxins. Long-term: Dredging would remove contaminants that can affect fish health. A reduction in vessel calls would reduce ambient noise and physical disturbance, which benefits fish.
Wildlife	Short-term: Construction may cause temporary displacement and has the potential for minor re-suspension of some bioaccumulative toxins. Long-term: Removal of sediments would remove contaminants that can affect the health of marine mammals and birds through their prey species.
Threatened and Endangered Species	Short-term: Dredging would cause noise and minor turbidity disturbance to the ESA-listed salmonids. Adherence to work windows and conservation measures would avoid potential significant impacts to juvenile salmonids. Long-term: The potential reduction in the number of vessel calls may have a slight reduction in ambient noise, which would benefit Southern Resident killer whales.
Cultural Resources	Short-term: No Historic Properties Affected Long-term: No Historic Properties Affected
Public Health and Safety	Short-term: Dredging may cause re-suspension of a very small quantity of chemicals that bioaccumulate in fish tissues, which humans may consume by humans who fish in the study area, although this is minimized by posted health advisories. Long-term: Dredging may remove unsuitable sediments from the study area, thereby having a minor improvement for seafood items in the study area.

The negative cumulative effects identified in this study would be the low, but not discountable probability, that migrating salmonids may be present in the Blair Waterway during dredging. These fish may encounter turbidity pulses near the dredge or minor underwater noise disturbance from dredging, as well as the same types of effects from planned upgrades on the Blair Waterway. This combination of effects would only occur if dredging in the Blair Waterway and Saltchuk construction is simultaneous with planned upgrades or other capital improvements that have in-water effects. Adult salmonids migrating upstream would not be affected by the potential re-suspension of bioaccumulative toxins from this action because they are no longer eating prey during their upstream spawning migration; however, these fish may have encountered contaminants in their juvenile life stage during their outmigration from the Puyallup River. Work windows further separate the potential for overlap in single year classes if four years of dredging are necessary because ending the work window in February limits juvenile salmonid exposure to construction. If dredging associated with channel deepening or dredged material placement associated with Saltchuk are not concurrent with other in-water work from other projects, then different year classes of salmon would not encounter noise and turbidity from other projects, and no single year class of migrating salmon would encounter all the projects and associated disturbances because adults largely return to the Puyallup River to spawn as three-year-olds or older (Marks et al. 2018).

The 27% reduction from 590 to 428 Panamax and Post-Panamax ships per year by 2035 is considered a countervailing effect for air quality, GHG emissions, underwater noise, and disturbance to fish and ESA-listed species because the reduced vessel traffic would be a long-term benefit.

5.9 Implementation Requirements

The following sections outline the requirements for the implementation of the Recommended Plan.

5.9.1 Non-Federal Sponsor

The Port of Tacoma is the Non-Federal Sponsor for the implementation of this navigation improvement project. The Port fully supports the Recommended Plan. The Port understands its responsibilities under the future Project Partnership Agreement required to design and implement the project. The Port provided a letter of support for the recommended plan. Self-certification of financial capability documentation will be included in subsequent agreements between the Port and the Corps.

5.9.2 Implementation

The schedule for project implementation is dependent on project authorization from Congress. After project authorization, the project would be eligible for construction funding. The project would be considered for inclusion in the President’s budget based on national priorities, the magnitude of the Federal commitment, economic and environmental feasibility, level of local support, willingness of the non-Federal partner to fund its share of the project cost, and the budget constraints at the time of funding. If Congress appropriates Federal construction funds, the Corps and the non-Federal sponsor would enter into a Design Agreement to complete design following receipt (or appropriation) of design funding. The Design Agreement would define Federal and non-Federal responsibilities for the completion of final designs for the project. If Congress authorizes construction and appropriates funding, the Corps and non-Federal sponsor would execute a Project Partnership Agreement (PPA) following design to construct the project. The PPA would define the Federal and non-Federal responsibilities to implement, operate, and maintain the project. Assuming efficient funding, PED is anticipated to last 30 months. Assuming efficient funding, construction is anticipated to occur throughout the six-month work window in four consecutive years.

5.9.3 Pre-Construction, Engineering, and Design (PED) Activities

Various activities will be performed in PED, which follows the completion of the feasibility study phase. The PED phase of project development encompasses all planning and engineering necessary for project construction. These PED studies are required to review the earlier study data, obtain current data, evaluate any changed conditions, establish the most suitable plan for accomplishment of the improvement, and establish the design of the project features in final detail. PED studies for projects authorized for construction will be programmed as "continuing" activities. The results of PED studies are presented in reports identified as "design memorandums." Preparation of design memorandums and plans and specifications will be cost shared in accordance with the cost sharing required for project construction. The non-Federal share of costs for this work will ordinarily be recovered during the first year of construction. Current engineering guidance regarding document preparation and approvals for Civil Works projects should be consulted (ER 1110-2-1150). The Corps will perform the following during PED. These activities are listed generally in the sequence they would occur, but may overlap:

1. A ship simulation study. A more rigorous ship simulation will be performed in PED to confirm the final channel design. The ship simulation will include Puget Sound Pilots and tug operators calling commands. The Corps will also seek input from USCG. An approved ship simulator will be used to test various environmental conditions, ship configurations, and berthing configurations (Appendix B). This ship simulation will include evaluation of Saltchuk and the mouth of the Hylebos Waterway to ensure safe transit of vessels calling on the waterway. Expected improvements include the following:
    a. More accurate representation of the actual ship sizes to call on Blair Waterway
    b. Better hydrodynamic interaction between transiting and docked vessels
    c. Variable wind conditions and wind shadowing effects from docked vessels
    d. Increasingly detailed visuals
    e. Updated tugboat library to include readily available tugs at the Port
    f. Increasingly detailed currents
2. Final channel design, including further Geotechnical analysis of existing conditions, soil sampling and characterization, evaluation of previous designs, and appropriate slope stabilization design.
3. Full dredged material suitability determination. A full suitability determination will be performed based on the final channel design by collecting sediment cores and analyzing these to determine their suitability for meeting open-water disposal guidelines required by the DMMP agencies. The sampling plan will have an independent review conducted by the Environmental and Munitions Center of Expertise (CEHNC) to advise that the plan is adequate and accounts for potential sources of environmental risk or liability from areas impacted by the project footprint.
4. USACE will engage the Puyallup Tribe and offer the opportunity to review and comment on the sampling design for the DMMP suitability characterization. USACE also will engage the Tribe regarding criteria for placement of sediments at the Saltchuk beneficial reuse site.
5. Upon receipt of the DMMP sampling data, and prior to a determination by the DMMP, USACE (including the Environmental and Munitions Center of Expertise (CEHNC)) will engage the US EPA to review the sampling results in the context of CERCLA and the Commencement Bay Nearshore Tideflats Superfund project. USACE will also engage the Toxics Cleanup Program at Washington Department of Ecology (Ecology). Through this engagement with EPA and Ecology, the regulatory agencies could make a site-specific risk management decision as to whether results from the DMMP sampling indicate any portions of the waterway that may warrant further investigation or remedial response under CERCLA or other applicable Federal or State environmental laws. Should EPA or Ecology make such a decision, the non-Federal sponsor will be fully responsible for coordinating and funding those efforts at 100% non-federal expense, prior to and outside of USACE proceeding with the navigation project.
6. Archaeological monitoring will occur during the fieldwork necessary for dredged material full suitability determination (see item 1 on this list). A qualified archaeologist will monitor and examine sediment cores.

7. Environmental coordination. The Corps will provide final designs, the suitability determination, and address early coordination comments received January 29, 2021 to complete the package of documents for Ecology's review. This is necessary to seek a Clean Water Act Section 401 WQC and concurrence with the consistency determination under the Coastal Zone Management Act. The Corps and local sponsor will continue coordinating with the local tribes for their concerns, such as avoiding impacts to tribal fisheries from construction schedules, and with natural resource agencies to determine whether any new environmental concerns have arisen since the signature of the Chief's Report. The Corps will review the need for supplemental environmental documentation (e.g., supplemental NEPA analysis) during PED.
8. Upland disposal and transloading plan. Following a full suitability determination by the DMMP agencies, upland disposal quantities will be finalized. At that point, the Corps will develop a disposal plan and identify a transloading facility.
9. For beneficial use of dredged material, the final design of the Saltchuk beneficial use site will be developed. The Corps will collaboratively engage with NMFS, state, federal, and tribal agencies in finalizing the Saltchuk design (Section 6.2 ESA). A full sediment characterization that will occur during PED will provide additional information about material suitability for Saltchuk. Coordination with natural resource agencies and tribes during PED will further inform the material's suitability for beneficial use.
10. Phase II Environmental Site Assessment. Additional investigations conducted under a Phase II Environmental Site Assessment are needed to delineate the nature and extent of contamination at the Former Lincoln Avenue Ditch Site as it relates to the deepening study. Given the length of time since completion of the remedial action in this area, contamination remaining in place, and uncertainty related to nature and extent, a Phase II assessment is considered necessary. These investigations are needed for both sediment and groundwater. Sediment testing may also confirm if contamination has the potential for migration. Should additional coordination during PED with EPA include availability of new data or design modifications that fully avoid Lincoln Avenue Ditch, a Phase II may not be warranted. The Environmental and Munitions Center of Expertise (CEHNC) will advise on any Phase II Site Assessments.
11. Additional coordination with EPA Region 10 and the Toxics Cleanup Program at Washington Department of Ecology is needed for the Occidental Chemical Corporation site (RCRA) and TruGrit Abrasives site (MTCA) to ensure there is no overlap or associated impacts at these HTRW sites resulting from the implementation of the Recommended Plan. At this time, preliminary investigations suggest these two HTRW sites will not be of concern but should be confirmed as the design progresses.
12. The Monitoring and Adaptive Management Plan (MAMP) (Appendix C) for the Saltchuck Beneficial Use of Dredged Materials site will be revised and updated based on more detailed construction designs in PED. The MAMP will be updated in accordance with the implementation guidance for Section 1161 of WRDA 2016 and other current guidance.
13. Develop a climate risk table summarizing the various sea level change and future climate related hydrologic risks as per Engineering and Construction Bulletin (ECB) 2018-14 analysis procedures. Ideally a hydrology expert would be brought on board to perform said analysis. The climate assessment would aim to contain the following elements:

a. Climate Hydrology Assessment tool (CHAT) analysis of Hydrologic Unit Code 8 (HUC-8) (Puyallup River-177110014)
b. Vulnerability Assessment Tool – Navigation Business Line
c. Qualitative risk assessment of climate risk and major project element variables such as sedimentation (disposal area capacity, O&M dredging), SLC (shoaling depth, navigability, access to LSF's).
d. Brief climate literature synthesis.

14. Implement applicable environmental commitments, such as develop monitoring plans and comply with reporting requirements as required for ESA compliance (Section 6.2). Ensure environmental commitments are included in plans and specifications, as appropriate (Section 5.9.5 Environmental Commitments and BMPs).

5.9.4 Operations, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R)

O&M dredging is assumed to occur at 25-year intervals to ensure shoaling depth does not impact navigation in the channel while minimizing mobilization costs of a dredge (see Appendix B, Annex B). The NED Plan OMRR&R estimate is $4,220,000 per 25-year dredge cycle or $8,440,000 over the 50-year period of analysis. The cost share for the OMRR&R is based on the NED Plan depth of -57 MLLW with 50% Federal and 50% non-Federal cost share. Non-Federal sponsor cost requirements are described in Section 5.4. Cost sharing allocation for construction and OMRR&R costs appear in Table 5-2.

5.9.5 Environmental Commitments and BMPs

This section summarizes all commitments made to comply with project requirements. These commitments and BMPs must be included in the project plans and specifications to ensure implementation.

1. Activities to be done in PED as listed in Section 5.9.3.
2. FWCA recommendations and responses appear in Section 5.7.
3. Terms and Conditions and BMPs from the NMFS BiOp appear in Section 6.2.
4. EFH conservation recommendations and responses appear in Section 6.9. The complete EFH response letter from the Corps to NMFS appears in Appendix D.
5. The Monitoring and Adaptive Management Plan for beneficial use of dredged material at Saltchuk is in Appendix C.
6. Recommendations and project assumptions from the 2019 DMMP advisory memorandum (Appendix B) for dredging and beneficial use of dredged material appear in Section 5.3.1 and Section 5.3.2, respectively.
7. BMPs for water quality protection appear in Section 4.6.2.

5.10 Risk and Uncertainty

5.10.1 Risk and Uncertainty Addressed to Date

The Corps has used a risk-based strategy in its approach to formulating and evaluating alternatives. Key risks, uncertainties, or assumptions for the study are summarized below, along with risk management strategies used to date.

5.10.1.1 Feasibility-Level Design

Channel design guidelines in EM 1110-2-1613 recommend a wider channel to accommodate the design vessel in the Blair Waterway. The Corps conducted feasibility-level ship simulation in April 2019, described in Section 3.3.2, and in Appendix B, to determine if a channel width narrower than Corps channel design guidelines is feasible, identify any potential berthing area overlap with the channel, and inform the proposed design used for evaluation during feasibility. Ship simulation results validated our narrower channel widths as being adequate for vessel transits while exposing areas where widening was beneficial, including the turning basin.

5.10.1.2 Suitability Determination and Disposal Assumptions

Assumptions regarding quantities of dredged material requiring upland disposal are based on results from the advisory-level DMMP sampling and testing. These testing results and associated assumptions regarding quantities for upland disposal provide sufficient data to estimate open-water, beneficial use, and upland disposal assumptions during the feasibility phase. Section 5.3 describes the suitability determination and disposal quantities. The Corps developed conservative estimates for use in the feasibility study for the quantity of material requiring upland disposal. In addition, the risk of potential change in quantities for upland disposal has been included in the cost schedule risk analysis and associated cost contingency.

5.10.1.3 Economics Assumptions

Commodity growth and fleet transition are the most critical assumptions in determining project justification. Trade volume can be volatile year-to-year based on exogenous political and economic conditions. The Corps uses a long-term commodity forecast based on prevailing and anticipated market conditions. While short-term variability between forecasted commodity volumes and actual trade is possible, longer-term divergence between the forecast and actual trade is a more influential study risk. Lower trade volume can reduce total vessel calls and slow the rate of fleet transition in the long run.

The Corps conducted various scenario analyses testing the sensitivity of project justification to more pessimistic commodity forecasts and the resulting slow-down in fleet transition (Appendix A, Section 5). Except for the no growth scenario (no change from the existing condition), the project remains justified under all scenario analyses, indicating a relatively low threshold for project justification. Breakeven analysis indicates project justification with as little as 33% and 17%of the forecasted fleet transition to PPX3 and PPX4 vessels, respectively.

The economic analysis also attributes deepening benefits by terminal based on each terminal's share of total trade volume. The ability of Husky and WUT terminals to berth two PPX4 vessels simultaneously means that these terminals can accommodate similar fleet distributions, leading to an equal share of benefits. The maximum vessel size at PCT will likely be a PPX3 vessel, leading to a slightly smaller fleet than Husky and PCT and potentially a lower share of benefits than its cargo share. To address these uncertainties, the analysis includes sensitivity runs to confirm that the entire channel is justified at the NED depth, and no combination of depths will raise net NED benefits higher than the NED Plan. Appendix A, Section 5, includes all sensitivity analyses and results.

5.10.2 Risk and Uncertainty to be Addressed

Key risks, uncertainties, or assumptions for implementation are summarized below, along with risk management strategies. There are no remaining high risks identified.

5.10.2.1 Side Slope Stability and Cost, Environmental Effects, and Associated Real Estate

As described in Section 3.3.4, side slopes in the proposed design have the potential need for additional stabilization at four sites in Blair Waterway. One risk with not selecting during feasibility which type of side slope stability that potentially will be needed at these sites is potential cost and environmental effects. The Corps included conservative cost estimate assumptions and environmental assumptions for effects analysis during feasibility to reduce this risk. In addition, the Corps will refine the design in PED based on a full ship simulation, sediment analysis, and operational constraints, which will inform selection of side slope stability at these sites.

Real estate availability is an uncertainty, specifically at sites 2 and 3 (Figure 3-4). The Puyallup Tribe owns two parcels along the north side of Blair Waterway. The proposed channel is based on feasibility-level analysis and is the appropriate width for navigation and avoids berth overlaps in the channel. However, the proposed channel overlaps with the tribal land. Per Corps policy, the non-Federal sponsor is required to provide all lands, easements, rights-of way, and relocations for a navigation project. However, the Port is not required to acquire real estate during feasibility. The risk is whether the Port will be able to acquire this land and the impact on the proposed project if the land is not available. To manage this risk, the Port is working closely with the Puyallup Tribe on acquiring the appropriate real estate for the project. The Port has provided evidence of an existing agreement for land transfer for the locations in question. The Port has confirmed that it is aware of the challenges involved in acquiring interest in Tribal land and has demonstrated an understanding of the difficulty involved as well as confidence in being able to perform the acquisition if necessary. The likelihood this risk associated with acquisition would be realized is low to moderate, based on the presence of this agreement and the history and ongoing partnership in the waterway between the Puyallup Tribe and the Port.

In addition, this real estate risk may be avoided as it may be possible to shift the channel alignment and avoid these tribal parcels as a result of design refinements in PED described above. If further design in PED does not avoid these parcels, and if the Port is unable to acquire this real estate, the Corps would reduce the recommended project scope. The Corps evaluated Alternative 2A (Husky Only; see Chapter 3) to make navigation improvements through the Husky Terminal only – the terminal closest to the waterway entrance. This would avoid the tribal land that overlaps the proposed channel. This alternative – including economic and environmental analysis – is documented in the IFR/EA.

Additional risk management the Corps considered for all four of these sites, but chose not to implement, includes additional ship simulation and sediment analysis during feasibility, rather than in PED. Given side slope stability at two of these locations is dependent first on the Port acquiring real estate, which is not required during feasibility, and that the Corps included a conservative cost estimate and environmental assumptions, additional technical analysis during feasibility would not reduce uncertainty about what side slope stability is needed or whether it is possible to narrow the proposed channel and avoid the need for real estate. In addition, more ship simulation and sediment analysis would exceed the time and cost constraints for feasibility studies.

5.10.2.2 Additional Environmental Considerations

The project location is located within a National Priorities List (NPL) Site known as the Commencement Bay Nearshore Tideflats Superfund Site pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. § 9601-9675. The Operable Units (OUs) associated with Blair Waterway include the Commencement Bay/Nearshore Tideflats Sediments OU (OU1) and the Commencement Bay/Nearshore Tideflats Source OU (OU5). The U.S. Environmental Protection Agency (EPA) issued a partial deletion in 1996 pertaining to the portions of the two separate OUs addressing sediments contained in and properties draining to the Blair Waterway. As such, no further Federal action is required for remediation of sediments or associated sources to Blair Waterway.

Although the Blair Waterway has been delisted, a Phase II Environmental Site Assessment will be conducted in PED to delineate the nature and extent of contamination at the Former Lincoln Ave Ditch Site as it relates to the Recommended Plan. These investigations are needed for sediment and groundwater. Sediment testing may also confirm if contamination has the potential for migration. This will help to address risk and uncertainty as the design progresses. Additionally, continued coordination with regulatory agencies will help ensure any HTRW material is accurately identified. If contaminated materials are encountered, or sediment sampling indicates the presence of regulated hazardous substances during design or construction of the authorized project, the Corps will immediately coordinate with the appropriate regulatory authority (EPA or Ecology) and the non-Federal sponsor, Port of Tacoma, to determine the appropriate next steps. The Corps will require the Port to assume responsibility for these materials and take the necessary actions to protect the U.S. from liability for such contamination by not proceeding further with design or construction until the necessary coordination is completed, the regulatory authority has determined the need for additional remedial response actions, and such remedial response actions have been completed. The non-Federal sponsor shall be responsible for ensuring that the development and execution of Federal, state, and locally required HTRW response actions are accomplished at 100% non-project costs. No cost-sharing credit will be given for the costs of response actions (ER 1165-2-132, para 6.c.).

5.10.2.3 Environmental Benefits

Evaluating the Saltchuk beneficial use site will be based on the establishment of the targeted habitat within the restoration site and on the ecological functioning of those habitats. The level of detail in the monitoring and adaptive management plan (Appendix C) is based on currently available data and information developed during plan formulation as part of the feasibility study. Uncertainties remain concerning the exact project features, monitoring elements, and adaptive management opportunities that will be further defined as the design is further developed. Components of the plan, including costs, were similarly estimated using available information. Verification of assumptions relied upon during feasibility will be addressed in the PED phase; the monitoring and adaptive management plan will be revised to incorporate more detailed monitoring and adaptive management plans and cost breakdowns.

5.11 Environmental Operating Principles and Campaign Plan

The Corps has reaffirmed its long-standing commitment to environmental conservation by formalizing a set of Environmental Operating Principles (EOPs) applicable to decision-making in all programs. The EOPs outline the Corps' role and responsibility to sustainably use and restore our natural resources in a complex and changing world. The Recommended Plan meets the intent of the EOPs. In coordination with agencies, tribes, and other stakeholders, the Corps proactively considered the environmental consequences of the proposed deepening project. The project would be constructed in compliance with all applicable environmental laws and regulations. In accordance with the EOPs, the Corps has proposed a project that supports economic and environmentally sustainable solutions.

The Corps' Campaign Plan includes specific goals and objectives to deliver integrated, sustainable water resources solutions. This project primarily supports the Corps' Campaign Plan Goals 2 and 4. These goals include the transformation of the Civil Works process to deliver enduring and essential water resource solutions using effective transformation strategies as well as build resilient people, teams, systems, and processes to sustain a diverse culture of collaboration, innovation, and participation to shape and deliver strategic solutions. The project meets the intent of these Campaign Plan goals by working within the Civil Works transformation framework to recommend a plan intended to improve safety and efficiency.

6 Compliance*

This chapter provides documentation of how the Recommended Plan (agency preferred alternative) complies with all applicable Federal laws, statutes, and executive orders.

6.1 National Environmental Policy Act

The National Environmental Policy Act (NEPA) (42 U.S.C. § 4321 *et seq*.) commits Federal agencies to consider, document, and publicly disclose the environmental effects of their actions. This integrated IFR/EA is intended to achieve NEPA compliance for the proposed project. Before preparing this document, the Corps published a Notice of Preparation of an EA and held a public information meeting in the study area on January 17, 2018. All comments received at the public information meeting and during the comment period of December 21, 2019, through February 21, 2019, were considered in determining whether it will be in the public interest to proceed with the proposed project and which resources must be considered in a detailed analysis. Progress of the feasibility study is regularly reported to decision-makers. The Draft IFR/EA was published for a 60-day comment period beginning December 18, 2019 and received 72 comment submittals (Appendix E).

6.2 Endangered Species Act of 1973

The Endangered Species Act (ESA) (16 U.S.C. §§ 1531-1544), Section 7(a) requires that Federal agencies consult with NMFS and USFWS, as appropriate, to ensure proposed actions are not likely to jeopardize the continued existence of endangered or threatened species or to adversely modify or destroy their critical habitats. The Corps held meetings with natural resource agencies, including NMFS and USFWS, on October 25, 2018, and September 16, 2019, with additional phone calls and emails for informal coordination throughout the study. The Corps prepared a Biological Assessment based on the feasibility-level design of the Recommended Plan and submitted the Biological Assessment to NMFS and USFWS per consultation procedures under Section 7 of the ESA on March 20, 2020. This BA also evaluated potential effects of the project on Essential Fish Habitat (EFH; Section 6.9) under Public Law 104-297 (the Sustainable Fisheries Act of 1996), which amended the Magnuson-Stevens Act, as well as addressing effects to marine mammals protected under the Marine Mammal Protection Act (MMPA) of 1972 (16 U.S.C. §§ 1361-1407).

Additional information was requested and received by USFWS, in correspondence and in meetings, from May, June, and December 2020; June and December 2021; and January 2022. USFWS concurred with the Corps' effect determinations of "not likely to adversely affect" (NLAA) listed species on February 2, 2022 (Appendix D). Additional information was requested and received by NMFS, in correspondence and in meetings in May, June and December of 2020; February, March, and July through December 2021; and January and February 2022.

NMFS issued a BiOp February 16, 2022 (Appendix D), which concurred with the Corps' effects determinations except NLAA for steelhead; instead, NMFS determined the action is likely to adversely affect steelhead. In addition, NMFS' action area extends farther into Puget Sound where Humpback whale, Central America DPS and Mexico DPS, could be present and determined the action is NLAA the species whereas the Corps determined the action would have no effect.

The NMFS BiOp (Appendix D) included mandatory Reasonable and Prudent Measures (RPMs), and the Terms and Conditions that implement the RPMs provide as follows:

1. The Corps shall minimize incidental take of listed species resulting from entrainment and strike.
    - Operate dredge equipment slowly to minimize strike and entrainment
    - Monitor during dredging for entrained fish in dredged material from each new area of activity or after six hours of inactivity.
2. The Corps shall minimize incidental take of listed species resulting from elevated noise.
    - Adhere to in-water work window August 16 – February 15 for the four years of construction.
    - Monitor underwater noise while dredging at the mouth of the Blair Waterway.
    - Submit a noise monitoring plan that includes the methods of observation, such as hydrophones, and a list of activities monitored, including dredging operation, vessel operations, and sediment deposits at Saltchuk for NMFS review at least 60 days prior to construction.
3. The Corps shall minimize incidental take of listed species resulting from suspended sediment and re-suspended contaminants during dredging, shoreline stabilization, and material placement.
    - Monitor water quality to comply with the WQC
    - Dredge in a manner that minimizes spillage of excess sediments from the bucket and minimizes potential entrainment of fish.
    - Ensure that an emergency cleanup plan is in place in the event the barge, truck, or railcar has an incident where unsuitable material is spilled.
    - Ensure dredging contractor utilizes a current, accurate Global Positioning System (GPS) dredge positioning to control the horizontal and vertical extent of the dredge to ensure dredging does not occur outside the limits of the dredge prism.
4. The Corps shall develop a monitoring and reporting plan to ensure that the RPMs are implemented as required and take exemption for the proposed action is not exceeded, and that the terms and conditions are effective in minimizing incidental take.
    - Submit all reports to NMFS within four months of the end of any work window where in-water work occurred unless otherwise specified and provide monitoring plans to NMFS for review at least 60 days before construction activities.
    - Monitor underwater for fish prior to dredging in the Blair Waterway and material placement at Saltchuk.
    - The Corps will develop an Underwater Observation Monitoring Plan that includes methods and schedule to monitor for ESA-listed fish presence immediately preceding dredging within the Blair Waterway. It will also include methods to monitor abundance and diversity of ESA-listed fish using Saltchuk prior to initiation of construction activities during the first year, and to monitor abundance and diversity of ESA-listed fish using Saltchuk immediately preceding material placement at Saltchuk unless thin-layer placement via barge or excavator-assisted placement is not used.

- Submit annual monitoring reports within 4 months after the work window closes in each of the four years of construction, summarizing the following for the previous calendar year:
  i. Hours of dredging completed per day;
  ii. The number of days of dredging per month and for the entire year;
  iii. The total daily and cumulative sediment removal totals;
  iv. Total sediment disposed at each location (Open water site, Saltchuk, upland);
  v. Turbidity levels from monitoring and whether state turbidity compliance was met;
  vi. Results from dredging monitoring
  vii. Results from noise monitoring;
  viii. Results from underwater observation associated with dredging in Blair Waterway and material placement at Saltchuk.
  ix. Monitoring reports shall be submitted to: projectreports.wcr@noaa.gov, include WCRO-2020-00645 in the subject line.
- Monitor and report the abundance and diversity of ESA-listed fish and natural recruitment of eelgrass and submerged aquatic vegetation at Saltchuk in years 3, 5, and 10 after construction

5. The Corps shall develop a plan to enhance restoration efforts implemented at the Saltchuk site and improve nearshore habitat conditions for listed species. Additionally, the Corps and non-federal sponsor shall engage NMFS in finalization of construction and beneficial material use designs to ensure take of listed species is minimized.
   - Collaborate with NMFS, Federal, state, and tribal agencies to finalize the design for beneficial use of dredged material at Saltchuk
   - Provide NMFS with finalized project designs within a minimum of 60 days prior to commencing construction.

As acknowledged in Section 5.9.5, the Corps expects to continue coordination with the USFWS and NMFS during the PED phase. The Corps will implement the following BMPs and conservation measures in the NMFS BiOp (Appendix D).

1. Comply with all applicable water quality standards and enforceable conditions issued in the water quality certification and adhere to monitoring protocols in the water quality monitoring plan
2. Dredge and place material at Saltchuk only within the designated in-water work window of August 16 through February 15
3. Prior to dredging, the entire footprint of the Blair waterway project area would undergo additional sediment testing to determine suitability for aquatic disposal, and all material determined unsuitable for in-water disposal would be transported for upland disposal at an appropriate facility
4. An environmental clamshell bucket would be used in all areas in which sediment has been determined unsuitable for aquatic disposal to minimize resuspension of contaminated sediment

5. The side slopes of the navigation channel would be graded to ensure that no sloughing would occur
6. All equipment would be inspected daily to ensure that it is in proper working condition and has no leaks of fuel or hydraulic fluids. Each vessel would have a spill kit on board at all times

Please note that grading refers to the process where the navigation channel would be dredged to allow the sideslopes to come to a stable equilibrium to avoid sloughing later. An environmental bucket would be used to remove unsuitable material.

6.3 Clean Water Act of 1972

The Clean Water Act (33 U.S.C. § 1251 et seq.) requires Federal agencies to protect waters of the U.S. The regulation implementing the Act disallows the placement of dredged or fill material into water unless it can be demonstrated that no practical alternatives are less environmentally damaging. The Sections of the Clean Water Act that apply to the proposal are 401 regarding discharges to waterways and 404 regarding fill material in waters and wetlands.

6.3.1 Section 401

Any project that involves placing dredged or fill material in waters of the U.S. or wetlands or mechanized clearing of wetlands requires a water quality certification from the State agency as delegated by EPA. For the Tacoma Harbor project, the delegated authority is Ecology. The Corps initiated coordination with Ecology at the Corps' Semi-Annual Tribal and Natural Resource Agency Dredging Meeting October 25, 2018 to certify the proposed Federal action will not violate established water quality standards. The Corps submitted documentation for Ecology's review based on the feasibility-level design on December 18, 2019. Ecology responded on January 27, 2021 in support of the Corps' continued efforts to seek funding for the Tacoma Harbor project. Ecology also provided comments on the submitted documentation that will be addressed by the Corps in PED. The final review will occur after the final DMMP Suitability Determination (valid for three to five years), when final design specifications are available. Should further analysis and design in PED determine additional side-slope stabilization measures are warranted, to the extent this activity would also result in jurisdictional activity under Section 404 of the CWA that is not administered by Ecology, the Corps will also seek a Section 401 WQC to address this activity from the Puyallup Tribe.

6.3.2 Section 404

The Corps is the regulatory agency that provides individual and general Section 404 permit decisions. Compliance with Section 404 requires public interest review, and it is necessary to avoid negative effects on waters of the U.S. wherever practicable, minimize effects where they are unavoidable, and compensate for effects in some cases. The Corps does not issue itself a Section 404 permit and instead conducts a substantive Section 404(b)(1) Evaluation and public interest review. These appear in Appendix D. The findings are that there would be no significant adverse effects on aquatic ecosystem functions and values under Alternative 2b (Blair Waterway Deepening to -57 MLLW [NED Plan/Preferred Alternative]), and this project is within the public interest.

6.4 Coastal Zone Management Act of 1972

The Coastal Zone Management Act of 1972, as amended (16 U.S.C. §§ 1451-1464) requires Federal agencies to conduct activities in a manner consistent to the maximum extent practicable with the enforceable policies of the approved State Coastal Zone Management Program. The Corps has prepared a Consistency Determination for the project according to the relevant enforceable policies and found the project is substantively consistent with the enforceable policies of the Pierce County and City of Tacoma's Shoreline Master Programs. The Corps submitted documentation for Ecology's review based on the feasibility-level design on December 18, 2019. Ecology responded on January 27, 2021 in support of the Corps' continued efforts to seek funding for the Tacoma Harbor project (Appendix D). A final review will occur when final design specifications are available.

6.5 Clean Air Act of 1972

The Clean Air Act (CAA), as amended (42 U.S.C. § 7401, *et seq.*) prohibits Federal agencies from approving any action that does not conform to an approved state, tribal, or Federal implementation plan. Under the CAA General Conformity Rule (Section 176(c)(4)), Federal agencies are prohibited from approving any action that causes or contributes to a violation of a NAAQS in a nonattainment area.

The proposed action would occur in a maintenance area for $PM_{2.5}$ and PM_{10}, according to Washington State standards and NAAQs. Construction activities associated with the proposal will create air emissions, but these would not affect the implementation of Washington State's CAA implementation plan. Construction work of the magnitude included in the proposal is not typically a concern in maintenance areas. The estimated emissions are expected to meet the standards set forth by the EPA and implemented by Washington State. Under the preferred alternative, the total direct and indirect emissions associated with the Federal action would not equal or exceed the applicability rate as specified at 40 CFR 93.153 for PM2.5 and PM10. Therefore, a general conformity determination is not required.

6.6 National Historic Preservation Act of 1966

Section 106 of the National Historic Preservation Act (NHPA) (16 U.S.C. § 470), as amended through 2000 (Public Law 102-575), requires Federal agencies to account for the indirect, direct, and cumulative effects of their undertakings on Historic Properties (i.e., archaeological sites, Traditional Cultural Properties, buildings, structures, objects, districts, and landscapes listed in or eligible for listing in the National Register of Historic Places). Section 106 and its implementing regulations at 36 C.F.R. § 800 establish procedures for Federal agencies to follow in identifying Historic Properties and assessing and resolving effects of their undertaking on them in consultation with State Historic Preservation Officers (SHPO), Indian tribes, Native Hawaiians, and the Advisory Council for Historic Preservation (ACHP), as appropriate.

The Corps is consulting with the SHPO, Muckleshoot Indian Tribe, Nisqually Indian Tribe, Puyallup Tribe of Indians, Snoqualmie Tribe, Squaxin Island Tribe, and Confederated Tribes and Bands of the Yakama Nation under Section 106 of the NHPA. On October 19, 2018, the Corps sent an APE letter to the SHPO describing the project and APE. The SHPO responded on October 30, 2018, and agreed with the APE. On October 29, 2018, the Corps sent letters to the SHPO, Muckleshoot Indian Tribe, Nisqually Indian Tribe, Puyallup Tribe of Indians, Snoqualmie Tribe, Squaxin Island Tribe, and Confederated Tribes and Bands of the Yakama Nation describing the project and asking if there are any properties of cultural or religious significance that would be affected by the project. On March 26, 2019, the Corps sent a letter to the SHPO and aforementioned Tribes, providing a project update and revising the APE. The SHPO responded on April 8, 2019, concurred with the revised APE. To date, the Corps has not received a response from the Tribes regarding Section 106. In November 2019, the Corps submitted a letter to the Washington State Historic Preservation Officer with the determination of no adverse effect on known cultural resources and the condition of cultural resources monitoring during geotechnical testing of soils that will occur during the PED phase. The Corps received a letter from SHPO indicating a concurrence of no effect on November 7, 2019. Seeking clarification of the SHPO concurrence, the Corps contacted Rob Whitlam, State Archaeologist on April 27, 2021. SHPO issued its concurrence with the Corps determination of no adverse effect on historic properties via email on April 27, 2021. No response has been received by any of the aforementioned Tribes.

6.7 Federal Trust Responsibility

The Federal trust responsibility to Native American Tribes arises from the treaties signed between the Tribes and the U.S. Government. Under the U.S. Constitution, treaties are part of the supreme law of the land, with the same legal force and effect as federal statutes. Pursuant to this principle, and its trust relationship with federally recognized tribes, the United States has an obligation to honor the rights reserved through treaties, including rights to both on and, where applicable, off-reservation resources, and to ensure that its actions are consistent with those rights and their attendant protections. The Corps has a trust obligation to consult with, and consider views of, federally recognized American Indian Tribes when proposing an action that may have the potential to significantly affect tribal rights, resources and lands; including, but not limited to the impact of the proposed activity on tribal reserved treaty rights. See Department of Defense Instruction (DODI) 4710.02, Section 3, Subject: DOD Interactions with Federally Recognized Tribes (24 September 2018). The Supreme Court has held these commitments create a trust relationship between the U.S. and each treaty tribe, and impose upon the Federal government "moral obligations of the highest responsibility and trust."

The six federally recognized tribes in the area, the Muckleshoot Indian Tribe, Nisqually Indian Tribe, Puyallup Tribe of Indians, Snoqualmie Tribe, Squaxin Island Tribe, and Confederated Tribes and Bands of the Yakama Nation have signed treaties with the U.S. Government. All tribes except the Snoqualmie Tribe have treaty-reserved U&A fishing rights, but only Puyallup Tribe has U&A fishing sites in Commencement Bay. Tribal members have rights to commercial fishing, as well as ceremonial and subsistence harvest of salmon, shellfish, and non-salmon fish resources. Tribal fisheries are central to the cultural and economic existence of tribes and their members. Within the study area, the Puyallup Tribe of Indians exercise their fishing rights by harvesting salmon from the Puyallup River and harvesting crab and other shellfish from south Puget Sound Salmon Management Area (SMA) 11, which extends from the Tacoma Narrows Bridge to the northern tip of Vashon Island. The Muckleshoot Indian Tribe exercises their fishing rights in the Puyallup River Basin. No known tribal fishery occurs within the Blair Waterway but crab harvest occurs at the mouth of the Blair Waterway and the Saltchuk site. To avoid and minimize effects to tribal harvest, Corps coordination with the Puyallup Tribe will be necessary as outlined in Sections 5.9.3 and 5.9.5. In particular, but not limited to the following, the Corps will request feedback from the Tribe on construction scheduling and the Saltchuk design. While some degree of unsuitable sediment resuspension is inevitable for navigation dredging, increased risk associated with contaminant body burden in fish is not anticipated.

For this project, USACE will follow all necessary steps to ensure environmental impacts are minimized, including water quality monitoring requirements under Clean Water Act Section 401, dredging during designated in-water work windows, and thorough characterization of dredge material through the DMMP. Outside of the USACE proposed project and Blair Waterway, the US EPA continues to monitor contaminant levels in fish tissue and the potential changes resulting from previously completed remedial actions as part of the Commencement Bay Nearshore Tideflats Superfund project.

These tribes have had representation in this feasibility study through the environmental coordination process as well as the tribal government-to-government consultation process. The Corps has coordinated with the tribes to hear their concerns.

6.8 Fish and Wildlife Coordination Act of 1934

The Fish and Wildlife Coordination Act of 1934 as amended (16 U.S.C. §§ 661-667e) ensures fish and wildlife conservation is given equal consideration as is given to other features of water-resource development programs. This law provides that whenever any water body is proposed to be impounded, diverted, deepened, or otherwise controlled or modified, the Corps shall consult with the USFWS and NMFS as appropriate, and the agency administering the wildlife resources of the state. Any reports and recommendations of the wildlife agencies shall be included in authorization documents for construction or modification of projects. Recommendations provided by the USFWS in Coordination Act Reports must be specifically addressed in Corps feasibility reports.

The Corps initiated coordination for consideration of fish and wildlife species at the outset of the feasibility study and hosted a meeting with all interested natural resource agencies and tribes on October 25, 2018. Further coordination occurred throughout the feasibility phase via email and phone with NMFS, USFWS, WDFW, other agencies, and tribes. The Corps received a PAL on September 6, 2019, from NMFS (Appendix D). Results of the coordination and NMFS recommendations that detail the full compliance appear in Section 5.7.

6.9 Magnuson-Stevens Fishery Conservation and Management Act of 1976

The Magnuson-Stevens Fishery Conservation and Management Act, (16 U.S.C. § 1801 *et seq*.) requires Federal agencies to consult with NMFS on activities that may adversely affect Essential Fish Habitat (EFH). The objective of an EFH assessment is to determine whether the proposed action(s) “may adversely affect” designated EFH for relevant commercial, federally managed fisheries species within the proposed action area. The assessment describes conservation measures proposed to avoid, minimize, or otherwise offset potential adverse effects to designated EFH resulting from the proposed action.

Estuaries of Washington, including Puget Sound, are designated as EFH for various groundfish, coastal pelagic species, and three species of Pacific salmon. The Corps prepared an EFH assessment included in the Biological Assessment prepared for ESA Section 7 consultation and submitted it to NMFS on March 20, 2020. The Corps has determined that the proposed action would adversely affect EFH because removal of dredged material would constitute a detectable adverse effect to EFH, and that the placement of suitable dredge material will also have a short-term adverse effect at the Saltchuk site, but is anticipated to ultimately benefit juvenile Chinook salmon by creating shallow water habitat that is scarce in Commencement Bay and improving the benthic environment. EFH coordination for disposal at the

Commencement Bay multi-user aquatic site was previously concluded. NMFS responded on February 16, 2022, determining that there would be no adverse impacts on Coastal Pelagic EFH, but the proposed action would have adverse impacts on Pacific Coast Groundfish EFH and Pacific Coast Salmon EFH, and providing recommendations to avoid, minimize, mitigate, or otherwise offset the impact of the proposed action on these EFH. NMFS determined that while the action increases the overall depth of the Blair Waterway by six feet, it would not change the functional characteristics of the habitat conditions within the waterway even though dredging would cause short-lived adverse effects on EFH from temporarily diminished water quality, disturbed benthic habitat and bottom sediments, and resuspension of sediment unsuitable for aquatic disposal contemporaneously with pulses of turbidity. NMFS also concluded the project would benefit species at the Saltchuk site long-term. NMFS provided EFH conservation recommendations (Appendix D) as follows:

1. Require vessel operators to operate at the lowest safe maneuvering speeds and power settings when maneuvering in waters close to the shoreline.
2. Allow no overflow from the barge or hopper.
3. When using a mechanical dredge increase cycle time and reduce bucket deployment.
4. Always use equipment that generates the least amount of sedimentation, siltation, and turbidity.
5. When using a clamshell bucket, dredge in complete passes.
6. Sample and monitor noise levels in real-time during dredging activities. If noise levels surpass accepted thresholds for aquatic organisms implement alternative methodology to reduce noise.
7. Incentivize development of peer-reviewed studies that identify how noise generated from dredging impacts aquatic organisms and EFH.
8. Restore eelgrass and nearshore habitat along the Northwest shoreline and throughout Commencement Bay nearshore areas.

The Corps must reply to NMFS within 30 days after receiving EFH conservation recommendations with the number of recommendations accepted. The Corps provided a response in a letter dated March 15, 2022, accepting recommendations one through five in full, number six in part, and numbers seven and eight in full as provided under existing Corps programs and authorities.

Recommendations one through five are generally standard practices within the Corps' dredging protocols and described in the specifications of dredging contracts. The Corps will include these recommendations in the applicable dredging contract(s).

The sixth recommendation is accepted by the Corps as follows: Underwater noise will be monitored as described in Reasonable and Prudent Measure 2, and its implementing Term and Condition 2 of the NMFS BiOp. Alternative methodologies to reduce noise during mechanical (clamshell) dredging are not feasible; however, mechanical dredging generates less noise than hydraulic dredging. Available measures to minimize noise will already be implemented, such as using a clamshell bucket and recommendations listed above under 1 and 3.

The seventh recommendation is accepted by the Corps as follows: Studies of dredging effects, including those from noise, are performed by the Corps' Engineer Research and Development Center (ERDC) under the Dredging Operations and Environmental Research Program (DOER;

https://doer.el.erdc.dren.mil). DOER supports the Corps' Operation and Maintenance Navigation Program. Research is designed to balance operational and environmental initiatives and to meet complex economic, engineering, and environmental challenges of dredging and disposal in support of the navigation mission. Research will continue under these and other applicable Corps programs and authorities. Results are disseminated to Corps technical staff through webinars, newsletters, and the online ERDC library, which is also available to the public at the link above. A portion of DOER and ERDC research result in peer-reviewed journal publications (https://erdc-library.erdc.dren.mil/jspui/). Navigation programs receive research information from technical staff, engineering regulations, and the annual Corps national dredging meeting, as appropriate.

The eighth recommendation is accepted by the Corps as follows: This project does not have an ecosystem restoration component, but the Corps has included beneficial use of dredged material at Saltchuk in the Recommended Plan that, once constructed, would be expected to improve nearshore habitat conditions along the northwest shoreline of Commencement Bay. Planting eelgrass is not part of dredged material placement at Saltchuk. However, the project will raise substrate to elevations suitable for potential eelgrass colonization (+5 to -10 feet mean lower low water). In addition, this may encourage others to further pursue habitat restoration actions in and near Saltchuk. The Port of Tacoma (Port), for instance, has expressed plans to perform habitat restoration adjacent to Saltchuk. Port actions are still being developed, but initial designs include tidal marsh benches, removal of shoreline structures, and riparian habitat improvements.

6.10 Marine Mammal Protection Act of 1972

The Marine Mammal Protection Act (MMPA) of 1972 (16 U.S.C. §§ 1361-1407) restricts harassment of marine mammals and requires interagency consultation along with ESA consultation for Federal activities. The MMPA protects all marine mammals regardless of whether they are endangered, threatened, or depleted. Marine mammal species that occur in the action area include harbor seals, Steller sea lion, harbor porpoise, California sea lions, gray whales, and rarely humpback whales and Southern Resident killer whales.

The primary concern for the protection of marine mammals is underwater noise from construction, which is described in detail in Section 4.14. During ESA consultation, NMFS evaluated the potential for a change in noise, ship strikes, and wake effects on Puget Sound shorelines resulting from the proposed action. NMFS found no information that supported an increase in negative impacts to listed fish or marine mammals. NMFS concurred with the Corps' determination of "not likely to adversely affect" SRKW.

Restrictions on tanker traffic in Puget Sound and adjacent waters (33 U.S.C. § 476) protect navigable waters, natural resources, and shore from environmental harm. Terminals, docks, or other facilities in Puget Sound may not be modified to increase the volume of crude oil being handled at any facility other than oil to be refined for consumption in the State of Washington. The scope of the Tacoma Harbor feasibility study does not include any terminal or dock modifications that would increase the volume of crude oil to be refined.

6.11 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 U.S.C. §§ 668-668c) applies to Corps Civil Works projects through the protection of bald and golden eagles from disturbance. A review of the iNaturalist (inaturalist.org) database showed no recorded eagle nesting sites within 2 miles of the study area, and eBird (ebird.org) had one observation of an eagle nest at the marina near Marine View Drive in 2016. Eagles perch near and fly over the study area, but they are assumed to be habituated to the seaport's industrial noise and activity. No aspects of the proposed project are anticipated to have any effect to eagles.

6.12 Migratory Bird Treaty Act of 1918 and Executive Order 13186 Migratory Bird Habitat Protection

The Migratory Bird Treaty Act (16 U.S.C. § 703-712) as amended protects over 800 bird species and their habitat and commits that the U.S. will take measures to protect identified ecosystems of special importance to migratory birds against pollution, detrimental alterations, and other environmental degradations. EO 13186 directs Federal agencies to evaluate the effects of their actions on migratory birds, with emphasis on species of concern, and inform the USFWS of potential negative effects on migratory birds. Implementation of the preferred alternative would not have any negative effects on migratory bird habitat and would only have minor and temporary effects on a small number of individual birds that may be present in the study area (Section 4.12). These birds are assumed to be habituated to the noise and activity of the industrial seaport.

6.13 Executive Order 13175 Consultation and Coordination with Indian Tribal Governments

Executive Order 13175 (November 6, 2000) reaffirmed the Federal government's commitment to a government-to-government relationship with Indian tribes and directed Federal agencies to establish procedures to consult and collaborate with tribal governments when new agency regulations would have tribal implications. The Corps has a government-to-government consultation policy to facilitate the interchange between decision-makers to obtain mutually acceptable decisions. In accordance with this Executive Order, the Corps has consulted the federally recognized tribes with interests in the study area (Muckleshoot Indian Tribe, Puyallup Tribe of Indians, Nisqually Indian Tribe, Snoqualmie Indian Tribe, Squaxin Island Tribe, and the Confederated Tribes and Bands of the Yakama Nation). The complete consultation process is described in Section 7.2.

6.14 Executive Order 12898 Environmental Justice and Executive Order 14008 Climate Crisis

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," provides that each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations. Environmental justice concerns may arise from impacts on the natural and physical environment, such as human health or ecological impacts on minority populations, low-income populations, and Indian tribes or from related social or economic impacts. Executive Order 14008, “Tackling the Climate Crisis at Home and Abroad”, amends Executive Order 12898 and has updated Federal agencies’ responsibilities for assessing environmental justice consequences of their actions. Sections 4.7 (Air Quality) and 4.8 (Greenhouse Gas Emissions) in the IFR/EA evaluated effects to these resources and are considered in the following analysis for compliance with EO 14008.

NEPA procedures are important in identifying and addressing environmental justice concerns. The Corps evaluated the nature and location of the proposed action and used the EPA Environmental Justice Viewer to determine whether minority populations, low-income populations, or Indian tribes are present and may be disproportionately affected (Table 6-1., Appendix C). Effects would be considered significant if the project caused substantial changes in the ways members of the surrounding community live, work, relate to one another, or otherwise function as members of society, or caused substantial negative environmental, human health, or economic effects on minority and low-income populations. The proposed project is within a highly industrialized environment that has been substantially modified and impacted over the last 100 years. Analysis for environmental justice evaluates potential project effects within this previously altered setting. The Corps analyzed the potential effects of the alternatives on communities within a 5-mile radius of the proposed action and found there would be no disproportionately high and adverse human health impacts to any environmental justice communities. Implementation of commitments listed in Sections 5.9.3 (PED Activities) and 5.9.5 (Environmental Commitments and BMPs) will further avoid and minimize effects to environmental justice communities. The proposed action would not disproportionately affect minority or low-income populations. No interaction with other projects would result in any such disproportionate impacts. Tribal governments that are also environmental justice communities in the project area have been engaged and informed about the proposed action. The Corps has determined the action would not directly or through contractual or other arrangements, use criteria, methods, or practices that discriminate on the basis of race, color, or national origin, nor would it have a disproportionate effect on minority or low-income communities. Appendix C contains the EPA Environmental Justice Viewer report and additional analysis details.

Table 6-1. EPA EJScreen Report (Version 2019) for a 5-mile radius around the Blair Waterway (full report appears in Appendix C).

Variable*	Value	State Average	Percentile in State	EPA Region Average	Percentile in EPA Region	USA Average	Percentile in the USA
Demographic Index	36%	29%	72	29%	73	36%	59
Minority Population	41%	30%	74	27%	78	39%	60
Low Income Population	31%	28%	62	31%	56	33%	53
Linguistically Isolated Population	4%	4%	70	3%	74	4%	69
Less than High School Education	10%	9%	68	9%	66	13%	54
Population under 5 years of age	6%	6%	55	6%	55	6%	56
Population over 64 years of age	12%	14%	44	15%	42	15%	41

*This table provides demographic raw data and percentiles to provide perspective on how the selected group compares to the entire state, EPA region, or nation. For example, if a variable is at the 95th percentile nationwide, this means that only 5%of the USA has a higher value than the variable location.

6.15 Executive Order 11990 Protection of Wetlands

Executive Order 11990 entitled Protection of Wetlands (May 24, 1977) requires Federal agencies to take action to avoid adversely impacting wetlands wherever possible, to minimize wetlands destruction and to preserve the values of wetlands, and to prescribe procedures to implement the policies and procedures of this Executive Order. The proposal will not affect wetlands. Aquatic disposal is approved under the DMMP approval for the use of the Commencement Bay open-water disposal site.

6.16 Executive Order 11988 Floodplain Management

Executive Order 11988 entitled Floodplain Management (May 24, 1977) requires Federal agencies to recognize the significant values of floodplains and to consider the public benefits that would be realized from restoring and preserving floodplains. It is the general policy of the Corps to formulate projects that, to the extent possible, avoid or minimize adverse impacts associated with the use of the base floodplain and avoid inducing development in the base floodplain unless there is no practicable alternative that meets the project purpose. Per the procedures outlined in ER 1165-2-26 (Implementation of Executive Order 11988 on Flood Plain Management), the Corps has analyzed the potential effects of the Recommended Plan on the overall floodplain management of the study area.

Executive Order 11988 outlines the responsibilities of Federal agencies in the role of floodplain management. Each agency shall evaluate the potential effects of actions on floodplains and should avoid undertaking actions that directly or indirectly induce growth in the floodplain or adversely affect natural floodplain values. This EA evaluates the effects of alternative water operations on flooding and floodplains. No development in any floodplain is anticipated because of the alternatives considered.

There are eight steps to the decision-making process required in this Executive Order. The eight steps and responses (in italics) to them are summarized below.

1. Determine if the proposed action is in the base floodplain.
   The proposed action is located within the base floodplain for the Puyallup River.
2. If the action is in the floodplain, identify and evaluate practicable alternatives to locating in the base floodplain.
   As the primary objective of the feasibility study is to investigate navigation improvements to the Blair Waterway, there are no practicable alternatives completely outside of the base floodplain that would achieve this objective.
3. Provide public review.
   The proposed project has been coordinated with the public, government agencies, and interested stakeholders. The preparation of this EA is a part of the public review process.
4. Identify the impacts of the proposed action and any expected losses of natural and beneficial floodplain values.
   Chapter 3 of this document presents an analysis of alternatives. Practicable measures and alternatives were formulated, and potential impacts and benefits were evaluated. The anticipated

impacts associated with the Recommended Plan are summarized in Chapter 4 of this report. While construction of the project would result in mostly minor and temporary adverse impacts to the natural environment, the proposed action will meet the proposed purpose of the project. For each resource analyzed in Chapter 4, wherever there is a potential for adverse impacts, appropriate best management practices or other environmental considerations were identified. No loss of natural or beneficial floodplain values are anticipated because of the proposed dredging operations.

5. Minimize threats to life and property and to natural and beneficial floodplain values. Restore and preserve natural and beneficial floodplain values.
   Implementing the proposed project would have no significant impacts on human health, safety, and welfare. The proposed project will not compromise the current safe navigation within the Blair Waterway.
6. Reevaluate alternatives.
   Chapter 3 of this document presents an analysis of alternatives. There are no practicable alternatives completely outside of the base floodplain that would achieve study objectives.
7. Issue findings and a public explanation.
   The public will be advised that no practicable alternative to locating the proposed action in the floodplain exists, as indicated in Item 3 above.
8. Implement the action.
   The proposed project does not contribute to increased development in the floodplain and does not increase flood risk. The Recommended Plan is consistent with the requirements of this Executive Order.

6.17 Executive Order 13045 Protection of Children from Environmental Health Risks and Safety Risks

Executive Order 13045 (April 21, 1997) points out that children may suffer disproportionately from environmental health and safety risks due to their bodily systems still developing at the same time of eating, drinking, and breathing greater quantities in proportion to their size compared to adults. Federal agencies are required to identify and assess environmental health risks that may disproportionately affect children and ensure activities address disproportionate risks to children that result from environmental health or safety risks. The Corps has identified a potential, but discountable, risk of elevated contaminants in seafood in the study area and will rely on the Washington State Department of Health to issue advisories as appropriate. There is no disproportionate risk to children from the proposed action as the health risk advisories account for children as well as adults. After a period of several years following completion of the navigation improvement project, the Corps anticipates a net reduction in bioaccumulated contamination within the ecosystem.

6.18 Puyallup Land Settlement Claims Act

On August 27, 1988, the Puyallup Land Settlement Agreement ("Agreement"; 25 U.S.C. 1773, et. seq.) was signed by, among others, the United States, the Puyallup Tribe of Indians ("the Tribe"), the Port, and the State of Washington. Implementation of key aspects of this Act were effectuated by a Consent Decree in 1995 (Doc No. 8867921; https://semspub.epa.gov/src/collection/10/SC39440). The Settlement

Agreement provides that the Port will transfer to the United States, in trust for the Tribe, six (6) parcels of property, which are defined as the "Settlement Properties." The Settlement Properties are the Inner Hylebos Property, Upper Hylebos Property, Taylor Way Property, East-West Road Property, Blair Waterway Property, and Blair Backup Property. The Settlement Agreement provides further that prior to transfer of the Settlement Properties, the Port will perform cleanup actions, as necessary, in order to assure that such properties comply with applicable Federal, tribal, and state contamination law and can be used for commercial and industrial purposes. For the Inner Hylebos Property, cleanup was completed in 2011. In 1991, an investigation determined that cleanup was not required for the Upper Hylebos Property. And in 1996, EPA deleted the Taylor Way, East-West Road, Blair Backup, and Blair Waterway Properties from the NPL list because all required cleanup was completed. Remediation of the Former Lincoln Avenue Ditch Site was also performed as part of the Puyallup Land Claims Settlement (see Section 4.10). As of EPA's fifth Five Year Review for the Commencement Bay Nearshore Tideflats Superfund Site, Institutional Controls still need to be implemented for the Blair Backup Property (EPA 2020).

The Port is responsible for coordinating navigation conflicts between Tribal fishing and commercial shipping in Commencement Bay as described by the Agreement; this does not apply within the Blair Waterway. For example, conflicts will be reduced through a Navigation Agreement between the Port and Tribe which will: (a) Establish vessel traffic lanes for shipping traffic; (b) Identify anchoring sites for ships; and (c) Set forth operation and communication procedures for implementation of the Agreement. To further avoid conflicts, the Agreement prescribes a vessel traffic lane for the movement of deep draft commercial vessels in and out of port, anchoring sites for ships awaiting berthing space or otherwise seeking safe harbor anchorage, and operation and communication procedures necessary for effective implementation. The Agreement also outlines communication guidelines that designate points of contact, fishing seasons, and communication with the Tacoma Harbormaster for vessel operations.

In addition to coordination by the Port, the Corps will continue to evaluate potential conflicts between Tribal fishing and construction actions in PED (Sections 5.9.3 and 5.9.5) by soliciting feedback from the Puyallup Tribe on the Corps' construction schedule for measures to avoid and minimize effects to Tribal fishing, and consider other measures such as restricting construction vessels to within the authorized navigation channel as modified by the proposed design to avoid conflicts with fishers. Finally, as the Agreement states, side slopes in the Blair Waterway should be no steeper than 2H:1V from -10 to +8 MLLW, which will be considered during PED.

There is a possibility that after the final design of the new waterway channel is completed that the Port of Tacoma, as the non-federal sponsor for this project, will need to acquire a permanent interest in the form of a Channel Improvement easement over some parts of land in the Blair waterway that are in Tribal trust. This easement would not change the relationship that the Port already has under the Puyallup Land Settlement Claims Act, as the rights conveyed to the Port for purposes of project construction will be limited to a permanent easement over the land for channel improvement. The sponsor has issued a letter in support of this acquisition and confirmed both their ability to work in a productive way with the Puyallup Tribe, as well as to support and conform to the environmental requirements of the recommended plan. The acquisition and use of the above easement for project purposes will be considered by both the Puyallup Tribe and the Port under the guidelines of the existing institutional controls pursuant to the Puyallup Land Settlement Claims Act before being acquired and recorded by the Port for project purposes. At this time there is no reason to suspect that the Port's acquisition of an easement interest in any of the Tribal trust lands governed by the Settlement agreement will change the obligations and responsibilities of the parties to the agreement.

7 Public Involvement, Review, and Consultation

Public involvement activities and agency coordination are summarized in this chapter.

7.1 Public Involvement Process

Corps Planning Policy and NEPA emphasize public involvement in government actions affecting the environment by requiring the benefits and risks associated with the proposed actions be assessed and publicly disclosed. In accordance with NEPA public involvement requirements (40 C.F.R. § 1506.6) and Corps Planning policy (ER 1105-2-100), the Corps presented opportunities for the public to provide oral or written comments on potentially affected resources, environmental issues to be considered, and the agency's approach to the analysis. Efforts to involve the public included a notice of preparation of an EA with a 60-day public comment period issued December 21, 2018, and a public information meeting with two sessions (morning and evening) held January 17, 2019, soliciting relevant scoping information from the public and explaining procedures of how interested parties can get information on the planning process. The Corps released the draft IFR/EA for a 60-day public comment period beginning December 18, 2019, and received 72 comments. Comments and responses appear in Appendix E. Comments largely focused on issues that have commonly arisen during other dredging and port facility construction projects in the Pacific Northwest region, such as effects to water quality, wildlife and fish, and vessel traffic. Comments unique to Tacoma Harbor also identified concerns related to the protection of tribal treaty resources, export of natural gas or other petroleum products, CERCLA sites, and effects to ESA-listed SRKW and salmon. The Corps held a public information meeting with two sessions (early afternoon and evening) on January 15, 2020, to present the tentatively selected plan to the public and collect written and oral comments.

7.2 Tribal Government Consultation and Coordination Process

In accordance with Executive Order 13175 Consultation and Coordination with Indian Tribal Governments, the Corps identified affected tribes of the study area and provided information regarding the feasibility study, proposed Federal action, and opportunities for the tribes to provide information and comment on the project. Consultation began with introductory letters describing the proposed study, which the Corps sent during the feasibility phase to six tribes (Muckleshoot Indian Tribe, Nisqually Indian Tribe, Puyallup Tribe of Indians, Snoqualmie Indian Tribe, Squaxin Island Tribe, and the Confederated Tribes and Bands of the Yakama Nation) near the study area. During the course of the project, the Corps determined all six tribes should be consulted regarding the project for purposes of Section 106 of the NHPA. The Corps sent a letter to the tribes on October 31, 2018. The Puyallup Tribe provided natural resources specialists from its staff to participate in meetings regarding the protection of natural resources. The Corps provided the tribes' natural resources departments a copy of the draft IFR/EA for their review.

The following list provides information regarding the Corps' efforts to coordinate with the tribes:

1. Introductory letter mailed October 3, 2018, describing the investigation of potential navigation improvements at Tacoma Harbor
2. Tacoma Harbor project special session presented at the Corps' Semi-Annual Tribal and Natural Resource Agency Dredging Meeting October 25, 2018; project presented, and dialog encouraged

3. Staff-level meeting with Puyallup Tribe of Indians December 17, 2018, to discuss the project and receive input on resources to consider in the draft report Notification of a public information meeting held January 17, 2019
4. Staff-level discussion with Corps and the Puyallup Tribe of Indians regarding sediment sampling locations in the Blair Waterway for the partial DMMP characterization held January 31, 2019
5. Staff-level meeting among the Puyallup Tribe of Indians, Port of Tacoma, and Anchor QEA regarding the sediment sampling and analysis plan February 8, 2019
6. Government-to-Government meeting with Puyallup Tribe of Indians held on March 21, 2019
7. Meeting held on April 25, 2019, with tribes and natural resources agencies discussing the initial array of alternatives and soliciting feedback regarding potential impacts to consider
8. Meeting held September 16, 2019, with tribes and natural resources agencies presenting the final array of alternatives and soliciting feedback regarding the analysis of potential impacts of the proposed action. This information was presented at a staff-level meeting with the Puyallup Tribe of Indians on October 10, 2019
9. Staff-level discussion between Corps DMMO and the Puyallup Tribe of Indians regarding results of the advisory–level DMMP memo held on November 11, 2019
10. Government-to-Government meeting with the Puyallup Tribe of Indians held on December 3, 2019
11. Notification of availability of IFR/EA beginning December 18, 2019
12. Public information meeting held during the public comment period of the draft IFR/EA
13. Staff-level discussion with the Puyallup Tribe to discuss the Tacoma Harbor economic analysis and environmental updates February 3, 2022

Tribal coordination will continue throughout PED and construction.

7.3 Agencies and Persons Consulted*

The Corps consulted the following list of agencies, tribes, and individuals during the plan formulation and environmental compliance of this feasibility study and preparation of the Integrated FR/EA.

- U.S. Environmental Protection Agency, Region 10
- National Marine Fisheries Service
- U.S. Fish and Wildlife Service
- U.S. Coast Guard
- Muckleshoot Indian Tribe
- Nisqually Indian Tribe
- Puyallup Tribe of Indians
- Snoqualmie Indian Tribe
- Squaxin Island Tribe
- Confederated Tribes and Bands of the Yakama Nation
- Washington Department of Archaeology and Historic Preservation
- Washington Department of Fish and Wildlife
- Washington Department of Ecology
- Washington Department of Natural Resources
- Puget Sound Pilots

8 Recommendations

The following draft text outlines the Corps' recommendations for project approval and authorization for implementation based on information available at this time.

I concur with the findings, conclusions, and recommendations of the reporting officers. Accordingly, I recommend that navigation improvements for Tacoma Harbor be authorized in accordance with the reporting officers' Recommended Plan with such modifications as in the discretion of the Chief of Engineers may be advisable. The estimated project first cost of the Recommended Plan is $295,328,000 (October 2021 price level). The Federal portion of the estimated first cost is $148,942,000. The non-Federal sponsor's portion of the required cost-share of total project first costs is $146,386,000. Project cost share after 10% payment of GNFs less credit for LERR of the NED Plan over 30 years brings the cost share to $120,701,000 Federal and $174,627,000 non-Federal. Project first costs of the Recommended Plan includes an incremental cost of $9,542,000 for beneficial use of dredged material, and the incremental cost is reasonable in relation to the environmental benefits achieved. The Federal portion of the incremental cost of beneficial use is $6,202,000. The non-Federal sponsor's portion of the incremental cost of beneficial use is $3,340,000. My recommendation is subject to cost sharing, financing, and other applicable requirements of Federal and state laws and policies, including Section 101 of WRDA 1986, as amended.

My recommendation is subject to cost sharing and other applicable requirements of Federal laws, regulations, and policies. Federal implementation of the project for commercial navigation includes, but is not limited to, the following items of local cooperation to be undertaken by the non-Federal sponsor in accordance with applicable Federal laws, regulations, and policies:

a. Provide the non-Federal share of construction costs, as further specified below:

1) Provide, during design, 50percent of the costs of design for the general navigation features of the project and beneficial use in accordance with the terms of the design agreement for the project;

2) Provide, during construction, 50 percent of the costs of the general navigation facilities allocated to that portion of the project with a channel depth in excess of 50 feet and 35 percent of the costs of beneficial use of dredged material;

b. Provide all lands, easements, and rights-of-way, including those required for relocations and dredged material placement facilities, acquire or compel the removal of obstructions, and perform or ensure the performance of all relocations, including utility relocations, as determined by the Federal government to be necessary for the construction, operation, and maintenance of the general navigation features;

c. For each relocation of a utility, or portion thereof, located in or under navigable waters of the United States that is required to accommodate a channel depth over 45 feet, pay to the owner of the utility at least one half of the owner's relocation costs, unless the owner voluntarily agrees to waive all or a portion of the non-Federal sponsor's contribution;

d. Pay, with interest over a period not to exceed 30 years following completion of construction of the general navigation features, an additional amount equal to 10 percent of the construction costs of the general navigation features less the amount of credit afforded by the Federal government for the value of the real property interests and relocations, including utility relocations, provided by the non-Federal sponsor for the general navigation features, except for the value of the real property interests and relocations provided for mitigation, which is included in the construction costs of the general navigation features;

e. For general navigation features in excess of 50 feet (MLLW), pay 50 percent of the excess cost of operation and maintenance of the project, which includes operation and maintenance of dredged material placement facilities, over that cost which the Federal government would have incurred for operation and maintenance of the project if the channel had a depth of 50 feet;

f. Ensure that the local service facilities are constructed, operated, and maintained at no cost to the Federal government, and that all applicable licenses and permits necessary for construction, operation, and maintenance of such work are obtained;

g. Give the Federal government a right to enter, at reasonable times and in a reasonable manner, upon the real property interests that the non-Federal sponsor owns or controls for the purpose of operating and maintaining the project;

h. Hold and save the Federal government free from all damages arising from design, construction, operation and maintenance of the project, except for damages due to the fault or negligence of the Federal government or its contractors;

i. Perform, or ensure performance of, any investigations for hazardous, toxic, and radioactive wastes (HTRW) that are determined necessary to identify the existence and extent of any HTRW regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9601-9675, and any other applicable law, that may exist in, on, or under real property interests that the Federal government determines to be necessary for construction, operation and maintenance of the general navigation features;

j. Agree, as between the Federal government and the non-Federal sponsor, to be solely responsible for the performance and costs of cleanup and response of any HTRW regulated under applicable law that are located in, on, or under real property interests required for construction, operation, and maintenance of the project, including the costs of any studies and investigations necessary to determine an appropriate response to the contamination, without reimbursement or credit by the Federal government;

k. Perform the non-Federal sponsor's responsibilities in a manner that will not cause HTRW liability to arise under applicable law to the maximum extent practicable; and

l. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended, (42 U.S.C. 4630 and 4655) and the Uniform Regulations contained in 49 C.F.R Part 24, in acquiring real property interests necessary for construction, operation, and maintenance of the project including those necessary for relocations, and placement area improvements; and inform all affected persons of applicable benefits, policies, and procedures in connection with said act.

The recommendation contained herein reflects the information available at this time and current departmental policies governing the formulation of individual projects. It does not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program or the perspective of higher review levels within the executive branch. Consequently, the recommendation may be modified before it is transmitted to the Congress as a proposal for authorization and implementation funding. However, prior to transmittal to Congress, the State of Washington, the Port of Tacoma (the non-Federal sponsor), interested Federal agencies, and other parties will be advised of any significant modifications and will be afforded an opportunity to comment further.

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Colonel, Corps of Engineers
District Commander

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