Oregon International Port of Coos Bay

Proposed Section 204(f)/408 Channel Modification Project

Main Report

June 2024

Executive Summary

Introduction

The Oregon International Port of Coos Bay (OIPCB) seeks approval to modify portions of the Coos Bay, Oregon Federal Navigation Project under the authority granted by Section 204(f) of the Water Resources Development Act (WRDA) of 1986, as amended. The purpose of this Section 204(f)/408 report is to provide sufficient information to the Assistant Secretary of the Army for Civil Works (ASA(CW)) to determine whether it is in the Federal Government's interest to assume operation and maintenance of the navigation channel improvements to be implemented by the OIPCB. The Section 408 proposal will request approval for the OIPCB to modify the existing Federal navigation project.

This Section 204(f)/408 Report proposes a project to deepen and widen a portion of the existing Federal navigation project at the Port of Coos Bay, Oregon from the ocean to River Mile (RM) 8.2. This is a single-purpose project for deep draft navigation that is a component of the OIPCB's Pacific Coast Intermodal Port Project (PCIP). Constructing and operating the PCIP would include three elements:

1. Building a maritime container terminal and railyard on OIPCB property in Coos Bay,
2. Improving the existing Coos Bay Rail Line (CBRL) to accommodate container traffic, and
3. Modifying the existing Coos Bay Federal Navigation Channel (FNC) to allow sufficiently large vessels to bring containers to and from the PCIP.

When fully operational, the PCIP would handle up to 2 million containers per year creating a new gateway for the nation's imports and exports. Intermodal operation means that containers would be moved to and from the marine terminal completely by rail without the use of over the road trucks.

The combined elements of the PCIP will substantially increase rail intermodal capacity on the U.S. west coast, increase the amount of cargo that is transported across the nation by rail, reduce truck transport and associated greenhouse gas emissions, and substantially reduce cargo transportation costs for the nation.

The OIPCB proposes deepening and widening the FNC to more effectively and efficiently meet the demand for the cargo services the OIPCB provides now and is projected to provide in the future. Improvements to operations at the OIPCB, which would result from the project, include:

- Allow existing and projected future cargo vessels to have less restricted access to berths and terminals, reducing delays and increasing the efficiency of port operations;
- Allow existing and projected future cargo vessels to be loaded more efficiently;

- Allow larger cargo vessels to be used that can deliver more cargo at lower unit costs; and
- Accommodate the development of more efficient berths and terminal utilization.

Widening and deepening the navigation channel would increase the efficiency of cargo vessels currently using the Port, as well as allow the use of larger, more efficient vessels in the future. This increase in efficiency will result in significant transportation cost savings compared to the expected future without-project conditions.

Section 204(f) delegates authority to the Assistant Secretary of the Army for Civil Works (ASA(CW)) to approve requests by non-federal entities to design and construct improvements to federal navigation projects at their own expense and to approve federal assumption of operations and maintenance (O&M) responsibility for the project after non-federal construction is completed. The OIPCB also must obtain permission to modify the existing Coos Bay Federal Navigation Project under Section 14 of the Rivers and Harbors Appropriation Act of 1899, 33 United States Code (USC) 408 (Section 408). A Section 404/10 evaluation is also being conducted and a separate permit application and accompanying environmental report to be converted by the USACE into their Environmental Impact Statement (EIS) is being prepared by the OIPCB. A new ocean dredged material disposal site will be selected as per Section 103 of the Marine Protection, Research, and Sanctuaries Act.

This study will result in two major decision documents: (1) Port of Coos Bay Channel Improvement Project Section 204(f)/408 Report; and (2) the PCIP EIS and Records of Decision. A single EIS for the proposed channel modification project will be prepared by the United States Army Corps of Engineers (USACE) and will be used to develop three decisions: 1) Section 204(f) Assumption of Maintenance decision (by the Secretary of the Army), 2) the 33 United States Code (USC) 408 decision (by the North Northwestern Division Commander), and 3) the Section 404/10 Permit Application decision by the Portland District Commander.

Guidance concerning the criteria for approval of a Section 204(f) project is provided by ER 1165-2-211, which requires that the project be:

- Economically justified (i.e., project benefits exceed project costs);
- Environmentally acceptable; and
- Consistent with federal policy, including the policy that project benefits do not accrue to a single privately owned facility.

Proposed Alteration

The FNC improvements selected by the OIPCB is the Proposed Alteration (PA). The PA will deepen and widen the FNC from the ocean entrance to RM 8.2. The PA is shown in Figure ES-1 and consists of the following elements:

- ***Dredging the Coos Bay navigation channel*** from the offshore extent of the improved channel at RM -1 to approximately RM 8.2. The PA has a width of 1,180 ft and a depth of -57 ft MLLW at its offshore entrance. The channel width decreases continuously to a width of 600 ft at RM 0.3. The Entrance Channel has a 600-ft width from RM 0.3 through RM 1. Upstream of RM 1, the PA tapers down to a nominal width of 450 ft and a depth of -45 ft MLLW. Proposed channel modifications will not extend upstream of RM 8.2. The total volume of material dredged under the PA is expected to be about 20.28 million cubic yards (mcy) *in situ*, of which 13.93 mcy is sand and 6.34 mcy is rock.

- ***Post Panamax Generation 3 (PPX3) Containership Turning Basin at RM 5.0.*** A turning basin at the container facility is needed to accommodate the PPX3 containership. Based on the vessel's dimension, the proposed turning basin is 2,000 feet long (parallel to the channel) and 1,600 feet wide. The turning basin's design bottom elevation is -45 ft MLLW, the same as the PA channel.
- ***Capesize Turning Basin at RM 8.0.*** A Capesize turning basin will be constructed at RM 8.0. Operationally, this turning basin will be used by inbound empty bulk vessels. Therefore, the turning basin's design bottom elevation is -37 ft MLLW. The improved navigation channel (450-ft wide at -45 ft MLLW) continues through the length of the turning basin.
- ***Dredged material placement.*** Capital dredging material will be placed within disposal sites established for this project or placed beneficially. Dredged sediment is expected to primarily include fine- to medium-grained sand with trace amounts of fines. Dredged rock is expected to be siltstone and sandstone (sedimentary rock). The majority of the dredged sediment will be placed in a nearshore Beneficial Use Site established for this project; approximately 6.6 million cubic yards (mcy) *in situ* is expected to be available for beneficial placement in this site. The remainder of the capital dredging material will be placed within a new one-time use, ocean dredged material disposal site designated specifically for this project (proposed ODMDS Site L) and approved by the Portland District Commander and U.S. Environmental Protection Agency (USEPA) per Section 103 of the Marine Protection, Research, and Sanctuaries Act. After the completion of initial construction, the additional increment of O&M dredging material produced in subsequent years will be placed in ODMDS F, where annual maintenance material from the existing channel is currently being placed.
- ***Protective measures for the North Jetty*** to alleviate potential impacts from the Entrance Channel widening and deepening. A rock apron at the toe of the North Jetty will be constructed to protect against any potential impacts of side slope equilibration and scour from currents. The rock apron will extend from the relict jetty head through a portion of the jetty trunk.
- ***Relocation of aids to navigation (ATON).*** The revised channel shifts the centerline alignment of every reach from the Entrance Range through the Jarvis Turn, which will require relocating existing range markers. Channel widening will require relocation of the majority of the fixed and floating channel markers, although no new ATON are required.
- ***Advance Maintenance Dredging (AMD).*** AMD will be increased to 6 ft in the Entrance Channel downstream of Guano Rock (RM -1 to RM 0.7), and 1 ft in areas where Guano Rock is present (RM 0.7 to RM 1). AMD will be 1 ft upstream of RM 1. An additional rock buffer is proposed in areas where rock is present, including Guano Rock and RM 2.0 through RM 6.3; this rock buffer has a depth of 1 ft and a width of 25 ft.

The above modifications are shown in Table 10-1 and Table 10-2; no dredging is proposed beyond the boundaries in these tables. These tables also contain the dimensions of the Existing Condition and Proposed Alteration Features

Figure ES-1 shows the proposed alteration and location of the adjacent federal infrastructure: the two jetties that run parallel to the channel from RM 0 to RM 1 and the pile dikes located along the north bank of the channel from RM 6.4 to RM 7.5.

Table ES-1
Channel Widths for Existing Project and PA

Range(s) and RM	Existing Authorized Project	PA
Longitudinal Extent		
Offshore Limit including AMD Dredging	RM - 0.55	RM -1
Offshore Limit of Navigation Channel	RM 0	RM -0.9
Channel Width (feet)		
Offshore Inlet Offshore Limit of Navigation Channel to RM 0.3	700 narrowing to 550	1,280 narrowing to 600
Entrance Range RM 0.3 to 1.0	550 narrowing to 300	600
Entrance Range RM 1.0 to 2.0 and Turn	Varies up to 740	Varies up to 1,140
Inside Range RM 2.0 to 2.5	300	500
Coos Bay Range RM 2.5 to 4.3	300	450
Empire Range RM 4.3 to 5.9	300	450
PPX3 Turning Basin RM 4.7 to 5.6	None	2,000 x 1,600
Lower Jarvis Range RM 5.9 to 6.8	300	450
Jarvis Turn RM 6.8 to 7.3	400	500
Upper Jarvis Range RM 7.3 to 8.2	300	450 decreasing to 300
Capesize Turning Basin RM 7.6 to 8.0	None	2,000×1,100

Table ES-2
Channel Depths for Existing Project and PA

Range(s) and RM	Authorized Depth (ft)		Advance Maintenance Dredging (ft)	
	Existing Condition	PA	Existing Condition	PA
Offshore Limit of Navigation Channel to RM 0.3	-47	-57	5	6
Entrance Range RM 0.3 to 1.0	-47 decreasing to -37	-57 decreasing to -45	Varies 5 to 1	Varies 1 or 6
Entrance Range and Turn RM 1.0 to 2.0	-37	-45	1	1
Inside Range RM 2.0 to 2.5	-37	-45	1	1
Coos Bay Range RM 2.5 to 4.3	-37	-45	1	1
Empire Range RM 4.3 to 5.9	-37	-45	1	1
PPX3 Turning Basin	None	-45	None	1
Lower Jarvis Range RM 5.9 to 6.8	-37	-45	1	1
Jarvis Turn RM 6.8 to 7.3	-37	-45	1	1
Upper Jarvis Range RM 7.3 to 8.2	-37	-45	1	1
Capesize Turning Basin RM 7.6 to 8.0	None	-45	None	1

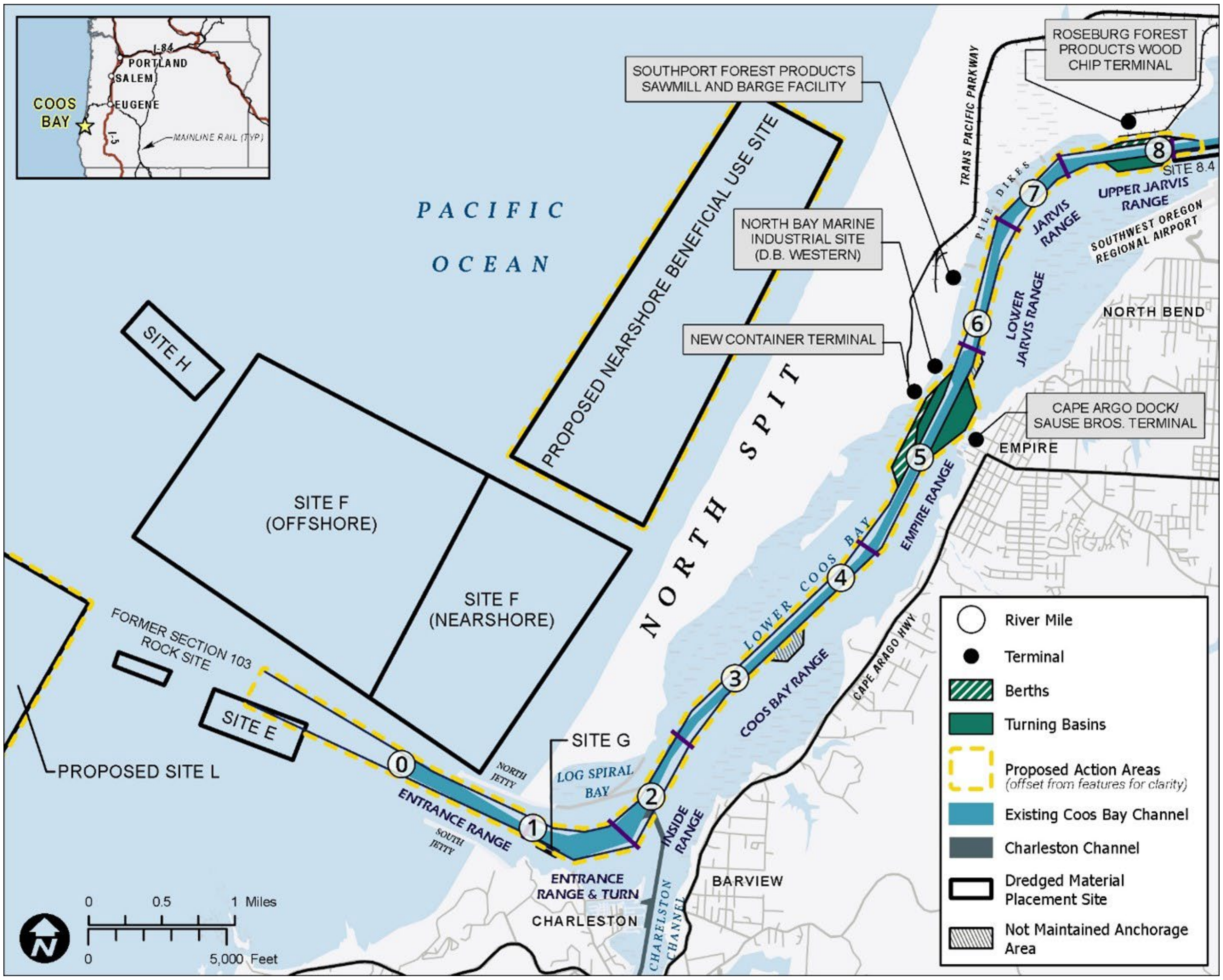

Figure ES-1: Summary of Proposed Alteration

The National Economic Development benefit of a navigation project is the reduction in the value of resources required to transport commodities. USACE categories of benefits that occur when the commodities have the same origin and destination under without and with-project conditions:

- More efficient use of existing vessels (reduced ocean voyage costs), and
- Shift in mode benefits (truck transport replaced by rail transport).

In both the without and with-project conditions, the same number of TEUs and the same vessel fleet are projected to transport cargo between the same origins and destinations (Far East Asia and U.S. inland states). The difference between the without and with-project conditions is the availability of Coos Bay as an alternative rail intermodal port. Vessel operating cost savings are based on the hours of ocean transport to the USEC by vessel class under without-project conditions and the hours of ocean transport to Coos Bay under with-project conditions. These vessel operating cost savings are calculated as a component of project benefits.

In addition, passage through the Panama Canal is avoided for Far East Asia cargo that uses Coos Bay as an alternative to USEC ports. For this reason, transportation cost savings also includes the reduction in Panama Canal operating costs attributed to U. S. exports and imports due to fewer vessels transiting the canal under with-project conditions.

The shift in mode benefits is based on the shift:

- from TEUs being transported by <u>truck</u> between USEC ports and U. S. inland states under without-project conditions, and
- to TEUs being transported by <u>rail</u> between Coos Bay and the U. S. inland states under with-project conditions.

Project costs include the full cost of constructing and operating the PCIP because each component of the PCIP is necessary for the realization of benefits. The project generates substantial net benefits (Table ES-3).

The PA meets the three criteria of economic justification, environmental acceptability, and consistency with federal policy and therefore is recommended for 204(f) and 408 approval.

Table ES-3
PA AAEQ Net Benefits and Benefit/Cost Ratios

Economic Parameter	PA
Vessel Operating Cost Savings	$294,548,000
Panama Canal Operating Cost Savings	$58,144,000
Landside Transportation Cost Savings	$1,303,560,000
Total Annualized Project Benefits	**$1,656,252,000**
Annualized Project Costs	$162,573,000
Annual Maintenance Costs	$114,893,000
Total Annual Costs	**$277,466,000**
Net Benefits	$1,378,786,000
Benefit/Cost Ratio	6.0

All material dredged by the OIPCB contractor(s) during construction will be either placed at the North Spit Nearshore Littoral Placement Beneficial Use Site (sand only), or disposed at ODMDS L (a Section 103 disposal area for rock and the remaining sand that cannot be placed at the beneficial use site). All post-construction maintenance material will be disposed of at ODMDS F. The recommended dredged material management plan is the Federal Standard, is environmentally acceptable (Figure 6-4), and consists of:

- Establishment of proposed ODMDS L for the placement of mixed (sand and rock) construction material;
- Beneficial placement of the maximum amount of sandy material (consistent with operational and environmental constraints) in the Proposed North Spit Nearshore Littoral Placement Site; and
- Continuance of existing maintenance operations, which include, beneficial placement of maintenance material (sand) in the existing nearshore section of ODMDS F to supplement the littoral system.

Impacts of the Proposed Alteration

Pertinent to the Section 408 decision, the PA will have no negative impacts on safety or on the Federal project's ability to provide intended benefits. Impacts on future project operations and maintenance are primarily financial (i.e., incremental shoaling and O&M costs) and are consistent with the intent and purpose of a Section 204(f) project. Effects on the Federal project include:

- Reduction in the size and capacity of ODMDS E;
- Increase in the depth of in-bay disposal Site G;
- Increase in the proximity of the channel to the North Jetty; and

- Increase in future maintenance dredging requirements.

ODMDS E is authorized for the disposal of sand dredged from below RM 12, but it was not used at all between 1990 and 2005 due to mounding. Most recently in 2006, 79,900 cy of material was disposed at the site. The site has not been used since 2006 because a significant percentage of the material disposed in Site E migrates back into the navigation channel; therefore ODMDS E is an ineffective placement site. For this reason, future use is unlikely other than temporarily during extreme adverse weather conditions and if no other site is available.

Under with project conditions the ODMDS E footprint would be reduced to avoid channel overlap. The area of ODMDS E is reduced from 116 acres under the existing condition to 93 acres under the PA. Table ES-4 shows static and annual capacity under the without-project condition and PA (see Section 8.2.4 ODMDS E). The annual capacity under all project conditions exceeds projected annual use of the site, which has been used only once since 1990. The PA would reduce the static capacity of ODMDS E by 30% to 51,000 cy/year. Given the infrequent use of Site E and its lack of efficiency as a viable placement site, the minor reduction is site capacity is considered to be a negligible impact on the FNC project.

Table ES-4
Capacity of ODMDS E

Condition	Static Capacity (cy)	Annual Capacity* (cy/yr)
Existing Condition	457,000	72,000*
PA	322,000	51,000

*Note: assumes 50-year life

Site G is managed as a dispersive site, as identified by the USACE (2009). It is located just inside the Entrance Channel and is used only if ocean conditions are too hazardous for a dredge to access the ODMDS or if hydraulic cutterhead (pipeline) dredging is conducted in the Charleston Access Channel (USACE 2015). Placement in Site G has been highly variable during the last 29 years, ranging from zero in 10 different years, less than 10,000 in seven different years, to a maximum of 55,300 cy in 2011. The principal causes of annual variability in the use of Site G are sea conditions at the bar, which can restrict hopper dredge access to the ocean, and whether pipeline dredging of the Charleston Access Channel occurs in a given year. Review of bathymetric surveys in the years following placement at Site G indicate no accumulation, supporting the dispersive designation. The lack of sediment accumulation at Site G or in the deepest segment of the natural bathymetry is consistent with the general hydrodynamics of the area. The natural bathymetry of the Entrance Turn is between -50 ft MLLW and -55 ft MLLW deep. This is a self-scouring area where strong currents transport sediment elsewhere. Site G is ideally located on the outer bank of the turn, where current speeds are highest. USACE reports that material is disposed via pipeline dredge only during ebb tides to allow dispersal of the material to the ocean (USACE 2015).

Implementation of the PA or NED Plan are not anticipated to impact USACE's existing or future use of Site G or threaten the reliability of the existing/future FNC. It is expected that sediment disposed in Site G will continue to disperse as it does today. Material disposed in Site G will not accumulate along the cross section (which includes Site G, the dredged PA/NED Plan, or in the bottom of the riverbed). Material will continue to be flushed offshore by ebb currents or in-bay by flood currents. Implementation of the PA will not change the physical forces at Site G, which have made it a dispersive site for the historically disposed volumes.

After dredging, side slope equilibration may mobilize the material underlying Site G, causing the site to deepen and increasing the volume of Site G by the amount of material that equilibrates off the channel side slope. Under the PA, side slope equilibration has the potential to adjust the depth and the angle of the channel slope below Site G. The natural bathymetry at the existing and PA channel alignments is deeper than the currently authorized and proposed channel depths; however, equilibration of the PA side slopes is projected. At the channel centerline the existing bathymetry is -53 feet MLLW and the PA depth is -46 feet MLLW. Because of the naturally deep conditions at Site G, construction dredging for the PA and side slope equilibration are projected to require removal of only 60,000 cy from the channel in the vicinity of Site G. This minor change to bathymetry at site G is not projected to substantially change hydrodynamics at the site and the dispersive nature of the site would not be affected.

Potential impacts to Site G were evaluated for 3 time periods 1) during construction, 2) post-construction, during the equilibration period, and 3) post equilibration, during long-term O&M.

Capital dredging period. The present Site G is deeper than the existing FNC. Moreover, all dredging associated with the PA will occur at depths deeper than the existing FNC. Any maintenance material disposed by USACE in Site G during construction of the PA would be disposed below the existing FNC. Therefore, any material disposed at site G during capital dredging would not affect existing navigation within the FNC. Material disposed in Site G would continue to disperse as it presently does. Finally, OIPCB's contractors will be present to remove any material that sloughs into the PA channel during construction, including all equilibration material and any material disposed in Site G that might disperse into the PA design prism.

Equilibration period. Side slope equilibration at Site G will continue until 6 years after capital dredging is complete (Year 9). Material volumes associated with side slope equilibration at Site G are presented in Table ES-5. For the purpose of definitively accounting for all equilibrated material, it is conservatively assumed that 100% of all side slope equilibration material will remain in the channel reach adjacent to Site G and must be removed during maintenance dredging, even though the historical evidence shows that this area is dispersive (Section 2.4.4) and much of the material will be flushed with the tide.

Table ES-5
Site G Side Slope Equilibration Volume by Year

Project Year	Side Slope Equilibration Volume (cy)
1	0
2	17,800
3	14,600
4	10,800
5	7,200
6	4,400
7	2,400
8	1,200
9	500
10	0

Note: Construction Years 1 – 3, Post Construction Years 4 - 10

Side slope equilibration will deepen the riverbed at Site G by up to 8 feet. Material disposed by USACE into Site G during the equilibration period will continue to disperse as it does presently (i.e., sediment will not accumulate at Site G nor does it slough to the bottom of the channel). This is because the physical forces, which cause Site G to be dispersive are not affected by the PA. As a result, USACE can continue to use Site G as it does now, with no impact on Site G or the deepened and widened Federal Navigation Channel.

Long-Term, Post Equilibration Period. After side slope equilibration is complete, it is expected that Site G will continue to behave consistent with the historical and present conditions because nothing will have been changed by the PA to affect the dispersive nature of the site. Figure 3-8 of the Engineering Appendix, Sub-Appendix 4 *(Offshore and Ocean Entrance Dynamics)* shows velocity vectors under the PA. Difference plots of current velocities for 5 different conditions, comparing without-project conditions with the PA, were investigated. Under each condition, current velocities are not projected to change at Site G. Therefore, USACE will be able to place material at Site G consistent with the existing practices, and the material will disperse consistent with existing dispersal.

While it is unclear without a detailed tracer study where the material that disperses out of Site G eventually settles (i.e., in or out of the estuary or the FNC), this dispersal process will not be changed by the PA. So, to the extent that some of the material may settle in some portion of the FNC, it is already included in existing shoaling rates and projected dredge volumes. And for that portion of material dispersing from Site G that settles outside of the FNC, it does not affect dredging quantities or the availability of Site G. Analysis of the PA already accounts for the volume and eventual location of material dispersing from Site G.

Analysis of existing and with-project bathymetry, projected side slope equilibration, and without- and with-project current velocities supports the conclusion that Site G will continue to be dispersive under with-project conditions for the volumes of material historically disposed at the site.

The North Jetty toe experiences scour at multiple locations under existing conditions. Under the PA, the meander of the ebb current's flow out of Coos Bay is expected to shift closer to the jetty, enhancing the potential for further erosion. Potential erosion is between 1 and 3 ft. The proposed rock apron along the North Jetty has been designed to protect against this potential scour. To be conservative, the rock apron has been designed to protect against up to 10 ft of erosion, well in excess of predicted erosion rates. Construction of the rock apron is a component of the PA, therefore no effects to the North Jetty toe stability are expected.

Effects of erosion along the toe of the South Jetty were evaluated based on the same sediment transport model used for the North Jetty. The PA is not expected to increase erosion in the vicinity of the South Jetty. No effects from sediment transport are expected.

Annual maintenance dredging is projected to increase from 832,000 cy/year to 1,166,000 cy/year for the PA (an increase of 334,000 cy/year). Operation and maintenance (O&M) dredging is presently conducted by two USACE dredges, the *Essayons* (in the Entrance Channel) and the *Yaquina* (in the estuary), and by contract dredges. The increased O&M volume in the Entrance channel would require approximately nine additional days of dredging by the *Essayons* relative to without-project conditions. The increased O&M volume in the estuary would require approximately ten additional days of dredging by the *Yaquina* relative to without-project conditions. The overall increase in the annual cost of maintenance dredging is estimated to be $3,101,000 for the PA.

Annual shoaling volumes vary widely from year to year, which creates the risk that there will not be sufficient resources (time, equipment or budget) in some years to maintain the entire channel. As stated by a Memorandum for the Record[1] (MFR) signed July 16, 2018 by OIPCB and USACE:

> *Recognizing the limitations of modeling and relying upon past shoaling rates, and that it is possible that more extensive shoaling could occur in extreme years in the future, the Port is willing to accept the risk that occasionally the full channel depths of 45 feet MLLW may not be able to be maintained by the Corps using one foot of AMD (i.e., by dredging to 46 feet MLLW, plus overdepth). The Port is willing to accept this risk with the full understanding that the impacts to commercial navigation will be negligible due to: 1) required use of the 6 foot tidal advantage by LNG vessels, 2) flexibility in use of tides by dry bulk vessels, and 3) the fact that the constraining reach from a shoaling standpoint is the entrance channel, not the inner channel. The Port is willing to acknowledge their acceptance of the minor shoaling risk that the 45-foot channel may not always be able to be maintained in the Maintenance Agreement that will be signed between the Port and the Corps prior to assumption of maintenance.*

Environmental effects of the proposed project and mitigation required for environmental impacts are being determined by USACE in the EIS. The OIPCB will fulfill all mitigation requirements determined to be necessary through the NEPA and permitting processes.

[1] Burns, J. OIPCB. 2018 Jul 16. Memorandum for the Record: Agreements Reached at the July 12, 2018 Meeting between Kevin Brice and Pat Duyck (CENWP), John Burns and Mike Dunning (OIPCB), and David Miller (DMA) Regarding Coos Bay Section 204/408 Project Channel Design Construction and Maintenance. MFR to Brice, K.

Conclusion and Recommendations

The results of these investigations demonstrate that the Proposed Alteration is economically justified, environmentally acceptable, and consistent with Federal policy. On this basis, the OIPCB recommends the PA be approved by the ASA(CW) for federal assumption of maintenance under the authority granted by Section 204(f) of the Water Resources Development Act (WRDA) of 1986, as amended. The investigations performed herein also demonstrate that the proposed alterations are safe and do not adversely affect the proper functioning of the Federal Navigation Project. On this basis, the Port also recommends to the NWD Commander that the Project meets Section 408 requirements for approval under Section 14 of the Rivers and Harbors Appropriation Act of 1899, 33 United States Code (USC) 408 (Section 408). Finally, the Port has demonstrated that the physical effects of the project are minimal and therefore recommends that Portland District Commander issue a Section 404/10 permit for implementation of the Proposed Alteration.

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LIST OF ACRONYMS AND ABBREVIATIONS

AAEQ	average annual equivalent costs
AIS	Automatic Identification System
API	American Petroleum Institute
ASA(CW)	Assistant Secretary of the Army for Civil Works
ASCE	American Society of Civil Engineers
ATONs	aids to navigation
BLM	Bureau of Land Management
Bscf/d	billion standard cubic feet per day
CBEMP	Coos Bay Estuary Management Plan
CBR	Coos Bay Rail Link
CDF	Confined Disposal Facility
CEQ	Council on Environmental Quality
CO-OPS	Center for Operational Oceanographic Products and Services
CWA	Clean Water Act
cy	cubic yards
CZMA	Coastal Zone Management Act
DOT	U.S. Department of Transportation
DWT	deadweight tons
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EJ	Environmental Justice
ENSO	El Niño/Southern Oscillation
EQ	Environmental Quality
ER	Engineer Regulations

LIST OF ACRONYMS AND ABBREVIATIONS

ESA	Endangered Species Act
FAA	Federal Aviation Administration
FERC	Federal Energy Regulatory Commission
FY	Fiscal Year
HMMP	Henderson Marsh Mitigation Plan
IDC	Interest During Construction
IWP	Industrial Waste Pond
LNG	Liquefied Natural Gas
LOA	Length Overall
MHHW	Mean Higher High Water
MHW	Mean High Water
MLLW	Mean Lower Low Water
MLW	Mean Low Water
MMPA	Marine Mammal Protection Act
MMR	Major Maintenance Report
MMTPA	million metric tons per annum
Mph	miles per hour
MPRSA	Marine Protection Research and Sanctuaries Act
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	Mean Sea Level
MTL	Mean Tide Level
NAVD88	North American Vertical Datum of 1988
NED	National Economic Development
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRA	National Recreation Area
OCIMF	Oil Companies International Marine Forum
OCMP	Oregon Coastal Management Program
ODMDS	Ocean Dredged Material Disposal Site
ODOT	Oregon Department of Transportation
OHP	Oregon Highway Plan
OIPCB or Port	Oregon International Port of Coos Bay
OLMIS	Oregon Labor Market Information System
OSE	Other Social Effects
OTSP	Oregon Territorial Sea Plan
P&G	Principles and Guidance
PCGP	Pacific Connector Gas Pipeline
PORTS	Physical Oceanographic Real Time System
RED	Regional Economic Development
RFP	Roseburg Forest Products
RM	River Mile

LIST OF ACRONYMS AND ABBREVIATIONS

SIGTTO	Society of International Gas Tanker and Terminal Operators
SMMP	Site Management/Monitoring Plan
TSP	Tentatively Selected Plan
USACE or Corps	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
WRDA	Water Resources Development Act
WSA	Waterway Suitability Assessment
WSR	Waterway Suitability Report

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1. INTRODUCTION

The Oregon International Port of Coos Bay (OIPCB) is proposing the construction and operation of a new container terminal on Port property along the North Spit of Coos Bay. When fully operational, the new Pacific Coast Intermodal Port Project (PCIP) would handle up to 2 million containers per year creating a new gateway for the nation's imports and exports. Intermodal operation means that containers would be moved to and from the marine terminal completely by rail without the use of over the road trucks.

Constructing and operating the PCIP would include three elements:

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5. Improving the existing Coos Bay Rail Line (CBRL) to accommodate container traffic, and
6. Modifying the existing Coos Bay Federal Navigation Channel to allow sufficiently large vessels to bring containers to and from the PCIP.

The Port's project funding could be through multiple sources, including grants from the State of Oregon and the U.S. Department of Transportation (USDOT), as well as a public-private partnership and with the PCIP terminal operator. The Port is seeking funding through multiple sources, including programs of the USDOT's National Infrastructure Project Assistance program[2] which supports large, complex projects that are difficult to fund by other means and likely to generate national or regional economic, mobility, or safety benefits. Under the USDOT's program, eligible projects include "*a freight intermodal (including public ports) or freight rail project that provides public benefit*."

The proposed container terminal is being designed to service containerships ranging in size from Panamax (958 feet length overall (LOA), beam of 106, and an operating draft of 40 feet) to Post-Panamax Generation III (LOA 1201, beam of 168, and an operating draft of 45 feet). Safe, regularly scheduled, operation of these vessels in the federal channel at Coos Bay would require modification of the existing channel. A series of ship simulations have been performed to identify the channel modifications needed to support safe navigation for the projected future containership fleet and for cape size bulk vessels that are also projected to use the improved channel in the future.

This Section 204(f)/408 Report analyzes and evaluates an array of alternatives and recommends a plan to deepen and widen a portion of the existing Federal navigation project at the Port of Coos Bay, Oregon from the ocean to River Mile (RM) 8.2. This study is a single-purpose study for deep draft navigation conducted by the OIPCB under the authority granted by Section 204(f) of WRDA 1986 (as amended). The existing channel at the Port of Coos Bay was last improved by USACE in 1998, when the channel was deepened by two feet. Before 1998, the channel had last been improved in the early 1970s. Since 1998, vessels calling at the Port have increased in size. In addition, existing and new development projected to occur along the improved channel would benefit from implementation of the recommended channel improvements.

1.1 Study Authority

The OIPCB seeks approval to modify portions of the Coos Bay, Oregon Federal Navigation Project under the authority granted by Section 204(f) of the Water Resources Development Act (WRDA)

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[2] https://www.transportation.gov/grants/mega-grant-program

of 1986, as amended by Section 1014(b) of the Water Resources Reform and Development Act (WRRDA) of 2014, and Section 1127 of Water Infrastructure Improvements for the Nation (WIIN) Act of 2016. Section 204(f) delegates authority to the Assistant Secretary of the Army for Civil Works (ASA(CW)) to approve requests by non-federal entities to design and construct improvements to federal navigation projects, and to approve requests for the Federal Government to assume operations and maintenance (O&M) responsibility for the project after non-federal construction is completed. The OIPCB also seeks permission to modify the existing Coos Bay Federal Navigation Project under Section 14 of the Rivers and Harbors Appropriation Act of 1899, 33 United States Code (USC) 408 (Section 408). A Section 404/10 evaluation is also being conducted and a separate permit application and accompanying environmental report to be converted by the USACE into their Environmental Impact Statement (EIS) is being prepared by the OIPCB.

This study will result in two major decision documents: (1) Port of Coos Bay Channel Improvement Project Sections 204(f)/408 Report; and (2) the PCIP EIS and Records of Decision. The exact format of the PCIP EIS has not been determined by the USACE as the lead Federal agency under NEPA. The draft EIS will comprehensively include all three elements of the PCIP: the proposed channel modification project, the container terminal and railyard, and the rail improvements along the OIPCB rail line. While each of these are separate elements, none of them have independent utility and they are all connected actions, necessary for the implementation of the PCIP.

The environmental report supporting the USACE's EIS will be prepared by the OIPCB and the channel modification component of the EIS will be used to develop three decisions related to the channel modification: 1) Section 204(f) Assumption of Maintenance Decision (by the Secretary of the Army), 2) the 33 United States Code (USC) 408 decision (by the North Northwestern Division Commander), and 3) the Section 404/10 Permit Application decision by the Portland District Commander.

The purpose of the Section 204(f)/408 report is to provide sufficient information to the ASA(CW) to determine whether it is in the Federal Government's interest to assume operation and maintenance of the navigation channel improvements to be implemented by the OIPCB. The Section 408 proposal will request approval for the OIPCB to modify the existing Federal navigation project.

Section 204(f) requires that approval for Federal assumption of maintenance be received from ASA(CW) before project construction is initiated. Initiation of construction is currently defined by ASA(CW) as occurring at the solicitation of the first construction contract. Therefore, no construction contract solicitation will be made by OIPCB until the Section 204(f) decision is received from ASA(CW). Physical construction cannot commence until the 33 U.S.C. 408 approval and Section 404 (Clean Water Act [CWA]) permit are received from the USACE.

1.2 Study Purpose and Scope

Congestion in the shipment of container cargo to and from United States west coast (USWC) ports has been an ongoing problem.[3] In response, the major USWC ports (*i.e.*, Los Angeles, Long Beach, Oakland, and Seattle/Tacoma) have implemented substantial infrastructure projects to

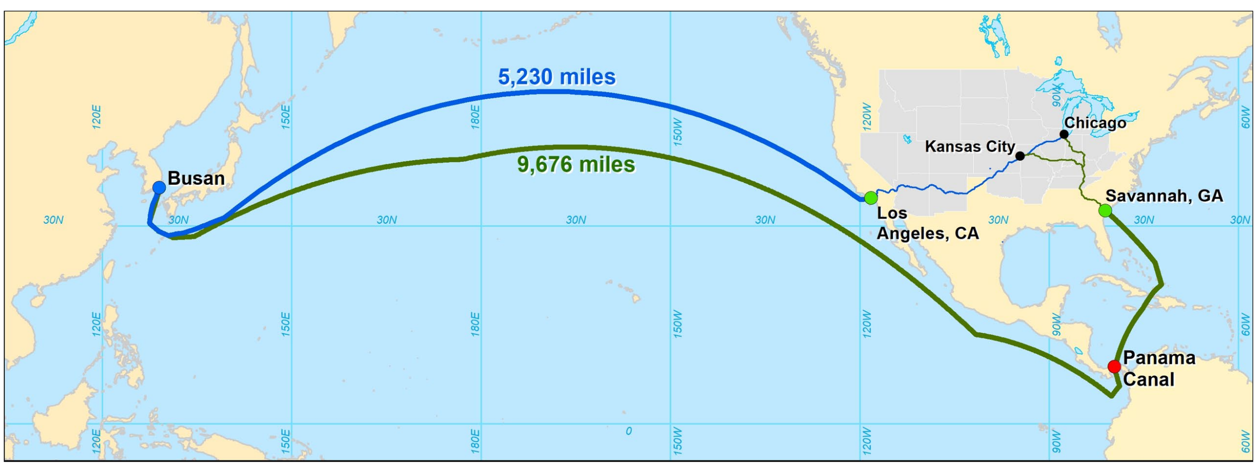
[3] https://www.freightwaves.com/news/congested-ports-choking-the-supply-chain

modernize terminals, enhance rail systems, and modify channels for larger vessels to improve efficiency.[4]

Despite these various west coast port improvements, container cargo delivery between far east Asia and interior locations of the US has increasingly landed containers at US east coast (USEC) ports and transported them via truck and rail into the interior of the US. In 2022 (*most recent data available*), 7.5 million TEUs[5] were shipped between far east Asia and the 25-inland US states, of which 4.0 million TEUs were estimated to have used USEC ports via the Panama Canal.[6] This containerized trade route adds additional days at sea and requires carriers to transit the Panama Canal when compared to delivering the same cargo through US west coast ports. However, shippers from far east Asia are choosing to send containers on the more expensive and less efficient route because there is greater certainty of on-time delivery.

Figure 1-1 shows how container cargo originating in northeast Asia (shown as Busan, South Korea) destined for locations within the 25 interior states shown in gray, is currently being delivered via both US ports on the west coast (shown as Los Angeles, CA) and US ports on the east coast (shown as Savannah, GA). For the example shown, Los Angeles represents the relative distance to US west coast ports and Savanna represents the relative distance to US east coast ports. Container cargo delivery from northeast Asia to interior locations of the US has had a growing proportion that is getting delivered via US east coast ports (e.g., Savanna, GA; Charleston, SC; Norfolk, VA; New York/New Jersey, NY/NJ) instead of being delivered via US west coast ports (e.g., Los Angeles/Long Beach, CA; WA; Oakland, CA; Seattle/Tacoma). At present, these carriers are choosing a longer vessel transit through the Panama Canal, delivering containers to USEC ports, and then using rail (i.e., intermodal transport) and truck to reach their destinations within the gray 25-state area.

Figure 1-1.
Container Trade Route Differences



The process of diverting containerized cargo from USWC ports to USEC ports reduces uncertainty in total delivery time for shippers because of intermodal capacity constraints at USWC ports.

[4] https://pacmar.com/article/infrastructure-projects-in-full-swing-at-major-west-coast-ports/
[5] A TEU is a "twenty-foot equivalent unit" or a standardized 20-foot shipping container.
[6] Economics Appendix Table A-10

However, using USEC ports requires substantially longer distances travelled onboard vessels and then using truck or rail to and from customers in the 25-state area depicted.

As shown in Figure 1-1, sailing a containership from Busan, South Korea to the USEC port of Savannah, GA requires more than 4,000 additional miles at sea than transiting directly to Coos Bay and requires transiting the Panama Canal. This equates to 9-10 more days of ocean travel for a containership to go from Busan, South Korea to Savannah, GA (21 days) than it would take to go from Busan to Los Angeles (11-12 days) (OIPCB, 2023). As such, sailing directly to the USWC from Busan would save the cost of 9-10 days of ocean transport and Panama Canal fees that are required to sail to Savannah, GA.

The U.S. Department of Transportation's Maritime Administration (MARAD) is committed to using an integrated, multimodal transportation system approach to optimize the contribution of water transportation to the cost-effective, reliable, safe, secure, and environmentally responsible movement of goods and people (USDOT, 2020). In the USDOT's 2020 Report to Congress titled Goals and Objectives for a Stronger Maritime Nation, there were specific goals to support the enhancement of US port infrastructure and performance. Specifically, DOT's objectives included:

- Leveraging America's Marine Highways Program to further reduce landside congestion and increase port efficiency;
- Coordinating with port authorities, Metropolitan Planning Organizations, State DOTs, and other stakeholders to significantly reduce national port congestion through improved planning and information;
- Facilitating US port access to funding and financial assistance to modernize and improve port infrastructure and increase intermodal efficiency, including measures to improve infrastructure resiliency to storm surge and other risks; and
- Working with stakeholders and Federal partners to address US ports' capability to accommodate changes in waterway and vessel characteristics, including the recapitalization of aging waterway facilities, aids to navigation and construction tenders, infrastructure such as locks and dams, and navigation services to maintain a safe and efficient system (USDOT, 2020).

Both the US Congress and the President have asserted how improvements to our nation's ports and rail are necessary to help ease inflationary pressures, create conditions for businesses to thrive, and strengthen supply chains which will ultimately lower costs for families (White House, 2022). As the USDOT agency responsible for America's waterborne transportation system, the Maritime Administration (MARAD) supports the technical aspects of America's maritime transportation infrastructure (e.g., ships and shipping, port and vessel operations, national security, environment, and safety). MARAD is also tasked to promote the use of waterborne transportation and ensure that its infrastructure integrates seamlessly with other methods of transportation. Similarly, the U.S. Army Corps of Engineers (USACE) mission includes ensuring the nation has a safe, reliable, and efficient navigation system because a well-functioning navigation system is crucial to the nation's economy.

The purpose and need for the proposed Oregon International Port of Coos Bay's PCIP is to carry out USDOT's and USACE's missions of taking actions to provide an efficient and well-functioning navigation system for the nation. Funding, permitting, and approving of the three separate elements needed to construct and operate the PCIP would increase efficiency for a portion of the intermodal container cargo between Asia and customers within the interior of the US as shown in the 25-state area.

This Section 204(f)/408 Report is intended to determine the feasibility of constructing economically justified and environmentally acceptable channel improvements at the Port of Coos Bay in accordance with applicable permits and acceptable design standards, and it is intended to support the Federal Government's assumption of maintenance responsibility of the improved channel.

Analyses performed for this Section 204(f)/408 Report include evaluations of alternative plan effects on:

- the physical environment;
- federal and non-federal infrastructure;
- performance of the federal navigation project; and
- operation and maintenance of the federal navigation project.

Evaluations of alternative plan effects on natural and social resources are documented in the OIPCB's environmental report being turned into the USACE's EIS.

1.3 Study Area Description

The Coos Bay estuary (Figure 1-2) is on the southern Oregon coast, on the western slope of the Coast Range in Coos County, Oregon, and about 200 miles south of the Columbia River mouth and 450 miles north of San Francisco Bay (USACE, 1975). To the north of Coos Bay there are sandy beaches backed by sand dunes that are being windblown into stands of shore pine and spruce; to the south, the coast tends to be rocky, with headlands periodically reaching into the sea (USACE, 1970).

The bay itself is shaped as an inverted "U" and is the deep draft navigational approach to the City of Coos Bay. The bay is approximately 13,300 acres in size (USACE, 2015) and formed by the junction of Isthmus Slough, Coos River, South Slough, Kentuck Slough, Haynes Slough and Winchester Creek, which rise on the western slopes of the Coast Range (Figure 1-3). Deep-draft navigation is limited to the lower 15 miles of the estuary (USACE, 1994). Its drainage area (i.e., watershed) is approximately 605 square miles; the largest tributary, the Coos River, discharges at the southeastern end of Coos Bay (USACE, 1975).

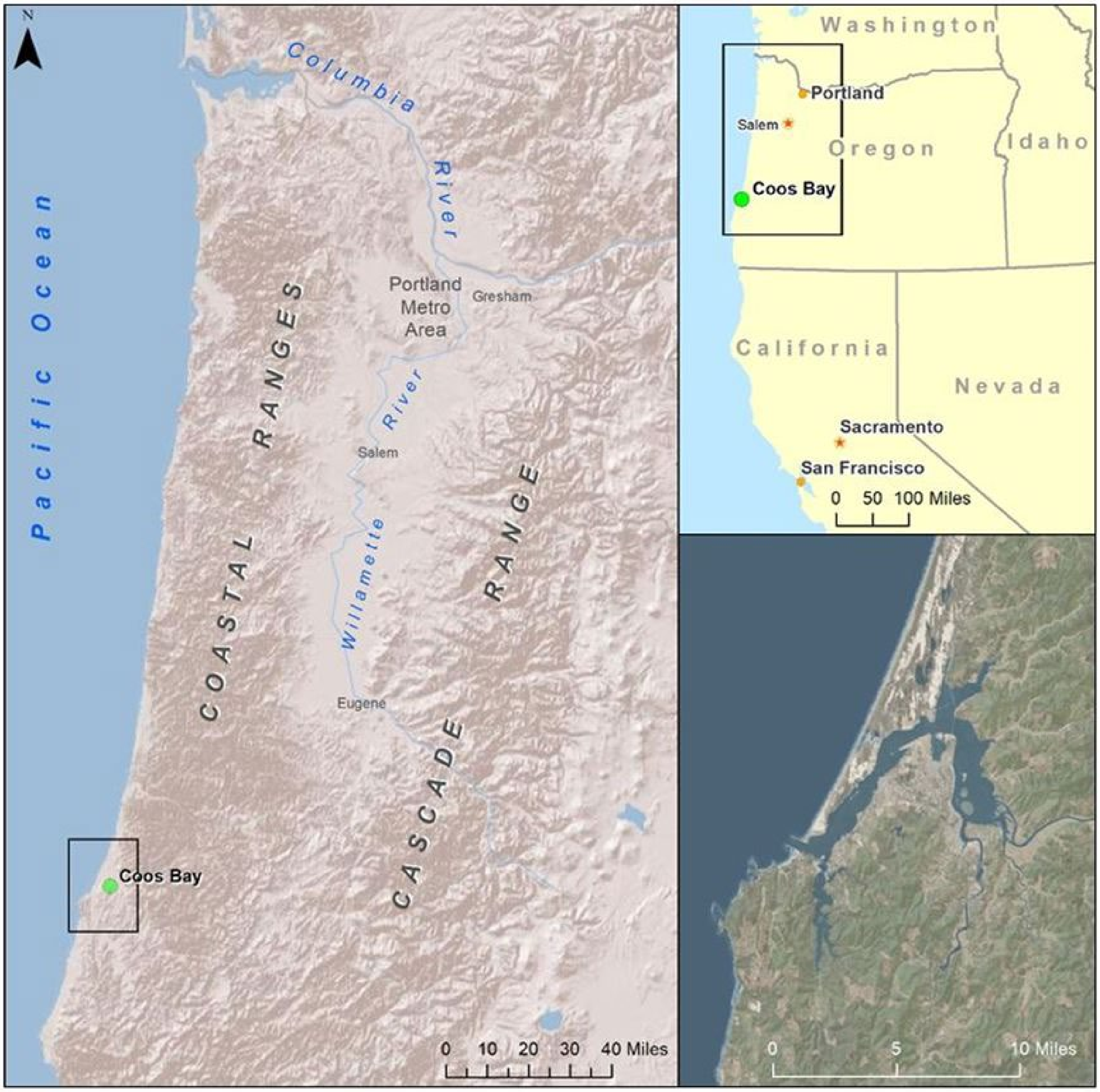


Figure 1-2: Coos Bay Location Map

Figure 1-3: Coos Bay and Tributaries

Within the Coos Bay estuary, the South Slough National Estuarine Research Reserve (SSNER) is a 4,771-acre natural area located in the South Slough of Coos Bay (See Figure 1-4). The SSNER was designated in 1974 as the first unit of the National Estuarine Research Reserve System and was established by the U.S. Congress with the Coastal Zone Management Act of 1972 (SSNER, 2017). National Estuarine Research Reserves provide opportunities for long-term research, education and interpretation,[7] and to promote informed management of the nation's estuaries and coastal habitats.

The South Slough Reserve is the only National Estuarine Research Reserve in Oregon and is managed through a partnership between the National Oceanic and Atmosphere Administration (NOAA) and the Oregon Department of State Lands (DSL) (SSNER, 2017). Oregon state law (O.R.S. 273.553 et seq.) complements and reinforces federal regulations by providing for the protection and maintenance of SSNER resources through state policy.

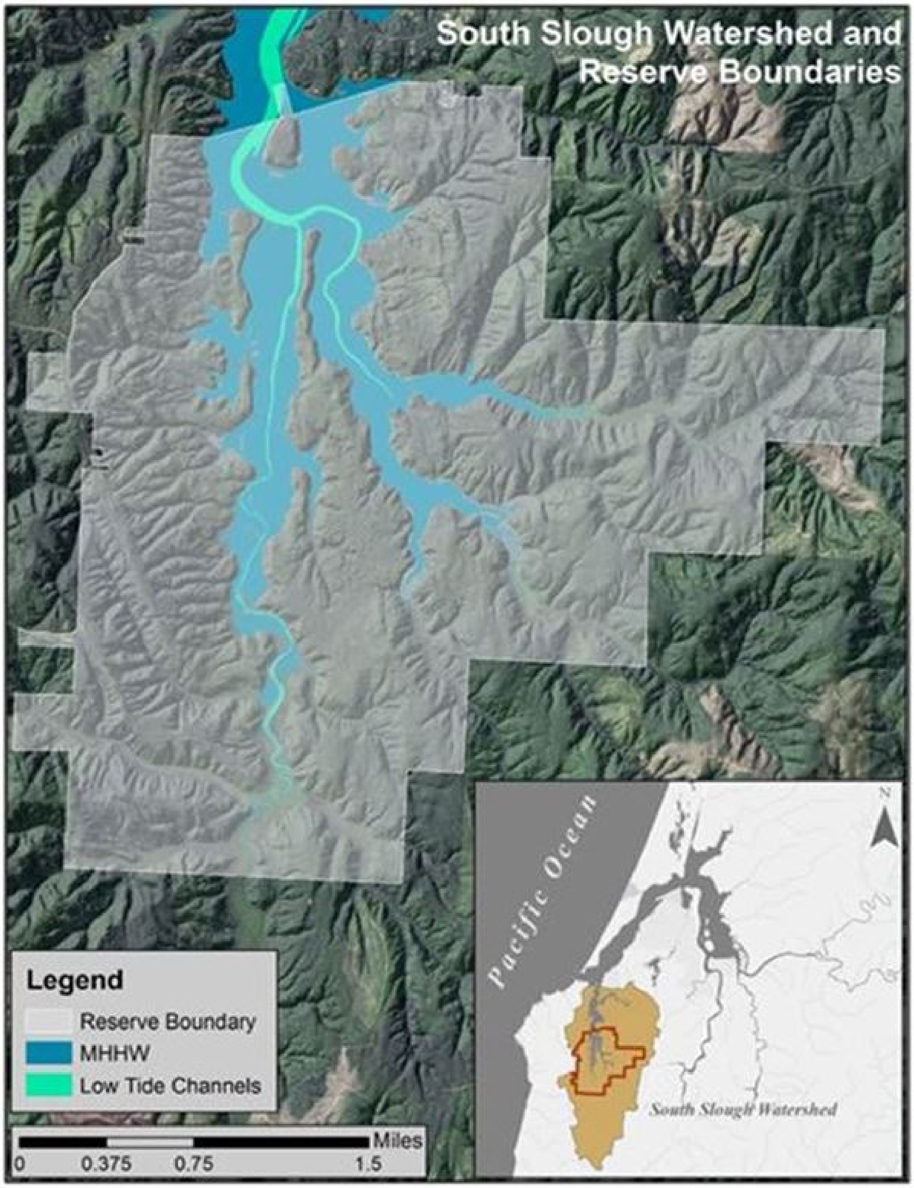


Figure 1-4: South Slough Watershed and Reserve Boundaries

[7] 15 C.R.F. § 921.1(a)

1.4 Existing USACE Navigation Project

The Coos Bay Federal Navigation Project was first authorized by the Rivers and Harbors Appropriation Act of March 3, 1899, and has been subsequently modified in 1910, 1919, 1922, 1927, 1930, 1935, 1948, 1960, 1970, and 1996. The 1970 project authorization allowed USACE to deepen and maintain the entrance channel at -45 feet deep Mean Lower Low Water (MLLW) and the inner channel to -35 feet deep MLLW. The most recent project modification was authorized in the fiscal year (FY) 1996 Energy and Water Development Appropriations Act, Public Law 104-46, which provided for deepening the channel by 2 feet to -47 feet MLLW from the ocean entrance to Guano Rock at river mile (RM) 1, and to -37 feet MLLW from RM 1 to RM 15. Public Law 104-46 also provided for deepening the turning basin at RM 12 by 2 feet and expanding it by 100 feet, which changed it from 800 feet by 1,000 feet to 900 feet by 1,000 feet.

The Coos and Milicoma Rivers Project was authorized in 1976 as a 50-foot wide, three to five-foot deep channel up the Coos and Milicoma Rivers. The project also included dikes and bulkheads at the Coos River mouth, which were never constructed. Maintenance of the Coos and Milicoma Rivers Project was discontinued in 1991, and there are no plans to dredge the rivers in the future.

Channel improvements assessed in this Section 204(f)/408 report include the reach from the ocean entrance to RM 8.2. Channel reaches upstream of RM 8.2 are not under consideration for improvement in this Section 204 (f) Report. It is assumed that USACE will continue to perform routine maintenance in the channel reaches upstream of the proposed channel improvements under without-project conditions and under with-project conditions.

1.4.1 Navigation Channel

The Coos Bay Federal Navigation Project, as authorized by the 1996 Energy and Water Development Appropriations Act, Public Law 104-46, consists of an entrance channel from the Pacific Ocean protected by two jetties and an approximately 90-degree turn to the north immediately inside the jetties and the inside channel. The existing channel is 15.2 miles long, with varying widths and depths (see Section 2.4.1 Channel Dimensions). Its authorized depth ranges from -47 feet MLLW at the channel entrance to -37 feet MLLW in the inner channel. Within the entrance, the channel is 1,060 feet wide. It narrows to 700 feet at RM 0, and then to 300 feet upstream of the jetties at RM 1.0. From RM 9.2 to RM 15 the channel is 400 feet wide.

The USACE Federal Navigation Project (Figures 1-5 and 1-6) consists of the following federally authorized elements:

- North Jetty (9,600 ft long) and South Jetty (3,900 ft long), located on either side of the Entrance Channel, including the two relic structures that extend from the root of the North Jetty, one of which extends into Log-spiral Bay (LSB) and the other of which extends into the estuary.
- An Entrance Channel with an authorized depth of -47 ft MLLW, which decreases from a nominal width of 700 ft at RM 0 to a nominal width of 300 ft at RM 1.
- An inner channel (from RM 1 to RM 15) that has an authorized depth of -37 ft MLLW, a nominal width of 300 ft from RM 1 to RM 9, and a nominal width of 400 ft from RM 9 to RM 15.
- Two (2) turning basins, both of which are 1,000 ft long. The first is located at RM 12, and has a width of 900 ft. The other, located at RM 14, has a width of 730 ft. Both have a depth of -37 ft MLLW, consistent with the channel depth.

- Five (5) pile dikes between RM 6.4 and RM 7.3 in the main channel.
- Continuation of the main channel beyond RM 15 (in the Isthmus Slough) with a width of 150 ft and a depth of -22 ft MLLW.
- A 150-ft-wide Charleston Access Channel that has a depth that varies from –17 to -16 ft MLLW.
- A breakwater and bulkhead at Charleston.
- Charleston Small Boat Basin (10 feet deep) constructed by USACE in 1956 and maintained by the OIPCB.
- Advanced maintenance dredging (AMD) of the channel extends offshore to RM -0.55, where the width of maintenance is 1,060 ft. Authorized AMD is 5 ft of depth in the Entrance Channel (RM 0.55 to RM 1) and 1 ft of depth upstream of RM 1.

There is currently no authorized anchorage area. Between 1970 and 1997, there was an authorized anchorage area measuring -35 feet MLLW deep, 800 feet wide, and 1,000 feet long at RM 5.5. Half of this anchorage has not been maintained, as mitigation for the 1998 channel modification project (USACE 1994).

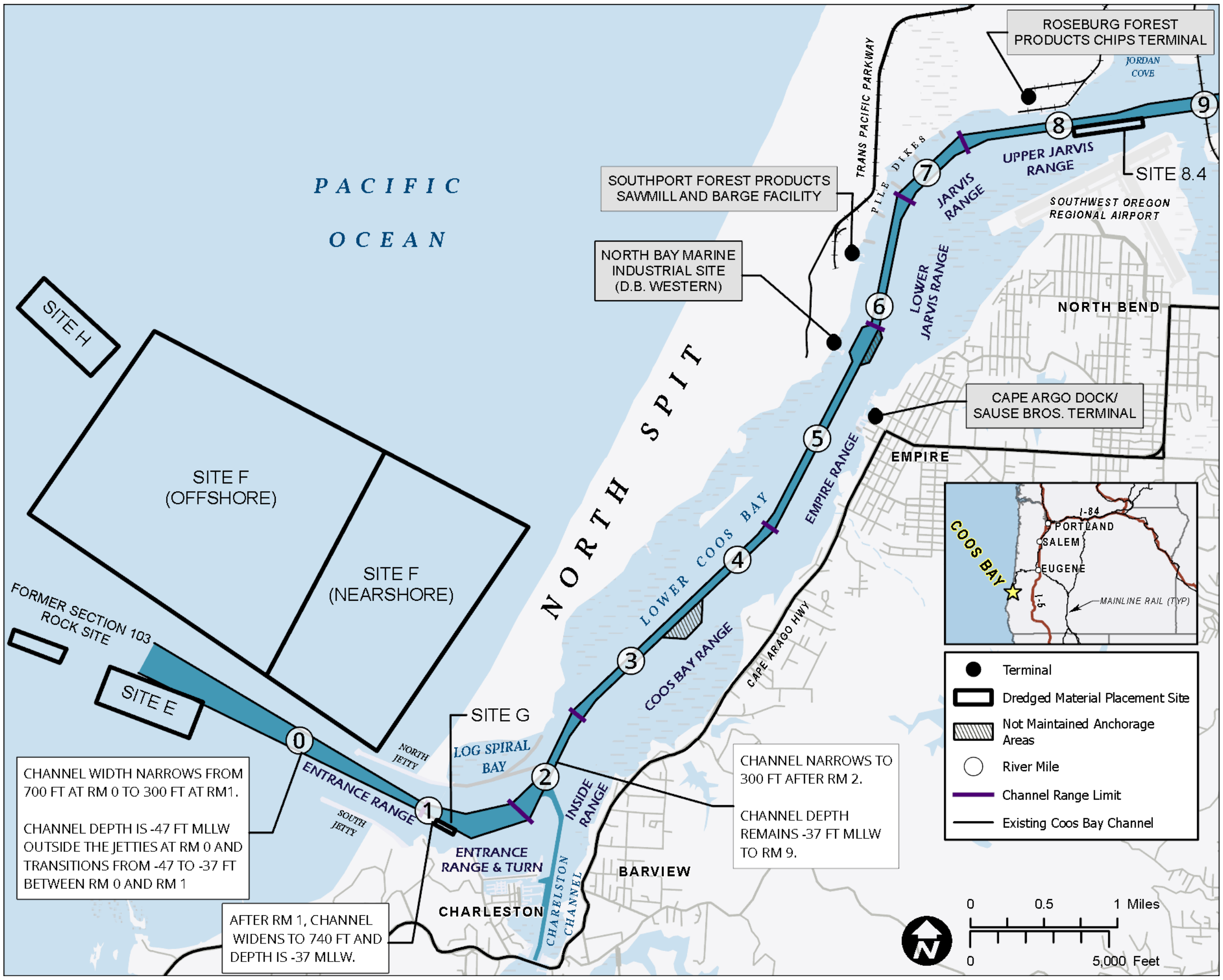


Figure 1-5: Federal Navigation Project (RM0 – RM9)

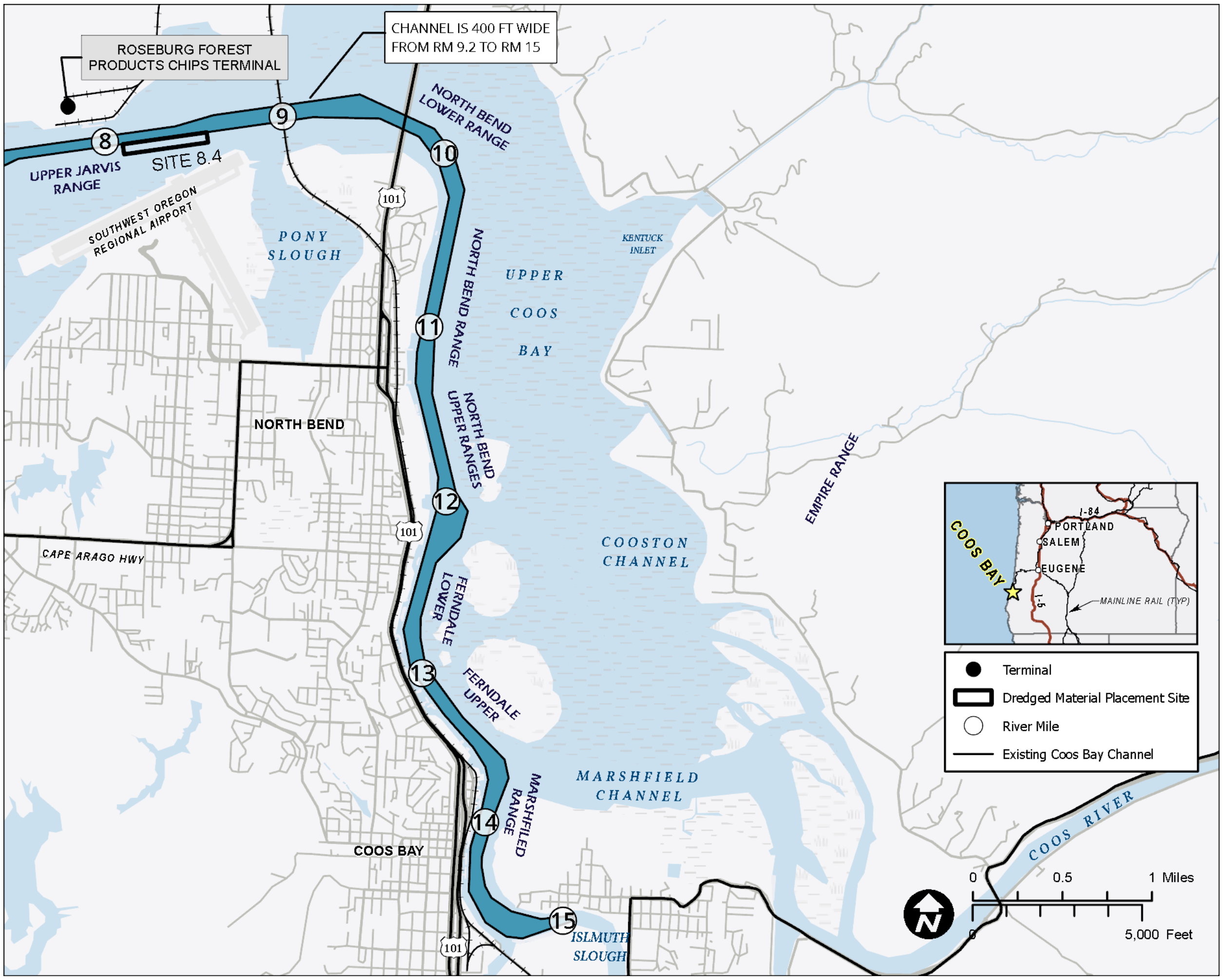


Figure 1-6: Federal Navigation Project (RM8 – RM15)

1.4.2 Operation and Maintenance

The Coos Bay channel is maintained by the USACE Portland District, primarily using hopper dredges below RM 12 and clamshell dredging above RM 12. Pipeline dredging in the Coos Bay Federal Navigation Channel (FNC) has not been used for FNC maintenance since the 1980's. Sea conditions normally limit dredging opportunities to the period from May through October, extending into November if favorable conditions exist at the entrance bar. Environmental work windows generally allow dredging from mid-June through mid-February.

The Coos Bay channel is maintained to the authorized project depth by a maintenance dredging program that employs a combination of USACE in-house dredging plant and contract dredges. Routine annual maintenance is typically required at the entrance bar and in the inner channel to RM 12. From RM 12 to RM 15, routine maintenance is typically scheduled for alternate years, but has rarely been funded on that frequent a cycle (see Section 2.4.2: Maintenance Dredging History for annual maintenance dredging volumes). When problem shoaling occasionally occurs in a critical area, such as in the approaches to the railroad bridge, emergency dredging by the USACE hopper dredge Yaquina, or by a clamshell dredge, has been performed to restore channel depths.

Non-federal maintenance dredging in Coos Bay is permitted as part of the OIPCB Department of the Army (DA) Permit. An average of approximately 10,000 cy per year is dredged from a variety of different terminals along the navigation channel.

1.4.2.1 Disposal Areas

Three ocean disposal sites identified as ODMDS E, F, and H have been designated by the USEPA under the authority of Section 102 of the Marine Protection, Research, and Sanctuaries Act (MPRSA). Since 1990, clean maintenance dredging material (primarily sand and silt) have been deposited mostly at ODMDS F and H, both of which are managed and monitored by the USACE and the USEPA in accordance with the Site Management/Monitoring Plan (SMMP) (USEPA and USACE 2006). A brief description of the three existing ODMDS follows:

ODMDS E (or Site E) is located approximately 1.5 mi southwest of the entrance to Coos Bay. The site is 3,600 ft by 1,400 ft, with an area of 116 ac and an average water depth of about 51 ft MLLW. ODMDS E is authorized for the disposal of sand dredged from below RM 12, but it was not used between 1990 and 2005 due to mounding. Most recently in 2006, 79,900 cy of material was disposed at the site. The site has not been used since 2006 because a significant percentage of the material disposed in Site E migrates back into the navigation channel. For this reason, future use is unlikely other than temporarily during extreme adverse weather conditions and if no other site is available.

ODMDS F (or Site F) is located outside the Coos Bay entrance. It is the largest of the Coos Bay ocean placement sites. Site F has been authorized for use by the USACE since 1977. It is designated by the USEPA for the disposal of coarse-grained channel maintenance material removed from areas below RM 12 (USACE, 2014a) and for OIPCB Unified Dredging Permit material that is less than 60% fines.

Site F has been expanded in past years (1989, 1995, and 2006), and currently has an area of 3,075 acres. Water depths range from -20 feet MLLW to -160 feet MLLW. Site F is informally divided into nearshore and offshore portions. The nearshore portion has depths shallower than -60 feet MLLW and dispersion rates that are sufficient for material disposed in the nearshore zone to migrate to adjacent beaches. The offshore portion has depths greater than -60 feet MLLW and lower dispersion rates (USEPA and USACE 2006).

Existing USACE maintenance dredging practices call for the majority of material to be disposed in ODMDS F Nearshore to support nourishment of the littoral environment. ODMDS F Offshore is used when weather and wave conditions do not allow dredging equipment to move into the shallower portions of ODMDS F Nearshore. Since the previous channel modification in 1998, the volume disposed in ODMDS F (Offshore and Nearshore combined) has averaged 770,000 cy/yr (see Table 2-16, presented later in this document). ODMDS F Nearshore has been used by the Portland District for the placement of dredged material into the littoral system with an average placement of 495,000 cy per year from 2006 – 2015 (McMillan, 2018). Approximately 14,000 cy of OIPCB Unified Dredging Permit material are disposed in Site F each three-year dredging cycle.

Based on the size of Site F, its dispersive characteristic, and preferential use of the nearshore portion of Site F for littoral nourishment "capacity is virtually unlimited" (USEPA 2006) for the placement of maintenance dredging material.

ODMDS H (or Site H) is the ODMDS located farthest offshore (3.4 NM) and in the deepest water (average water depth of -180 feet MLLW). It is 3,600 feet by 1,450 feet, with an area of 120 acres and is used for the disposal of finer-grained materials.

In-Bay Placement Sites. Two existing in-bay placement sites (refer to Figure 1-5) have been used for the past several decades. One of the in-bay placement sites is a rehandling site (Site 8.4) and the other is a flow-lane site (Site G). Both are described below:

- ***Site 8.4*** is a non-dispersive temporary storage site located adjacent to RM 8.4 and is used for material dredged from upper Coos Bay. The *Dredge Yaquina* places small loads of material from the upper Coos Bay at Site 8.4 until the material accumulates to typically no more than 40,000 cy. The accumulated material is then re-dredged and hauled off to ODMDS F. This rehandling process reduces time spent hauling loads to the ODMDS and provides the opportunity to avoid traveling out the ocean entrance during adverse weather conditions. Material disposed in Site 8.4 is removed every five to ten years.

  Site G is an in-bay, flow-lane dredged material disposal site located just inside the Entrance Channel, on the southern edge of the entrance, between buoy 4 and 6 (at RM 1). The site is 1,000 ft by 200 ft (4.6 acres), at a depth of -40 to -45 ft MLLW. Site G is used only when ocean conditions are too hazardous for a hopper dredge to access the ODMDS or when hydraulic cutterhead (pipeline) dredging is conducted in the Charleston Access Channel and Marina. USACE placement history is available at Site G from 1990-2018. Maintenance material has been disposed in Site G in 17 of the last 29 years. Pipeline dredging of the Charleston Access Channel has a large influence on the amount of material disposed at Site G. Average placement per dredging year by the Hopper Dredge Yaquina is 14,100 cubic yards. Average pipeline placement for the two years that the Charleston Access Channel was dredged is 36,600. Placement in Site G has been highly variable during the last 29 years, ranging from zero in 10 different years, less than 10,000 in 7 different years, to a maximum of 55,300 cy in 2011 (see Table 2-18, presented later in this document). The principal causes of annual variability in the use of Site G are sea conditions at the bar, which can restrict hopper dredge access to the ocean, and whether pipeline dredging of the Charleston Access Channel occurs in a given year.

1.4.3 Entrance Jetties

The USACE maintains two jetties at the entrance to the Federal channel. Construction of the North Jetty began in 1894. Construction of the South Jetty began in 1924. The north jetty is authorized at 9,600 feet long and the south jetty at 3,900 feet long.[8] However, neither jetty has been at its full authorized length since the early 1930s. However, the North Jetty was never built to its full authorized length and both jetties are currently substantially shorter than these authorized lengths. The North Jetty is currently undergoing a major rehabilitation that is scheduled for completion in December 2025.[9]

The south jetty was last rehabilitated in 1964. Currently, it has numerous scalloped areas on the channel side of its shoreward third, exposing the concrete core in a few places. Although it is tilted and broken in places, the concrete core is in relatively good condition and extends beyond the current jetty head. Some erosion has occurred at the south jetty root where it connects to the sea cliff (USACE 2012).

Prior to the current major rehabilitation, the North jetty head was last reconstructed in 1989. Since the last reconstruction the jetty has been receding at an observed rate of approximately five feet per year since 2012 (USACE 2017). The root of the north jetty has failed, with its crest elevation well below Mean Higher High Water (MHHW). Structural deterioration has resulted in several emergency repair actions to the North Jetty over the last 10 years. Shoreline erosion issues adjacent to the North Jetty, both interior to and exterior to the inlet, have threatened to destabilize the North Jetty and the inlet. Over the past 60 years, a typical log-spiral bay has formed at the root of the north jetty. The major rehabilitation will reconstruct the jetty head, repair critically damaged portions of the trunk and restore the jetty root elevation to control erosion.

Overall, the jetties are projected to continue to perform their function of supporting navigation and controlling shoaling in the entrance channel.

1.4.4 Pile Dikes

In 1957, pile dikes were constructed on the outer (northwestern) bank in the Jarvis Turn Reach to stop the channel thalweg (deepest part of the river) from shifting northwest towards the North Spit, and further eroding the outer bank of the Jarvis Turn (RM 6.3 to 7.3). Five pile dikes were constructed and named according to their approximate river mile location: CB-6.4, CB-6.6, CB-6.8, CB-7.0, and CB-7.3. The pile dikes consist of three major components: the pile dike, a pile dolphin, and a stone blanket. The wooden piles are creosote treated and about 12 inches in diameter. The dike piles extend up to +10 ft MLLW, and the dolphin piles extend 6 ft higher to +16 ft MLLW and help mark the location of the structures. Typically, the shoreward-most piles are 18 ft long and driven to -8 ft MLLW. As the structure extends further toward the channel, the length of piles increases to 50 feet and they are driven to 40 ft below MLLW. The pile dikes are in a deteriorated condition, however sufficient rock from the original placement is present at the pile dikes to provide protection.

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[8] http://www.nwp.usace.army.mil/Locations/OregonCoast/CoosBay.aspx accessed March 28, 2014.
[9] https://www.nwp.usace.army.mil/Media/News-Releases/Article/3327429/corps-of-engineers-to-begin-critical-repairs-to-coos-bay-north-jetty-closes-roa/ accessed 10Jun24

1.4.5 Aids to Navigation

Approximately 46 existing ATON help guide the Coos Bay Pilots from offshore up to RM 8.2. The existing lateral marker system up to RM 8, consists of 22 buoys and 4 fixed markers. The existing range marker system up to RM 8, consists of 20 range markers (located on 17 structures).

1.4.6 Associated Infrastructure

The channel is crossed by two bridges upstream of RM 9.0. At the swing-span railroad bridge (RM 9.2), the horizontal clearance is restrictive at 197 feet.[10] The McCullough Highway Bridge (on US 101), at RM 9.5, has a vertical clearance of 123 feet at zero tide.[11]

Utility crossings of the navigation channel occur at RM 5.7. A sewage line and a fiber optic line cross at a depth of -71.7 feet MLLW. A natural gas line crosses at a depth of -62 feet MLLW and a water line crosses at a depth of -90 feet MLLW.

1.5 Prior Reports

There have been many federal reports concerning the navigation channel at Coos Bay, since USACE first studied Coos Bay for the purpose of stabilizing the bay entrance in 1878 (USACE 1994). The most recent and relevant USACE reports relating to the Coos Bay Federal Navigation Project are listed below.

<u>Coos Bay, Oregon, Navigation Improvements Final Feasibility Report and Environmental Impact Statement</u>, USACE Portland District, January 1994.

The 1994 Feasibility Study and EIS was performed in response to a resolution of the Committee on Environment and Public Works of the United States Senate, adopted Nov. 2, 1983. The existing project at that time included a one-mile long entrance channel with a depth of 45 feet and a 35-foot deep inner channel extending for 15 miles. Five deepening alternatives were considered with the NED plan being a two-foot deepening in the entrance to -47 ft MLLW and the inner channel to -37 feet MLLW.

<u>Coos Bay Jetties Preliminary Major Maintenance Report</u>, USACE Portland District, July 2012.

The Coos Bay Jetties Preliminary Major Maintenance Report evaluates the Coos Bay navigation channels and jetty systems. It investigates several repair design alternatives with the primary goal of extending the functional life of the jetties and maintaining deep-draft navigation through the entrance; and it recommends a preferred project alternative based on structural, functional, and cost considerations. The study phase will be followed by the design phase and an environmental assessment. A commencement date for the design phase and environmental assessment has not been determined.

<u>Coos Bay Maintenance Dredging Environmental Assessment, USACE Portland District, June 2015.</u>

The Environmental Assessment addresses continued operation and maintenance dredging by the U.S. Army Corps of Engineers (USACE), Portland District of the Coos Bay Federal Navigation

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[10] NOAA Chart 18587, U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Coast Survey. Last Correction 3/26/2014. Accessed 13May2014: http://www.charts.noaa.gov/OnLineViewer/18587.shtml
[11] Ibid.

Project, and updates previous NEPA documentation providing further evaluation of the potential for environmental effects from these continued maintenance activities.

1.6 Public Involvement

In support of the project, the OIPCB will prepare and coordinate a community engagement plan with the USACE, Oregon State and Federal elected officials, federal and state agency leadership, Tribes, and other appropriate entities. Within that larger community engagement plan, the USACE will also identify the required steps for fulfilling their obligations under NEPA.

As required by NEPA, CEQ NEPA-implementing regulations (40 CFR 1500-1508), and the Army Corps Procedures for Implementing NEPA (ER 200-2-2), the USACE Portland District will conduct a public scoping process consistent with the procedural requirements of NEPA. In addition, the Bipartisan Permitting Reform Implementation Rule (CEQ, 2024) includes provisions to advance environmental justice and promote meaningful public input. The rule helps ensure projects are built smart from the start by promoting early and meaningful engagement with communities, fostering community buy-in, reducing or avoiding conflict, and improving project design. In addition, the rule:

- Directs agencies—consistent with current best practices—to consider EJ in environmental reviews and to encourage measures to avoid or reduce disproportionate effects on communities, including the cumulative impacts of pollution;
- Requires agencies to consider the needs of affected communities when developing outreach and notification strategies so communities know about and can participate in decisions that affect them; and
- Directs agencies to identify Chief Public Engagement Officers responsible for facilitating community engagement for environmental reviews.

1.7 Planning Process and Report Organization

The Port of Coos Bay Channel Improvement Project Sections 204(f)/408 Report serves two purposes:[12]

- provide sufficient information to the ASA(CW) to determine whether it is in the Federal Government's interest to assume operation and maintenance of the navigation channel (the 204(f) decision); and
- provide sufficient information to the North Northwestern Division Commander for approval for the OIPCB to modify the existing Federal navigation project (the 408 decision).

A single EIS for the proposed channel modification project will be prepared by the USACE with cooperating agencies and will be used to develop three decisions relative to the channel modification: 1) Section 204(f) Assumption of Maintenance Decision (by the Secretary of the Army), 2) the 33 United States Code (USC) 408 decision (by the North Northwestern Division

[12] EC 1165-2-220 Policy and Procedural Guidance for Processing Requests to Alter US Army Corps of Engineers Civil Works Projects Pursuant to 33 USC 408, 23Jan2018, states that to avoid duplication of documentation for the 204(f) and 408 authorities, districts should ensure that requirements for both are coordinated and leveraged to the maximum extent practicable.

Commander), and 3) the Section 404/10 Permit Application decision by the USACE Portland District Commander.

The planning process employed by the OIPCB for this Port of Coos Bay Section 204(f) Report has followed the USACE's six-step planning process as described in the Planning Guidance Notebook (ER 1105-2-100, dated 22 April 2000). The steps are:

- Specify water resources problems and opportunities;
- Inventory, forecast, and analyze the water and related land resource conditions within the study area;
- Formulate alternative plans that address the identified problems and take advantage of the opportunities;
- Evaluate the effect of alternative plans;
- Compare alternative plans; and
- Select the recommended plan.

The Principles and Guidelines[13] (P&G) adopted by the Water Resources Council guide the formulation and evaluation of Federal water resource projects. Although this study is being carried out by the OIPCB, USACE planning guidelines are being followed to support the ASA(CW)'s determination that the proposed work is economically justified and environmentally acceptable. The ASA(CW) must also certify that the work has been completed in accordance with applicable permits and acceptable design standards prior to the Federal assumption of project maintenance.

Preliminary plan formulation (Section 5) identified two plans to be advanced for more detailed evaluation (Section 6). The Proposed Alteration (PA) and an Abbreviated Proposed Alteration (APA) were equivalently evaluated and compared to the without-project condition (the No Action Plan) to identify the effects of each plan (Section 8). The USACE Deep Draft Navigation Planning Center of Expertise (DDNPCX) was used to run the HarborSym model to evaluate the bulk commodity transportation costs for the preliminary (Section 5) and the final (Section 7) economic evaluation of alternative plans. Note that the DDNPCX used commodity and fleet forecasts provided by the OIPCB when running the HarborSym model. The OIPCB evaluated the containerized commodity transportation costs for the preliminary and the final economic evaluation of alternative plans, also presented in Sections 5 and 7, respectively.

The Dredged Material Management Plan (DMMP) investigated potential dredged material placement measures and evaluated alternative placement plans (Appendix B). The DMMP recommendation is the least cost plan (the Federal Standard) that manages PA construction material and long-term maintenance dredging material in a technically feasible and environmentally acceptable manner. The DMMP includes disposal at a "one-time-use" Ocean Dredged Material Disposal Site (ODMDS). The final location of the new ODMDS will be decided through the Marine Protection, Research, and Sanctuaries Act (MPRSA) Section 103 application and permitting process, which takes place concurrently with the Section 10/404 permitting process. The MPRSA Section 103 application and permitting process requires the evaluation of beneficial use of dredged material as an alternative to ODMDS placement (40CFR part 227.16; Section 102

[13] The Water Resources Council's P&G (February 3, 1983) are composed of two parts: (1) The Economic and Environmental Principles for Water and Related Land Resources Implementation Studies and (2) The Economic and Environmental *Guidelines* for Water and Related Land Resources Implementation Studies. The P&G were updated in 2014.

of the Marine Protection Research and Sanctuaries Act of 1972). This beneficial use evaluation led to the development of the North Spit Nearshore Littoral Placement Site, which will be used for up to 6.0 million cubic yards of construction material into the littoral system and 9.9 million cubic yards of maintenance material into the littoral system based on continuation of the existing maintenance regime over 20 years (Section 10).

The EIS and the analysis of effects to environmental and social resources is being performed by the OIPCB as a stand-alone document incorporating the Section 204(f)/408 Report by reference. The environmental and social impacts of the project are the basis for the determination of the mitigation plan (Section 9).

The remainder of the Section 204(f)/408 report is organized as follows, with three appendices:

Section 2 – Existing Conditions

Section 3 – Without-Project Conditions

Section 4 – Problems, Opportunities, and Constraints

Section 5 – Formulation and Preliminary Evaluation of Alternatives

Section 6 – Detailed Description of Final Alternative Plans

Section 7 – Economic Evaluation of Final Alternative Plans

Section 8 – Physical Effects of Final Alternative Plans

Section 9 – Environmental Effects of Final Alternative Plans

Section 10 – Recommended Plan

Section 11 – Risk and Uncertainty

Section 12 – Implementation Requirements

APPENDIX A: ENGINEERING

APPENDIX B: DREDGED MATERIAL MANAGEMENT PLAN

APPENDIX C: ECONOMICS

2. EXISTING CONDITIONS

This section of the Section 204(f)/408 report presents existing physical, environmental, and economic conditions in the study area. Physical conditions include the climate and physical infrastructure. Environmental conditions include upland, wetland, and marine ecosystems. Economic conditions include general socioeconomic conditions, OIPCB operations, and port-related activities. Note that more detailed discussions and citations are provided in the Engineering and Economics, and the Environmental Impact Statement prepared by USACE.

2.1 General

2.1.1 Temperature and Precipitation

The normal daily maximum temperature ranges from 52.7° F in January to 67.6° F in August. Normal daily minimum temperatures range from 39.4° F in January and December to 52.9° F in August. Normal monthly precipitation ranges from 0.51 inches in July to 10.42 inches in December. Average annual precipitation is 64.43 inches.

2.1.2 Sediment Characteristics

The Coos Bay dune sheet is the largest coastal dune accumulation in the United States. It extends northward for nearly 150 miles, from the North Spit at the mouth of the Coos Bay estuary to Heceta Head to the north. The continental shelf off Coos Bay is approximately 14 miles wide. Regional offshore bathymetric contours generally run northeast to southwest, parallel to the coastline. Analysis of the material in sands that now lie underwater in the continental shelf shows that the movement of beach sand during lower sea levels was to the north, with a significant fraction of the material on the beach sourced from the Klamath Mountains to the south rather than from the Oregon coast range. Multiple investigations, described briefly below, indicate that much of the Coos Bay channel system, from the entrance to RM 6, has a bed of clean, fine-grained sand underlain by very soft to soft marine sedimentary rock. Outcroppings of harder, unweathered marine sedimentary rock are found at the entrance and beyond RM 6 (OIPCB 2018).

The results of chemical analyses of sediment samples have found that materials sampled from the federal navigation channel are clean and not polluted with contaminants (OIPCB, 2023). The sand and marine sedimentary rock do not accumulate contaminants in the marine estuarine environment (OIPCB, 2023). The Level 1 Site History prepared in 2023 by the OIPCB (OIPCB, 2023) at the request of the interagency Portland Sediment Evaluation Team (PSET) found no new contaminant sources since the 2014 sampling documented in the USACE 2015 sediment characterization report (USACE, 2015).

Detailed discussions of dredged material physical and chemical characteristics is presented in Section 6.2: Dredged Material Characteristics.

2.1.3 Bathymetry

For more than 100 years, the USACE has modified and maintained a deep draft navigation channel within the Coos Bay estuary. Prior to any alterations, the channel across the bar at the entrance to Coos Bay was approximately 10 feet deep and 200 feet wide (USACE, 1975). The channel wound to the north with a depth of about 11 feet and width of approximately 200 feet to the town of North

Bend and then gradually decreased in width to approximately 50 feet and in depth to six feet at what is now downtown Coos Bay (ODFW, 1979).

In addition to channel modifications, substantial intertidal[14] areas of the estuary have been diked and filled to create fastlands[15] for agriculture, municipal growth, and dredged material disposal islands. The surface area of Coos Bay in 1890 was approximately 19,000 acres at mean high tide and 5,800 acres at mean low tide (Baker et al, 2000); the estuary currently inundates approximately 12,160 acres at mean high tide and 3,840 acres at mean low tide (Wiley, 2018). Extensive filling and diking in the sloughs and tributaries have changed the bathymetric form of the estuary (ODFW, 1979).

Filled areas along the Coos Bay estuary's shorelines include much of Coos Bay's current business district, which was formerly marsh. Much of Coalbank Slough has been filled and Pony Slough was filled for construction of the North Bend Municipal Airport. Dredged material was placed south of the Marshfield Channel at Eastside and on several tidal flats creating large spoil islands (PCW, 2015b). The Oregon State Land Board has documented over 1,260 acres of fill on the submerged and inter-tidal land in Coos Bay as the result of in-bay dredge placement (USACE, 2015).

To assess the gross magnitude of the changes to the historic bathymetry of the Coos Bay estuary, a GIS assessment was conducted. Hard copies of historic navigational maps (1865 (CSO, 1865), 1937 (USC&GS, 1937), and 1971 (NOAA, 1971)) were obtained, scanned, and registered to Oregon State Plane South coordinates using an affine transformation.[16] For each of the three maps, the mean high-water line was digitized and converted to a polygon. In addition, bathymetric points and contours depicted in each map were also digitized into GIS feature classes and attributed with the depths in MLLW. Oregon State University provided 2017 bathymetry in digital format. The Table 2-1 shows the volume of the Coos Bay Estuary for each year and shows that the volume of Coos Bay within the areal extent of historic mapping coverage has increased more than 30,000 (68%) acre-feet since first being mapped in 1865.

[14] The estuary is composed of two tidal areas: the intertidal area, which is subject to daily tidal fluctuations, and the subtidal area, which is always inundated (PCW, 2015b).

[15] Fastlands are diked and drained former tidal wetlands.

[16] A geometric transformation that scales, rotates, skews, and/or translates images or coordinates between any two Euclidean spaces. It is commonly used in GIS to transform maps between coordinate systems. In an affine transformation, parallel lines remain parallel, the midpoint of a line segment remains a midpoint, and all points on a straight line remain on a straight line.

Table 2-1
Estimated Historic Estuarine Volumes

Year	Volume below MLLW (acre-feet)
1865	50,000
1937	53,000
1971	65,000
2017	84,000

2.1.4 Water Levels

The tides of Coos Bay are of the mixed semi-diurnal type, meaning that Coos Bay experiences two daily highs and two daily lows of unequal duration and amplitude. The National Oceanic and Atmospheric Administration (NOAA) Center for Operational Oceanographic Products and Services (CO-OPS) provides tidal information, based on the current epoch (1983-2001), for four locations in and close to the Coos Bay estuary. Table 2-2 provides data for the Charleston location within Coos Bay. The lowest and highest observed water levels have been included to provide an indication of the historical extreme water levels. The tidal range slightly increases upstream from the channel entrance to the city of Coos Bay. The tides at the city of Coos Bay lag the tides at Charleston by approximately 90 minutes.

Generally, there is a significant seasonal variation in water level. On average, water levels are up to one foot higher in February than in September. Water levels are also affected by the El Niño/Southern Oscillation (ENSO). During El Niño events, water levels offshore of Oregon may be higher than the multiyear average by as much as 6 inches, with the extreme residual water level (observed tide compared to astronomical tide) as high as 3 feet. The highest observed water level identified in Table 2-1 includes the effects of El Niño and storm surge. Projected effects to water levels are evaluated in Section 8: Physical Effects of Final Alternative Plans.

Table 2-2
Water Levels Measured in Charleston, Oregon

Water Level	Feet Relative to MLLW
Highest Observed Water Level (01/26/1983)	11.18
Mean Higher High Water (MHHW)	7.62
Mean High Water (MHW)	6.96
Mean Sea Level (MSL)	4.11
Mean Tide Level (MTL)	4.08
Mean Low Water (MLW)	1.27
North American Vertical Datum of 1988 (NAVD88)	0.50
Mean Lower Low Water (MLLW)	0.00
Lowest Observed Water Level (06/01/1973)	-3.08

Period of Record: 4/1/1970 to May 2013

2.1.4.1 Sea Level Rise

Guidance for incorporating the direct and indirect physical effects of projected future sea-level change in USACE projects is provided in "Incorporating Sea Level Change in Civil Works Programs", Engineering Regulation ER 1100-2-8162, December 2013 (USACE 2013).

The USACE guidance states that consideration should be given to how sensitive, adaptable, and resilient proposed alternatives are to climate change and other related global changes. Because of the variability and uncertainty in projected future sea levels, alternatives should be evaluated using low, intermediate, and high rates of future sea-level change for both "with" and "without" project conditions in order to bound the likely future conditions.

The mean sea level trend measured at Charleston is 0.19 ft/century based on monthly mean sea level data from 1970 to 2013 (NOAA 2015a). This rate may increase as a result of global climate change.

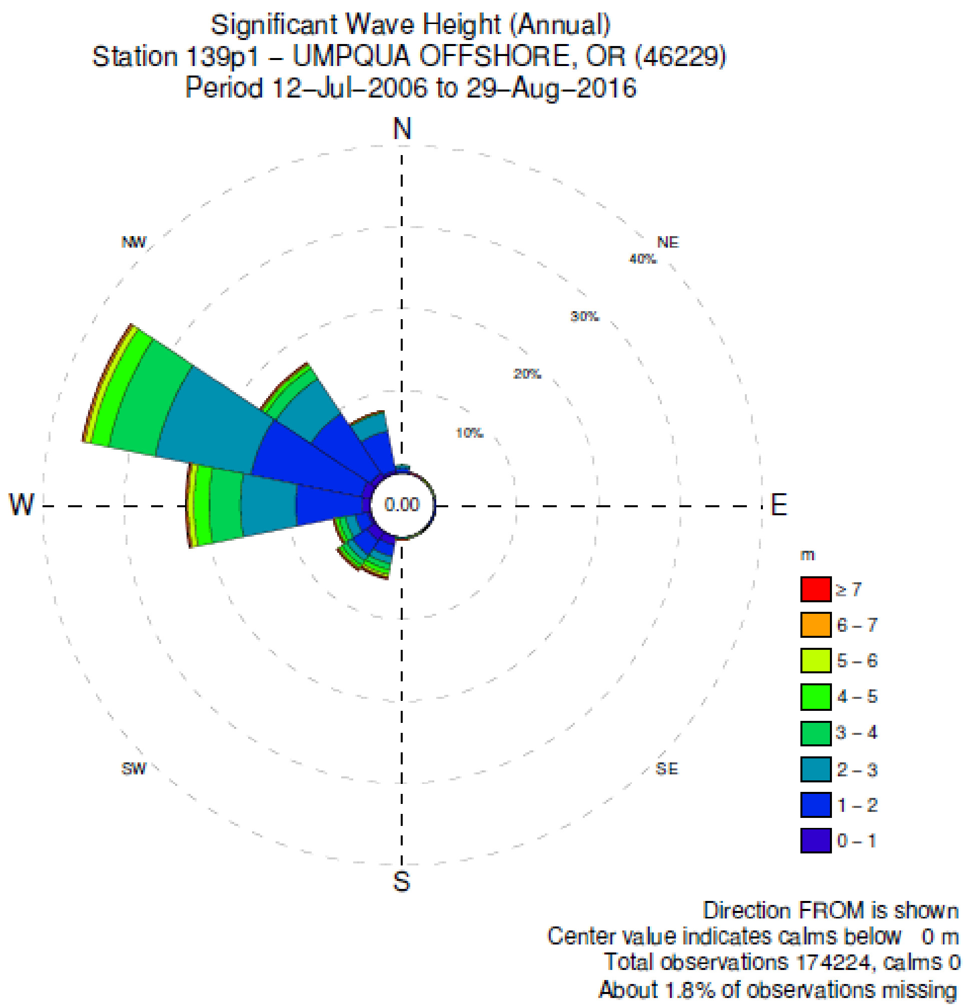
The base year of 1992 is selected for the USACE guidance because it is the midpoint of the 1983–2001 tidal epoch, used to define MLLW and other tidal datums in this report. The USACE guidance is based on NOAA's monthly extreme water levels, including a mean sea level trend of 0.42 ft/century based on monthly extremes data from 1970 to 2006 (NOAA 2015b). The National Research Council (NRC) report, which considers local geologic processes, contains sea level rise projections for the years 2030, 2050, and 2100 relative to year 2000 (NRC 2012). During the 50-year lifetime of the proposed project, through 2070, relative sea level is projected to increase by between 0.1 feet and 2.7 feet relative to present levels (see Engineering Report Section 2.2.1.2 Relative Sea Level Rise).

2.1.5 Waves

Buoys operated by Coastal Data Information Program (CDIP) of the Scripps Institution of Oceanography are used to quantify the offshore wave climate. Spectral data are available at 30-minute resolution and 3-degree directional resolution. The full directional 2D spectra were constructed from the measured data using the Extended Maximum Likelihood Method (Earle et al. 1999).

Annual wave roses for Buoy 139p1 are presented in Figure 2-1. Most offshore waves originate from a westerly and northwesterly direction (prevailing direction). Wave heights from the dominant directional sectors occur most frequently within the 1-4 m (3-13 ft) range. The winter storms have two directional peaks: the majority of waves approach from west to west-northwest, and there is a secondary peak from the southwest. The west to west-northwest waves are long period swell waves with periods on the order of 16 to 20 seconds generated by distant storms, while the southwest waves originate from nearby storms with periods generally less than 15 seconds. This southwest peak accounts for the highest storm waves. The maximum recorded wave height is 11.3 m (37.1 ft) from 270° (directly west) on December 10, 2015.

A detailed description of the offshore wave conditions can be found in the Engineering Appendix, Sub-Appendix 4 (*Offshore and Ocean Entrance Dynamics Report*).



Percentage of Occurrence

Significant Wave Height, m	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Total
Total	0.90								0.22	5.24	5.66	4.61	22.53	35.98	17.01	7.79	100.00
≥ 7										0.11			0.12				0.40
6 – 7										0.15			0.22	0.27			0.88
5 – 6										0.34	0.20	0.17	0.70	0.78	0.21		2.42
4 – 5										0.60	0.43	0.44	1.82	2.25	0.56		6.16
3 – 4										0.73	0.69	0.78	3.84	5.81	1.50	0.19	13.60
2 – 3	0.30									0.94	0.84	1.23	6.74	11.90	5.12	2.33	29.44
1 – 2	0.56									1.43	2.16	1.60	8.16	13.79	8.83	4.94	41.55
0 – 1										0.95	1.21	0.32	0.92	1.11	0.70	0.30	5.56

Percentage of occurrence was computed based on available observation data. Missing data were not included in the calculation.

Figure 2-1: Annual Directional Distribution of Significant Wave Height for Buoy 139p1

2.1.6 Tidal Currents

Currents in Coos Bay are dominated by tidal action. There can be a slight increase in ebb current velocities in the winter due to high river runoff; however, this increase is not significant relative to the overall range of velocities. Spring tidal currents at the entrance to Coos Bay (between the jetties) are generally 2 knots during flood tide and 3 to 4 knots during an ebb tide. Currents are highest in the lower bay and generally decrease further upstream. Projected effects to currents are evaluated in Section 8: Physical Effects of Final Alternative Plans.

2.1.7 Salinity

Coos Bay is a euryhaline system, where the salinity changes regularly (Table 2-3), with the head of tide extending into the South Fork Coos River and Millicoma River. The salinity distribution in Coos Bay is highly variable and changes with river flow and tidal fluctuations. In Coos Bay, the salinity is highest at high tide. Salinity is lowest at low tidal elevations during the spring freshet, when the freshwater inflow (primarily from the Coos River and its tributaries) is greatest. Salinities may range from 32 parts per thousand (ppt) at the channel entrance to 26 ppt at RM 6 down to 14 ppt at RM 8 at high tide (+6 feet MLLW). When the tide is lower (+3 feet MLLW), salinities are likely to range from 31 ppt at the channel entrance to 15 ppt at RM 6 down to 8 ppt at RM 8.0. For more information on salinity, see Sections 2.5 and 4.3 of the Estuarine Dynamics Report (Engineering Report). Projected effects to salinity are evaluated in Section 8: Physical Effects of Final Alternative Plans.

Table 2-3
Summer and Winter Mean Salinity at Select Locations

Location	Mean Salinity: Summer (psu)	Mean Salinity: Winter (psu)
BLM Sensor (Lower Bay)	32.5 psu (September)	23.0 psu (March)
North Point (Upper Bay)	31.6 psu (August)	20.5 psu (February)
Coos River	17.2 psu (September)	0.1 psu (March)
Catching Slough	25.0 psu (August)	3.8 psu (March)
Isthmus Slough	28.1 psu (September)	9.7 psu (March)
Valino Island (South Slough)	32.3 psu (September)	22.8 psu (March)

Note: psu = practical salinity units

2.1.8 Winds

Winds along the southern Oregon coast are dominated by large-scale pressure patterns over the North Pacific. During winter, the Gulf of Alaska Low produces frequent cyclonic storms that reach the coastline from the west and move towards the north. Winds exceeding 60 knots can occur along the southern Oregon coast several times each winter. Winds in the Coos Bay area have strong north-south directionality; onshore-offshore sea breezes are a relatively unimportant contributor to the winds. The strongest winds are from the south; winter winds are both stronger and more southerly than summer winds. Typical wind speeds are 10 to 15 knots from the north and 15 to 25 knots from the south. The strong southerly winds have been instrumental in creating the Coos Bay dune sheet to the north of Coos Bay.

2.2 Biological Resources

DLCD's Oregon Estuary Plan Book (1987) estuarine environment classification system[17] is used here to describe the present-day habitats of the Coos Bay estuary. Repeated substantially from the Oregon Estuary Plan Book, the estuary classification described below helps to identify unique environments that tend to control the production and composition of the communities that utilize them (DLCD, 1987).

Unconsolidated Bottom

Unconsolidated bottoms are defined as sub-tidal (i.e., always submerged below the changing water levels of tidal processes) and may be composed of sand, sand/mud mix, mud, shell, wood debris/organic, and cobble/gravel. In general, the sand-mud bottoms are typically higher in organic content than sand bottoms and are firmer and more aerated than mud. The project area is mostly sandy bottom and very little mud bottom.

Coarse, clean sands are generally inhabited by organisms that filter food from the water column (e.g., clams). In quiet waters where fine, organically rich muds occur, deposit-feeding polychaetes or other invertebrates ingest the sediment directly. Since sediments largely influence the type of invertebrates colonizing an area, activities which alter sediment characteristics have the potential to have a significant impact on benthic communities. Although dredge or spoil sites can be recolonized, community structure will vary with new sediment properties. Actions from structures that alter existing currents affect patterns of erosion and deposition. Where deposition is rapid, benthic communities may be smothered, and where erosion is significant, only organisms adapted to unstable substrates may survive. An important consideration in evaluating proposed development in estuaries is its impact on current patterns and sedimentation processes, and the resulting effects on benthic habitats and communities.

Rock Bottom

Rock habitats in the high salinity zone near estuary mouths are highly productive environments for marine fishes and invertebrates and are defined as being less than 30 percent covered with vegetation. Most subtidal rock habitats are located near the mouth where strong tidal currents and turbulence require that organisms be firmly attached to the substrate or seek the protection of sheltered cracks and crevices. Specialized and diverse fauna are adapted for attachment or browsing along rock substrates. Sucking devices such as the tube feet of sea stars or more permanent methods of attachment such as the byssus threads of mussels are examples of adaptations to rocky substrates. A diversity of algal species attach to rocky substrates with a strong basal holdfast.

[17] Originally developed by Oregon Department of Fish and Wildlife (ODFW, 1979a), the classification system was partly based on the USFWS' operational draft of their habitat classification by Cowardin et al. (1977). ODFW modified the system to utilize only those parameters that have the greatest influence on Oregon estuarine habitat (DLCD, 1987).

Aquatic Bed -- Subtidal and Intertidal

The aquatic bed category includes both subtidal and intertidal algal and eelgrass beds that frequently occur in bay and slough sub-systems. These communities probably represent a significant portion of the primary production in Oregon estuaries. Eelgrass is the most common species of seagrass in Oregon estuaries and it flourishes in both sand and mud substrates. It is a rapid growing plant that provides habitat for a diverse community of estuarine plants and animals. Its leaves support large numbers of algal and invertebrate epiphytes which are consumed by larger invertebrates and fish and are the primary food of black brant during their migration along the Oregon coast.

Clam beds are associated with eelgrass and eelgrass leaves provide a spawning surface for herring. Thick beds of eelgrass reduce currents near the bottom and promote deposition of sediment, while roots and rhizomes of eelgrass bind sediments and prevent erosion. Finally, eelgrass decomposition contributes nutrients and carbon to the detrital food chain.

Algal beds occur over unconsolidated or rock substrates providing habitat for fish and invertebrates. Huge mats of algal species turn broad intertidal flats bright green during spring and summer. Biomass then declines as the algae decays and releases nutrients to the system. Within Coos Bay, long blades of kelp may be seen floating at the water's surface. Kelp holdfasts represent a unique microhabitat for a rich community of invertebrates.

Tidal Marsh

Tidal marshes (i.e., tidal wetlands) are characterized by rooted herbaceous or woody hydrophytes that grow between lower high tide and the line of nonaquatic vegetation. These can be divided into four major subclasses: high and low salt marsh in marine and brackish areas, and fresh and shrub marshes beyond saltwater influence. Composition of these marsh communities varies with tidal elevation, sediment types, and salinity regime.

Marshes are an important habitat for invertebrates, waterfowl, small terrestrial mammals, and insects. Detritus-feeding snails, scavenging crabs, and a variety of amphipods and other invertebrates seek the food and/or protection of marshes. The well-defined channels of high marshes are heavily used by juvenile Dungeness crab and a variety of small fishes. In some areas, they may provide important rearing habitat for juvenile Chinook salmon. Marshes also provide resting and feeding areas for large populations of migrating waterfowl.

Salt marshes have been ranked among the most productive ecosystems in the world. Plant producers in salt marshes include marsh grasses, macroalgae entwined among the grass stems, microalgae on the mud surface, and phytoplankton in the water column. Organic material and nutrients stored by marsh producers are consumed directly or transferred to other portions of the estuary as detritus. Estuarine marshes are important sediment traps that reduce the frequency of dredging required for navigation. They help to stabilize the shore, dissipate flood waters, and protect shoreland property from storms. Marshes also filter and process nitrates, phosphates, and other wastes, thus providing a pollution buffer between adjacent upland activities and the estuary.

Tremendous areas of Oregon marsh have been diked to create upland for pasture and other uses. Such diking has greatly reduced estuarine integrity and productivity. Extensive diking has resulted in altered marsh community composition, channelized estuarine water courses, reduced productive intertidal surface area, and restricted transport of organic materials and nutrients to and from the estuary. Construction of causeways and roadbeds has had identical results. Filling for shoreland development has sacrificed huge expanses of marsh in many Oregon estuaries.

2.2.1 Tidal Wetlands

The area of tidal marsh in Coos Bay estuary has been variously estimated since 1974 (Hoffnagle and Olsen, 1974; ODFW, 1979; DEQ, 1983; Baptista, 1989; Larsen et al., 2015; Wiley, 2018). Wiley (2018) identified and mapped approximately 1,738 acres of tidal marsh and connected freshwater emergent wetlands in the Coos Bay estuary. The mapping of tidal wetlands was conducted through a combination of field sampling, use of aerial imagery interpretation, and the use of LiDAR-generated topography. Wiley's investigation (2018) collected data at 132 sites throughout the estuary, linking aerial image signatures with actual vegetation community composition at GPS-located points throughout the estuary's emergent tidal wetland communities. At each sample point, species were recorded using USDA plant codes[18] based on Hoffnagle et al. (1974), Burg et al. (1980), and Partnership for Coastal Wetlands (PCW, 2016) publications.

Elevation is the controlling factor for tidally-influenced events of salt exposure and inundation. Soil capillarity, however, influences the extent of vertical and lateral distance above high water levels in which salty water is distributed in soil pores. Water may be lifted by capillary action in clean coarse sand only a few inches above a recent inundation height; silty clay loam may lift water via capillary action two to four feet above an adjacent water surface (Fetter, 1994).

Both inundation (as saturated soil oxygen depletion) and salt content in water are strong selection forces for plant occupation and survival at a given elevation relative to the tidal cycle. The tidal data suggest that tidal water level average values above mean sea level might be expressed as elevation bands of plant communities and thus explain the observed approximate correlation between the 1-2 foot elevation contours and various plant community distributions.

Figure 2-2 is a typical cross section through the tidal marsh plant communities showing the distribution of species along the elevation gradient (NAVD88). Tidal inundation at 8-feet, which occurs four to five times per month, appears to be effective in sustaining dominance of low marsh species in the six to eight feet range. Capillary rise in soils of salt water seems to favor lower tolerant species in the eight to 10 feet range.

[18] USDA plant codes are the first two letters of the plant's genus and the first two letters of the plant's species from their scientific name. For example, the plant code for broadleaf cattail (Typha latifolia) would be TYLA.

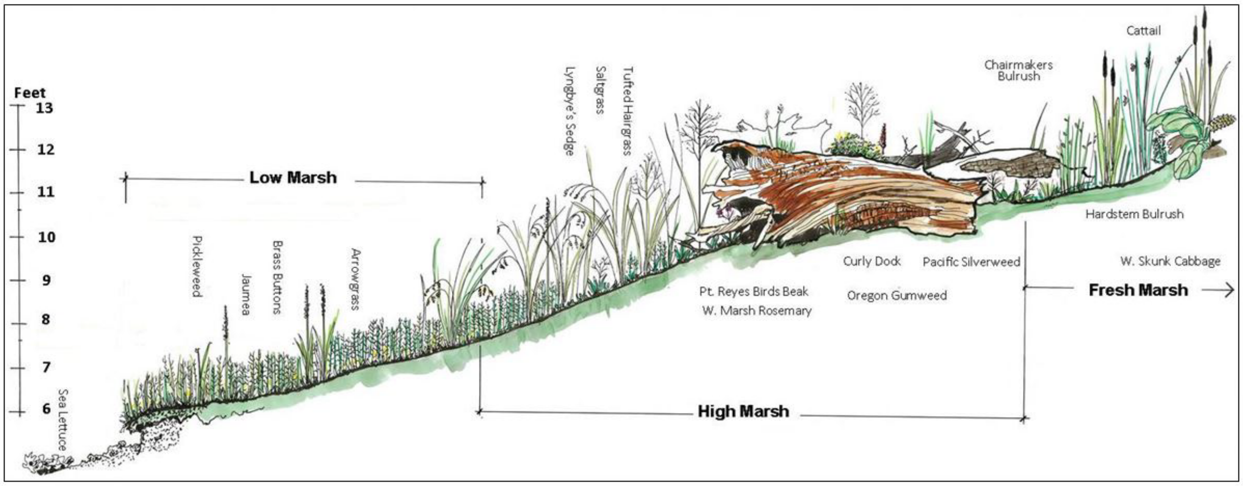


Figure 2-2: Cross Section of Coos Bay Tidally-Influenced Plant Distribution

Based on the Wiley (2018) assessment (Figure 2-3), high marsh and fresh marsh have declined by 18 and 27 percent, respectively (Table 2-4). Low marsh has, however, increased by 26 percent. Low marsh accretion may be the result of a combination of factors such as wetland restoration projects and the continued erosion of high-water-deposited sediments that have been colonized by marsh vegetation. Losses are highest for fresh marsh, which occurs at higher elevations and closer to human land use pressures.

Table 2-4
Comparison of Findings of Tidal Wetlands Area

Community	Hoffnagle et al. (1974) (AC)	Wiley (2018) (AC)	Difference (AC)	Percent Difference
Low Marsh	360.7	455.2	+94.5	+26%
High Marsh	1,354.3	1,110.6	-243.7	-18%
Fresh Marsh	237.2	172.2	-65.0	-27%
Totals	1,951.2	1,737.9	-213.2	-11%

Figure 2-3: Tidal Wetlands in the Coos Bay Estuary

2.2.2 Submerged Aquatic Vegetation

Eelgrass beds and benthic macroalgae frequently occur adjacent to each other along the littoral margins of tidal channels within Pacific Northwest estuaries; eelgrass beds (*Zostera marina*) and benthic macroalgae constitute the primary form of submersed aquatic vegetation that occupies the lowest fringe of the intertidal landscape in the Coos Bay estuary (Rumrill and Sowers, 2008). The lower intertidal community within the Coos Bay estuary includes a mixed species assemblage of submerged aquatic vegetation (i.e., native eelgrass [*Zostera marina*], dwarf eelgrass [*Zostera japonica*], macroalgae *Ulva* spp. [*Enteromorpha prolifera, Chaetomorpha californica*]), and a patch of bull kelp (*Nereocystis luetkeana*) as described below.

Algal mats composed primarily of the genus *Ulva* spp. were observed on both sand and silty substrates at the upper fringe of mudflats and sand plains at low tide. While providing important forage, and habitat for many marine species, the ephemeral occurrence, and distribution of these plants render mapping of the extent of algal mat habitat difficult. While visible in some imagery, it is absent in others, and thus is not discretely mapped.

A small bed of bull kelp (*Nereocystis luetkeana*) is a consistent and persistent feature in the subtidal shoreline to the east of the Coast Guard observation tower at Coos Head where the floating structures of the bull kelp can be seen at the water's surface in the shallows to the left of the rock cliffs. This annual species flourishes along the exposed rocky reefs outside the Coos estuary, and they are torn loose from the substratum during storms and high waves (Rumrill, 2005). The areal extent of the kelp bed is approximately one acre.

Eelgrass beds are recognized globally as nursery areas for many taxa and are considered one of the most important juvenile habitats for numerous fish species. They provide structured habitat, nourishment, and spawning areas for fish and invertebrates while also stabilizing sediments, improving water quality, and sequestering carbon; eelgrass beds play several important roles in coastal and estuarine ecosystems (Sherman and DeBruyckere, 2018).

Of particular importance is the use of eelgrass beds as a nursery area by commercially important fishery organisms including salmon and Dungeness crab (Thom et al., 2003). Several other species of invertebrates and fish reside within eelgrass beds and they have been observed to contain greater biomass of fish than non-vegetated areas (Sherman and DeBruyckere, 2018). Migratory and wading birds congregate on eelgrass beds for feeding and direct their migration routes toward areas of high eelgrass abundance (Thom et al., 2014). Eelgrass beds also provide recreational values by maintaining diverse and aesthetically pleasing coastal environments. In short, eelgrass beds in the Coos Bay estuary are seething with life in all forms and are arguably the most significant habitat type in the ecosystem.

The spatial extent of eelgrass in the Coos estuary has been mapped by the USEPA (Clinton et al., 2007), by the Pacific Marine and Estuarine Fish Habitat Partnership (PMEP), which conducted the Coos Bay Eelgrass Mapping Project (Sherman and DeBruyckere, 2018),[19] and by Merkel & Associates (M&A) for the OIPCB presented in Figure 2-5 (Merkel & Associates, 2023).

The M&A eelgrass survey (Figure 2-4) was performed in 2023 within areas that could undergo direct or indirect disturbance from the proposed channel modification as well as within reference areas that are outside of the areas of potential affect (APE) from the proposed action. Because of the dynamics of eelgrass and the shoals within Coos Bay that can alter the eelgrass distribution over time, coupled with aging historic data on eelgrass distribution in the bay, a broad survey coverage was undertaken to determine the distribution of eelgrass within and adjacent to the project area. Surveys were conducted within the project areas within suitable depths to support eelgrass,

[19] http://pmep.psmfc.org/wp-content/uploads/2017/09/PMEP2016annualreportFINAL.pdf

areas adjacent to the project area, and selected natural reference areas. The eelgrass survey serves to establish a baseline for project analysis and determining potential for impact and possible needs for compensatory mitigation of eelgrass impacts. Surveys will be used in conducting impact analysis comparing pre-construction surveys to post-construction surveys following the assessment methods of the California Eelgrass Mitigation Policy (CEMP, NOAA Fisheries, West Coast Region 2014).

The M&A eelgrass survey adopted eelgrass spatial and density metrics outlined in the CEMP. Under the CEMP, the vegetated areal extent of an eelgrass bed is defined as a physical space containing rooted eelgrass with a shoot density of one or more shoots per square meter located within 1 meter distance of other eelgrass shoots (NOAA Fisheries 2014; Shafer Nelson 2018).

M&A survey methods for the collection of eelgrass spatial extent data include high frequency sidescan sonar, single beam sonar providing information on presence or absence of eelgrass, and ground-truthing through use of a towed video camera array. Low-altitude true color aerial imagery was collected using an un-manned aerial vehicle from an altitude of 300 feet above ground level.

Eelgrass bed densities were collected within the project area and reference sites. Reference sites were distributed within each of the four channel reaches. Data were collected using a 0.25-meter quadrat (0.82 feet) distributed along four haphazardly aligned approximately shore normal transects across surveyed eelgrass beds at each location. Along each transect, density data were collected from the shallowest margin to the deepest margin of the sampling area for a total of 20 density counts per site. Concurrent with eelgrass density data within the project and reference areas, additional metrics were assessed using divers. These included extent of flowering as a percentage of the shoots present and canopy height for vegetative shoots.

Overall, eelgrass within the surveyed area had a spatial distribution of 687.13 acres and a percent vegetated cover of 67.9 percent (Table 2-5). The M&A survey indicates that the eelgrass beds within lower Coos Bay are predominated by larger coalesced beds that drive the ratio between vegetated areal extent and spatial distribution upward. Most of the eelgrass is found along shallow margins of the bay, well removed from the federal channel. As a result, no eelgrass occurs within the proposed channel and turning basin improvements. However, eelgrass does occur within areas identified as within the maximum predicted stable slope crest, and within 820 feet of the proposed dredge areas. These have loosely been defined as the APEs for the project and are subject to future revision as project information is further developed.

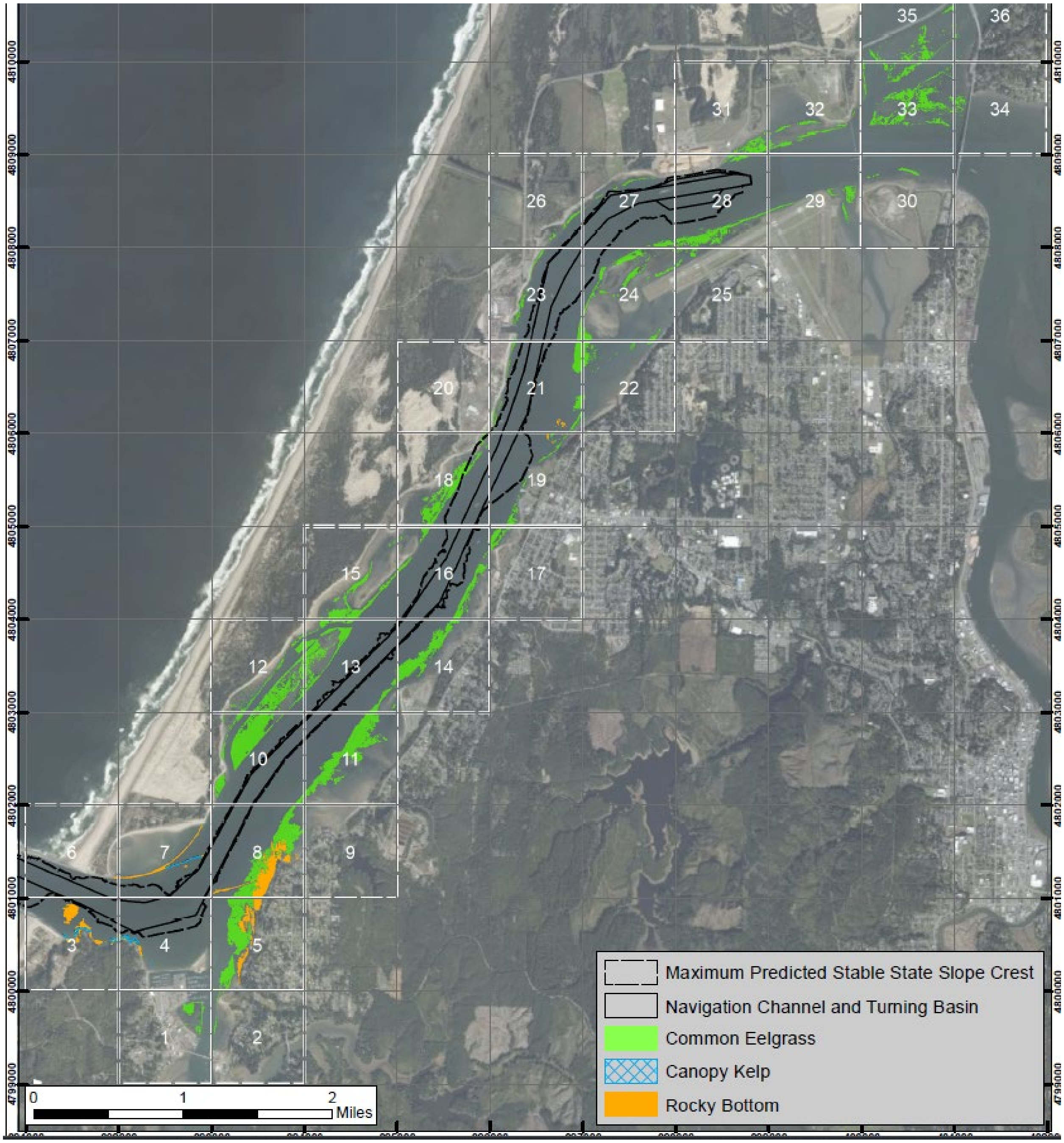


Figure 2-4: Eelgrass in the Coos Bay Estuary 2023

Table 2-5
Summary of Eelgrass Spatial Extent Metrics – September 2023

Area of Potential Effect	Vegetated Cover (AC)	Vegetated Aerial Extent (AC)	Spatial Distribution (AC)	Percent Vegetated Cover (%)
Channel & Turning Basins	---	---	---	---
Maximum Predicted Stable Slope Crest	3.06	3.42	6.37	53.7%
250-m Buffer around Dredge Areas	65.73	70.35	105.23	66.9%
Total Survey Area*	436.79	466.24	687.13	67.9%

*Includes areas of the survey beyond those individually quantified in the table

2.2.3 Federal and State Threatened and Endangered Species, Species of Concern, and Designated Critical Habitats

The proposed project has the potential to affect a variety of species inhabiting diverse marine, estuarine, riverine, and various terrestrial habitats. Species historically occurring in these habitats and protected under the federal Endangered Species Act (ESA) and Oregon endangered species act are listed in Tables 2-6 below. Table 2-6 will be updated appropriately in the EIS.

Table 2-6
Historical Federal and State Listed and Protected Species that May Occur Within Study Area

Species	Federal Status	State Status	Species and/or Habitat Present
Fish			
Eulachon (Southern DPS) (Thaleichthys pacificus)	T	NL	Adults are found rarely in Coos Bay, and spawning runs have not been documented for the Coos River. May utilize both shallow and deepwater habitat in bay and nearshore habitat for migration and foraging. Migration would occur in the offshore study area.
Green sturgeon (Southern DPS) (*Acipenser medirostris*)	T	SC	Adults known to occur in the Coos Bay. Green sturgeon may utilize both shallow and deepwater habitats within the project area. No spawning occurs in the project area. Migration would occur in the offshore study area. Coos Bay is designated critical habitat.
Oregon Coast coho salmon (*Oncorhynchus kisutch*)	T	SV	Suitable habitat is present in the project vicinity. They are known to occur in Coos Bay. Rearing and migration habitat is also present near Lower Coos Bay, Coos Bay Bureau of Land Management (BLM) district. The upper tributaries of Coos Bay provide rearing and migration habitat for coho.
Birds			

Species	Federal Status	State Status	Species and/or Habitat Present
Bald eagle (*Haliaeetus leucocephalus*)	D	NL	Suitable foraging and roosting habitat exist in the project vicinity. Henderson Site may provide suitable nesting habitat. The closest nests are Mettman Ridge and Echo Valley in upper Coos Bay.
California brown pelican (*Pelecanus occidentalis*)	D	E	The project vicinity may provide perching and roosting habitat during late summer and fall. Observed roosting and foraging in the bay and nearshore.
Marbled murrelet (*Brachyramphus marmoratus*)	T	T	May forage in the bay, nearshore, and offshore. No known occurrence within 2 miles of channel modifications, but scattered large sitka spruce may provide marginal nesting habitat in Henderson Site.
Short-tailed albatross (*Phoebastria albatrus*)	E	E	Not likely to occur in the project vicinity. The estuary provides no nesting habitat or foraging opportunities. Use of the offshore study area would be limited to extremely infrequent flyovers and short-term rest stops while foraging over open ocean during summer.
Western snowy plover (*Charadrius alexandrinus nivosus*)	T	T	The North Spit supports the most productive snowy plover population segment on the Oregon coast. Outside of the critical habitat, marginal foraging habitat may exist along the sandy shoreline of the project vicinity. The North Spit includes designated critical habitat.
Mammals			
Killer whale (Southern Resident DPS) *(Orcinus orca)*	E	NL	May occur in or travel through the offshore study area on an infrequent basis. Killer whales occasionally enter lower Coos Bay in search of prey resources.
Humpback whale (*Megaptera novaeangliae)*	E	E	Typically occur offshore on the continental shelf and far offshore. Humpback whales could be encountered near the mouth of Coos Bay in May and June, as well as August through October.
Blue whale (*Balaenoptera musculus*)	E	E	Typically offshore of Oregon from late July until January; typically occur farther off of Oregon coast than California, and are the least frequent of 5 balaenopterid species stranded on Oregon and Washington coasts.
Fin whale (*Balaenoptera physalus*)	E	E	Observed offshore of Oregon in summer; in North Pacific, are concentrated along the continental shelf edge and may occur similarly in the vicinity of the Oregon continental shelf.
Sei whale (*Balaenoptera borealis)*	E	E	Rarely seen, but expected to occur off continental shelf. Unlikely to enter project vicinity.
Sperm whale (*Physeter microcephalus)*	E	E	Prefer deep water, and is unlikely to be encountered in the project vicinity. Presence off shore most likely from March to September.
Loggerhead sea turtle (*Caretta caretta)*	E	T	Uncommon in Oregon and Washington but are occasionally cold stranded. Loggerheads are not anticipated to frequent the project vicinity, but their use of Oregon waters are not well known.
Green sea turtle (*Chelonia mydas)*	T	E	Suitable forage habitat exists in the project vicinity. Haul-out sites are located on offshore rocks between Coos Head and Cape Arago. In Oregon, critical habitat is limited to islands near Bandon.
Leatherback sea turtle	E	E	Information is sparse, but based on high quality habitat north of Cape Blanco, coastal waters near Coos Bay are expected to also provide important foraging habitat.

Species	Federal Status	State Status	Species and/or Habitat Present
(*Dermochelys coriacea)*			
Olive (Pacific) ridley sea turtle (*Lepidochelys olivacea)*	T	T	Species is rare along West Coast, but may be increasing; likelihood to occur within the study area is unknown as studies surrounding population structure and distribution are not fully assembled or analyzed.
Steller sea lion (*Eumetopias jubatus*)	T	NL	Suitable forage habitat exists in the project vicinity. Haul-out sites are located on offshore rocks between Coos Head and Cape Arago. In Oregon, critical habitat is limited to islands near Bandon.
Plants			
Pink sand-verbena (Abronia umbellate ssp. breviflora)	SOC	E	Known to occur on the North Spit on BLM and USACE property and outside the project area along the shores of Coos Bay at Pigeon Point. Habitat is limited by presence of European beach grass.
Point Reyes bird's-beak (Cordylanthus maritimus ssp palustris)	SOC	E	Suitable habitat exists in the tidally influenced portions of the project vicinity. Documented in 1982 within Jordan Cove, and a large population exists south of the North Bay Marine Industrial Park Site.

ODFW 2017. Lee et al. 2016. Adams et al. 2002. Sounhein et al. 2015.

SOC = species of concern; SC = state sensitive critical; SU = state undetermined status; SV = state sensitive vulnerable; C= Candidate; D = Delisted; T = Threatened; E = Endangered; S = Sensitive; NL = Not listed; DPS = Distinct Population Segment.

2.2.4 Fisheries and Aquatic Species

A wide variety of fish and aquatic species are known to occur within the vicinity of the proposed project, as described in detail in Tables 2-7 and 2-8. Note that Tables 2-7 and 2-8 will be updated in the EIS.

Table 2-7
Non-Listed Fish Species that May Occur in the Study Area

Species	State Status	Federal Status	Habitat Requirements	Species and/or Habitat Present
Anadromous Fish				
Coastal cutthroat trout *(Oncorhynchus clarki clarki)*	NL	NL	Utilize open water, channel, eelgrass, and mudflat habitat in estuaries. Large woody debris, in-stream structures and vegetation important for protection while in freshwater. Use clean gravel for spawning and rearing. Anadromous species migrate to the ocean after two to four years of rearing in headwater streams. Juveniles prefer side channels, backwater or pools for rearing.	Sea-run cutthroat would likely use the project area primarily for migration. However, any eelgrass beds and mudflats in the shallower part of the project area would provide potential rearing habitat.

Species	State Status	Federal Status	Habitat Requirements	Species and/or Habitat Present
Chinook salmon (Coastal SMU/ESU) (*Oncorhynchus tshawytscha)*	SV	NL	Subyearlings utilize salt marsh, eelgrass, and mudflat habitats before moving into deeper waters. Require streams with clean gravel, complex habitat, and cool temperatures for spawning and rearing. Require access for anadromous migration. Eelgrass habitat provides foraging and predator refuge.	Chinook would likely use the project area primarily for migration. However, any eelgrass beds and mudflats in the shallower part of the project area would provide potential rearing habitat.
Oregon Coast steelhead (*Oncorhynchus mykiss*)	SV	SOC	Inhabit intertidal and shallow subtidal, eelgrass beds. Require streams with clean gravel, complex habitat, and cool temperatures for spawning and rearing. Require access for anadromous migration. Highly diverse genetics and life history patterns.	Steelhead would likely use the project area primarily for migration. However, any eelgrass beds in the shallower part of the project area would provide potential rearing habitat.
Pacific Coast chum salmon *(Oncorhynchus keta)*	SC	NL	Spawn in lower reaches of rivers and prefer spawning grounds immediately above turbulent areas or where there is upwelling. Spawning occurs on gravel bars and in side-channels just out of reach of tidal influences. Migrate to ocean soon after emergence.	Any chum salmon present would likely use the project area primarily for migration. However, any eelgrass beds in the shallower part of the project area would provide potential rearing habitat.
Pacific lamprey (*Lampetra tridentata)*	SV	NL	During migration they utilize the water column. They prefer soft, muddy bottoms in shallow and deepwater habitats. They spawn in freshwater streams with fine gravel beds. Larvae burrow in fine sediment. Timing of development closely linked to water temperature. May aggregate in high densities.	Any Pacific lamprey that may be present would use the project area only for migration.
River lamprey *(Lampetra ayresi)*	SV	NL	Small tributaries and or river systems. Small, isolated populations.	They have not been documented in Oregon since 1980, and very little information is available for this species. This species is not expected to occur in the project area.

Species	State Status	Federal Status	Habitat Requirements	Species and/or Habitat Present
White sturgeon (*Acipenser transmontanus*)	NL	NL	Reside in estuarine waters. Spawning occurs in places with swift currents and rocky bottoms. Young feed on algae and aquatic insects. Adults feed on fish, lamprey, and aquatic invertebrates.	Small numbers have been documented using the project area for migration. The entire project area would provide suitable foraging habitat. No spawning habitat is present.
Groundfish				
Flatfish	NL	NL	Typically spawn offshore. Juveniles forage within the lower bay and are most abundant from spring through late summer.	Suitable rearing and foraging habitat occur throughout the project area, and these species are likely to be present.
Rockfish	NL	NL	They feed primarily on fish and benthic organisms. Their Essential Fish Habitat (EFH) is generally defined as all waters from the MHHW line, and the upriver extent of saltwater intrusion in river mouths along the coast. They are frequently associated with rocky substrates.	Very little suitable rocky substrate habitat occurs in the project area, and few are likely to be present.
Pelagic fish				
American shad (*Alosa sapidissima*)	NL	NL	Spawning usually occurs over gently sloping areas with fine gravels or sandy bottoms, and in tributaries or the upper estuary. In estuaries they feed on various small fish. They are opportunistic feeders and select most of their food from the water column rather than from the bottom or near the surface.	Suitable foraging and rearing habitat occur in the project area, and the species is likely to be present. There is no suitable shad spawning habitat in the project area.
Pacific herring *(Clupea pallasii)*	NL	NL	Spawn in intertidal or shallow subtidal waters in sheltered bays and estuaries. They deposit eggs on eelgrass and marine algae and other substrates such as rocks, logs, and pilings. They feed primarily on planktonic crustaceans.	Suitable foraging habitat for this species occurs throughout the project area, and any eelgrass beds in shallower portions of the project area would provide potential spawning/rearing habitat.

Species	State Status	Federal Status	Habitat Requirements	Species and/or Habitat Present
Silversides *(Antherinops)*	NL	NL	They attach large egg masses to eelgrass and algae by means of long filaments. They feed primarily on planktonic organisms. They utilize estuaries for part of their life cycle. They generally inhabit the plankton-rich upper water level of the bay and are abundant over tidal flats on the incoming tide.	May occur throughout the project area, and any eelgrass beds would provide potential spawning and rearing habitat.
Striped bass (*Morone saxatilis*)	NL	NL	They are anadromous and utilize riverine habitat for spawning. They are broadcast spawners and release their eggs directly into the water column. As hatchlings grow larger, they seek deeper holes and channels, with some entering the ocean.	They do not spawn in the project area but may forage in shallower areas of the project area. Juveniles may rear throughout the project area.
True smelts *(Osmeridae)*	NL	NL	Some anadromous species spawn in streams and rivers. Some deposit eggs on water's edge on beaches with a mixture of coarse sand and pea gravel.	They are likely to be present in the project area but do not spawn or rear there.

ODFW 2016. Streamnet 2006.

SOC = species of concern; SC = state sensitive critical; SU = state undetermined status; SV = state sensitive vulnerable; NL = Not listed.

Table 2-8
Non-Listed Invertebrate Species that May Occur Within the Study Area

Species	Habitat Requirements	Species and/or Habitat Present
Prey for Salmon		
Corophium	Abundant in intertidal areas and shallow water habitats with high percentages of fine or mud substrates. They feed on organic detritus, sorted by filtering gnathopods.	Suitable habitat exists in the shallow water habitats near the project area. They have been observed in estuaries in the South Slough of Coos Bay and Siuslaw estuary.
Polychaete	Abundant in intertidal areas and shallow water habitats with high percentages of fine substrates.	Suitable habitat exists in the project area. They have been observed near the navigation channel across from Jordan Cove.
Bay Clams		
Butter clams (*Saxidomus giganteus*)	Spawning generally occurs from late February through July. They are filter feeders, filtering phytoplankton, zooplankton, and detritus. They inhabit a variety of substrates but prefer sand, shell, and gravel	Suitable habitat may occur in the estuaries of lower Coos Bay, in proximity to the project area. They are common in bays and estuaries and rare on open coast or inlets with oceanic influence.

Species	Habitat Requirements	Species and/or Habitat Present
	beaches. They burrow as far as 30 centimeters below the surface. They can be found as deep as 50 feet below tide.	
Cockle clams (*Clinocardium nuttallii*)	Found 1 to 3 inches below the substrate. They inhabit eelgrass/mud habitats and sand and mud beaches of uniform, not very coarse sand, intertidally and sub-tidally 50 to 60 feet. Substrate type is typically fine/sandy. They are suspension feeders.	Suitable habitat exists in the project area. They have been documented in bay mouths on tide flats in most Oregon estuaries. Some have been found in the lower South Slough in Coos Bay, with another small population in Jordan Cove.
Gaper clams (*Tresus capax*)	They are frequently found near eelgrass beds, 2 to 3 feet below the substrate or in sheltered intertidal flats in sand and mud. Suspension feeder; feeds on planktonic organisms and detrital particles.	Suitable habitat may occur in eelgrass beds in lower Coos Bay. They have been documented in Coos Bay in high abundance.
Littleneck clams (*Protothaca staminea*)	Found 3 to 8 centimeters below the surface and around rocky ocean outcrops. They prefer coarse sand.	Suitable habitat exists in the project area. They are common in most of the larger Northwest estuaries and bays but were rarely found in a 2008 survey. May be present at the flats near Pigeon Point.
Softshell clams (*Mya arenaria*)	Utilize muddier habitats than other bay clam species. They burrow 12 inches deep in the substrate and can withstand anaerobic conditions for several days at a time.	Suitable habitat may exist in the project area. They have been documented in Coos Bay. They may occur within lower and upper Coos Bay, in Haynes Inlet, and Jordan Cove along the shoreline.
Crabs		
Dungeness crab (*Cancer magister*)	Occur within estuaries and coastal nearshore areas and prefer sandy to sandy-mud substrates. Mating occurs outside estuaries in coastal waters. Adults use deep subtidal portions of the estuary for feeding during the winter months. Juveniles settle in intertidal or shallow subtidal habitats, use eelgrass for feeding and predator refugia, and prefer gravel/sand substrates with a high content of clam and oyster shells.	Suitable rearing habitat exists in eelgrass beds and algal flats in the lower Coos Bay, near the project area. They have been documented in Northwest estuaries and offshore waters near shore and bays in summer.
Red rock crab (*Cancer productus*)	Found in estuaries and nearshore areas from the intertidal zone to greater than 100 feet and may utilize substrates or rocky shores, subtidal reefs, and coarse to silty sands. They prefer rocky or reef type substrate. They feed on various heavy-shelled animals.	They have been documented in Coos Bay estuaries. Potential habitat may occur in the sandstone outcrops in lower Coos Bay only, since rocky substrate is limited in other areas within the project area.
Oysters		
Olympia oysters (*Ostrea conchaphila*)	Use subtidal or intertidal areas and are associated with habitats with firm substrate characteristics. Filter feeders that rely on phytoplankton in the tidal waters as a food source. They grow best in coves, sloughs, and inlets that provide protection from currents and wave action.	Suitable habitat exists in the project area. Due to insufficient data, it is unknown whether they occur near the project area.
Other Invertebrates		

Species	Habitat Requirements	Species and/or Habitat Present
Ghost shrimp (*Callianassa californiensis*)	Found in upper to mid-intertidal zones. They build large, sloppy permanent burrows with side tunnels. They sift their food (organic detritus) from their burrow and tunnel constantly, reworking the sediment to a depth of about 30 inches in search of food.	They have been documented in Coos Bay. Suitable habitat may exist in lower Coos Bay and sparsely in Jordan Cove along the bay shoreline, adjacent to the project area. Approximately 40 shrimp burrowing holes per square meter were observed on the sand and mudflats of the project area.
Mud shrimp (*Upogebia pugettensis*)	Found in estuarine mudflats with mud or sandy mud substrates with some gravel and mid-to lower intertidal areas of bays. Feed on detritus. Larvae are food for plankton-eating fishes.	Suitable habitat may exist in the project area. They have been documented in Coos Bay estuaries and sloughs.
Newcomb's littorine snail (*Littorina subrotundata*)	Found at, or slightly above, mean high tide in areas of cold, clear, well-oxygenated water on a mixed sand or sand/gravel bottom with rooted aquatic macrophytes. Associated with pickleweed (*Salicornia virginica*) and possibly some other marsh plants.	This species is known to occur on BLM lands on the North Spit within the project area. This species could occur in other locations within the project area where pickleweed is found (within all salt marsh locations).

Rudy P et al. 1983, ODFW 2008.

2.2.5 Commercial Fishery

The commercial fishing port at Charleston, which is accessed by the Charleston Federal navigation channel, was the third largest commercial fishing port in Oregon by value and the 46th largest in the contiguous Unites States, in 2022 (NOAA 2024). Approximately 75 commercial fishing vessels use Charleston as their homeport (OIPCB, 2018). In 2023, commercial fishery landings at Charleston were 15.5 million pounds with a value of $27.1 million (ODFW 2024). The most valuable species in 2023 were Dungeness Crab and Pink Shrimp (Table 2-9).

Table 2-9
Charleston Commercial Fish Landings (Major Species, 2023)

Species	Pounds	Value
Dungeness Crab (Bay and Ocean)	7,845,866	$22,276,347
Pink Shrimp	5,475,285	$2,418,052
Albacore Tuna	617,234	$935,395
Sole (Petrale and Dover)	776,329	$434,767
Sablefish	317,563	$348,567
Pacific Halibut	55,487	$293,449
Lingcod	40,461	$83,252
Cabezon	10,665	$57,196

Source: ODFW 2024.

2.3 Intermodal Transportation System

The landside intermodal transportation system consists of the network of Port-owned railroads, highways, roadways, and airport facilities that work in conjunction with the port facilities to deliver goods into and out of the study area.

2.3.1 Rail Facilities

The rail line serving the Coos Bay area closed in 2007 and was subsequently purchased by OIPCB in 2009 for $16.5 million. Over $100M in federal, state, and other funding has been invested in the Coos Bay Rail Line (CBRL) over the past 12 years upgrading track, tunnels, and bridges. The Port received a $9.9 million grant in 2013 primarily for ties and ballast upgrades to allow increased train speed in many areas up to 25 mph. In addition, a $25 million grant was received in 2018 to repair 15 bridges to remove other speed restrictions.

The CBRL (Figure 2-5) is 134 miles long and extends from its connection with the Union Pacific Railroad in Eugene, through the study area, to the end of track near Coquille, Oregon (approximately 25 miles south of the project vicinity). A short spur line, constructed by the OIPCB in 2005, diverges from the main line and parallels the Trans Pacific Parkway on the North Spit. The spur line is approximately four miles long and terminates at the Southport Forest Products mill site. Figure 2-6 is a map of the major rail lines in southwestern Oregon.

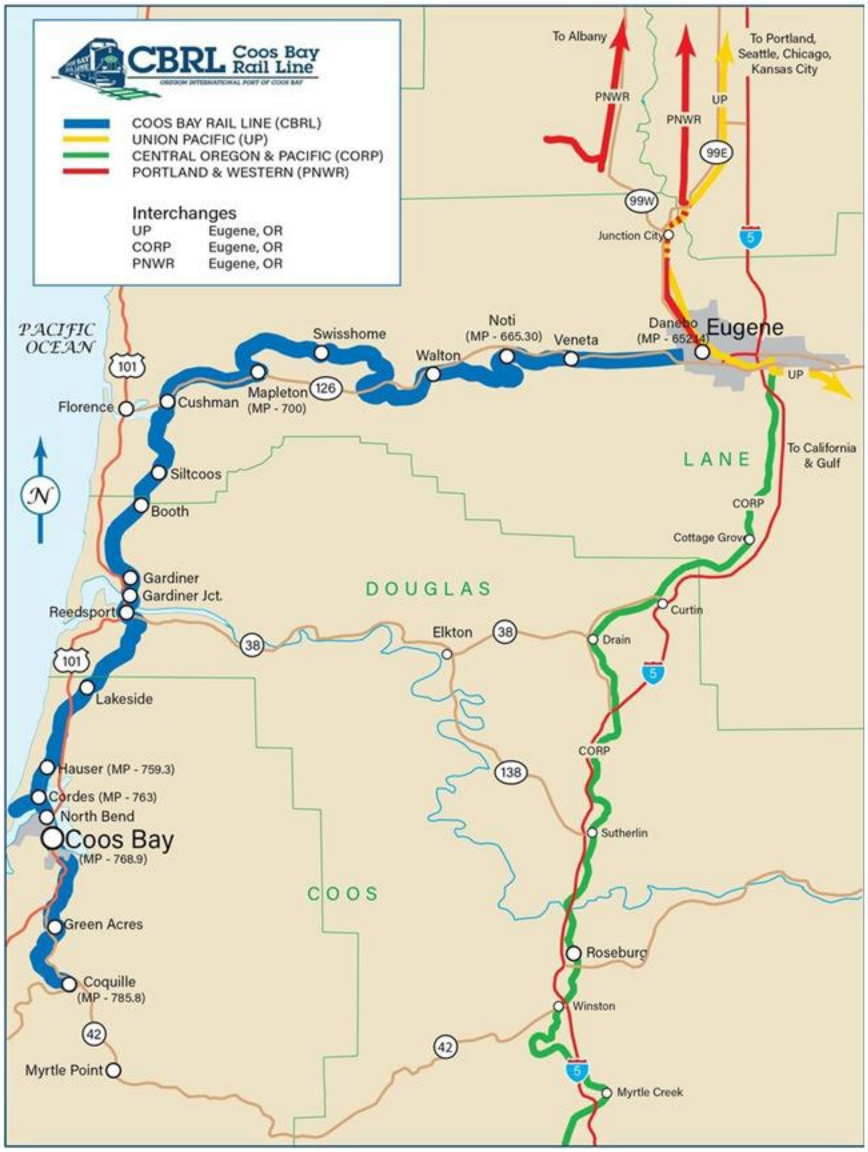


Figure 2-5: Major Rail Lines in Southwestern Oregon

The OIPCB reopened the Coos Bay rail line in late 2011 and operates the rail service under the name Coos Bay Rail Line (CBRL). The CBR moved 2,480 revenue car loads in 2012, its first full year of operation. CBRL projects the number of car loads to increase to 12,322 in CBRL's 2023/24 fiscal year (CBRL 2023). There are currently more than a dozen shippers using the line. Forest products and wood fiber are the dominant commodities, although other goods such as fertilizers and organic dairy feed are also carried on the line. The OIPCB has three major rail line rehabilitation projects ongoing, including Coos Bay Rail Line Tunnel Rehabilitation, Coos Bay Rail Line Timber Bridge Rehabilitation, and Coos Bay Rail Line Bridge Rehabilitation for many bridges and their abutments between Coos Bay and Eugene.

2.3.2 Highways and Roadways

US Route 101, designated as Oregon Coast Highway No. 9, is a state highway under Oregon Department of Transportation (ODOT) jurisdiction (Figure 2-6). The highway is a designated freight route and is classified as a highway of statewide importance by the 1999 Oregon Highway Plan (OHP). The OHP states, “The primary function of statewide highways is to provide mobility and connections among large urban areas, ports, and major recreation areas that are not directly serviced by interstate highways.” The Coos County Transportation System Plan (TSP) classifies US 101 as a principal arterial. It is also part of the National Highway System and is a Scenic Byway.

US 101 has a two- to three-lane section in the project vicinity, and it is carried by a causeway that runs north-south across Haynes Inlet. The posted speed is 55 miles per hour (mph) at its intersection with Trans Pacific Parkway. Approximately 1,000 feet south of the intersection of US 101 with Trans Pacific Parkway, the posted speed changes to 45 mph. The speed drops to 35 mph over the McCullough Bridge into North Bend. Approximately 1,200 feet south of the US 101 and Trans Pacific Parkway intersection, the causeway ends and US 101 bridges across Haynes Inlet to allow watercraft navigation. Although the bridge structure is wide enough to accommodate four to five travel lanes, it is currently striped for three lanes.

As US 101 approaches the city of North Bend from the north, it crosses over the historical Conde B. McCullough Memorial Bridge at RM 9.5. This two-lane bridge was constructed in 1936 and modernized in 1967. The bridge has a vertical clearance of 123 feet at zero tide.[20] The bridge represents a significant vehicular traffic constraint because of the limited traffic capacity afforded by its two-lane cross section. Several transportation studies have recognized the need for additional capacity in the corridor. However, the costs of such improvements are significant, and funding sources for additional traffic lanes over Coos Bay have not been identified.

A major bridge rehabilitation project, which consists of rehabilitation of the bridge railing, structural deck overlay, and cathodic protection of the substructure, is currently under way. However, the $30 million project does not address the need for additional traffic capacity.

Trans Pacific Parkway provides the only roadway access to the industrial, port, and recreational lands on the North Spit. The two-lane roadway is under Coos County jurisdiction, and it is classified as a collector by the Coos County TSP. In addition, it is classified as an intermodal connector by the OHP. Trans Pacific Parkway has no posted speed and is therefore governed by the basic rule (55 mph by statute).

Trans Pacific Parkway extends east-west across Haynes Inlet on a causeway. At the west end of the causeway, the roadway is carried by a bridge that allows watercraft to access the northern reaches of Haynes Inlet. At the east end of the causeway, Trans Pacific Parkway intersects US 101at a “T” intersection.

[20] NOAA Chart 18587, U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Coast Survey. Last Correction 3/26/2014. Accessed 13May2014: http://www.charts.noaa.gov/OnLineViewer/18587.shtml

Figure 2-6: Coos Bay Landside Transportation Infrastructure

Because of the industrial uses found on the North Spit, a significant proportion of year-round traffic on Trans Pacific Parkway is composed of trucks. A peak in traffic volumes occurs during the summer months due to the popularity of the Oregon Dunes National Recreation Area (NRA), which can also be accessed from Trans Pacific Parkway.

Recently, a segment of Trans Pacific Parkway has been realigned. This realignment combines two at-grade rail crossings into a single automated crossing, which creates a safer and more efficient alignment for the intersection of Trans Pacific Parkway with Horsefall Beach Road, a primary access road to the Oregon Dunes NRA.

Horsefall Beach Road is a two-lane road that provides access to the Oregon Dunes NRA, which contains numerous sites for hiking, fishing, picnicking, horseback riding, ocean beach access, ATV use, and overnight camping. The southern end of Horsefall Beach Road intersects Trans Pacific Parkway at a skewed intersection; however, this intersection alignment was recently improved to enhance safety and operations.

Jordan Cove Road is a Coos County roadway facility with two lanes, no shoulders, and no posted speed. This road starts at Trans Pacific Parkway at its northern end and terminates at the Roseburg Forest Products property at its southern end. Jordan Cove Road is used primarily as an access road to industrial areas.

Two bridges cross the Coos Bay main ship channel – the Coos Bay Railroad bridge and the McCullough Memorial bridge (U.S. Highway 101). Two other bridges cross navigable portions of the South Slough and Isthmus Slough. These bridges are described in Table 2-10 and located in Figure 2-7

Table 2-10
Bridge Features

Name	RM (Approx.)	Type	Vertical Clearance (ft MLLW)
Coos Bay Railroad	9.0	Swing	19
McCullough Memorial Bridge	9.8	Fixed	130
Cape Arago Highway	2.4*	Bascule	29
Newport Ave	16**	Bascule	36

* RM 0.7 of the South Slough
** RM 1.0 of the Isthmus Slough

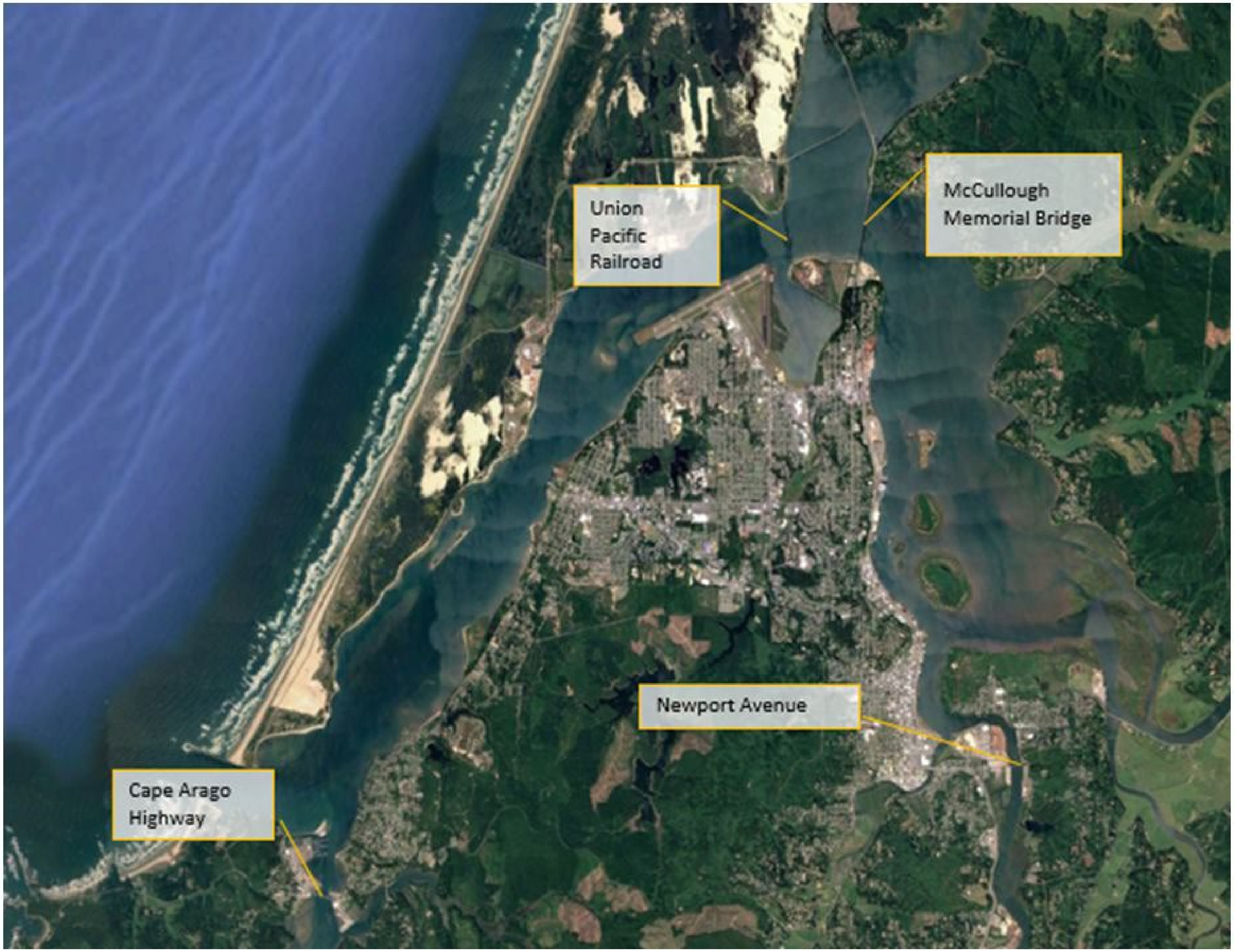


Figure 2-7: Bridges Over Federal and Non-Federal Channels

2.3.3 Southwest Oregon Regional Airport

The Southwest Oregon Regional Airport is located on the south side of the Coos Bay Federal Navigation Project (Figure 2-8). Federal Aviation Administration (FAA) regulations for clear space impose height restrictions on operations at potential terminal locations and on vessels operating within the channel. The restrictions are covered by FAA 14 CFR Part 77, Section 77.19, which describes the geometry of the imaginary surfaces that define the height restrictions of structures near an airport. The height restrictions are controlled by the precision instrument landing approach runway 4-22, which is aligned generally east-west. A potential future marine terminal site is directly off the end of runway 4-22 and is almost entirely under its approach surface. The precision approach surface is 1,000 feet wide and rises at a horizontal to vertical ratio of 50 to 1 for the first 10,000 feet beyond the end of the runway. The runway elevation is 17.1 feet NAVD88, based on the adopted Master Plan for the airport. The Federal navigation channel intersects with both approach surfaces. The elevations of the approach surfaces at the lowest points of intersection are as follows:

- The existing Federal navigation channel is treated as an obstruction with elevation 140 feet. This means that vessels transiting the channel may extend to an elevation 140 feet NAVD88 at their highest point;
- The existing Runway 4-22 precision approach surface has an elevation of approximately 105 feet NAVD88 at the existing Federal navigation channel; and
- The Runway 13-31 visual approach surface has an elevation of approximately 95 feet at the existing Federal navigation channel, upstream of the Channel Modification Project.

The Southwest Oregon Regional Airport has updated its Master Plan, which includes the extension of Runway 4-22 by 400 feet. This would lower the precision approach surface by an additional 8 feet at the Federal navigation channel. Planning for the proposed channel modification includes coordination between the OIPCB and the Southwest Oregon Regional Airport to develop appropriate procedures to manage increased air traffic and maritime traffic, as well as the greater penetration of shipping into the airspace for Runway 4-22.

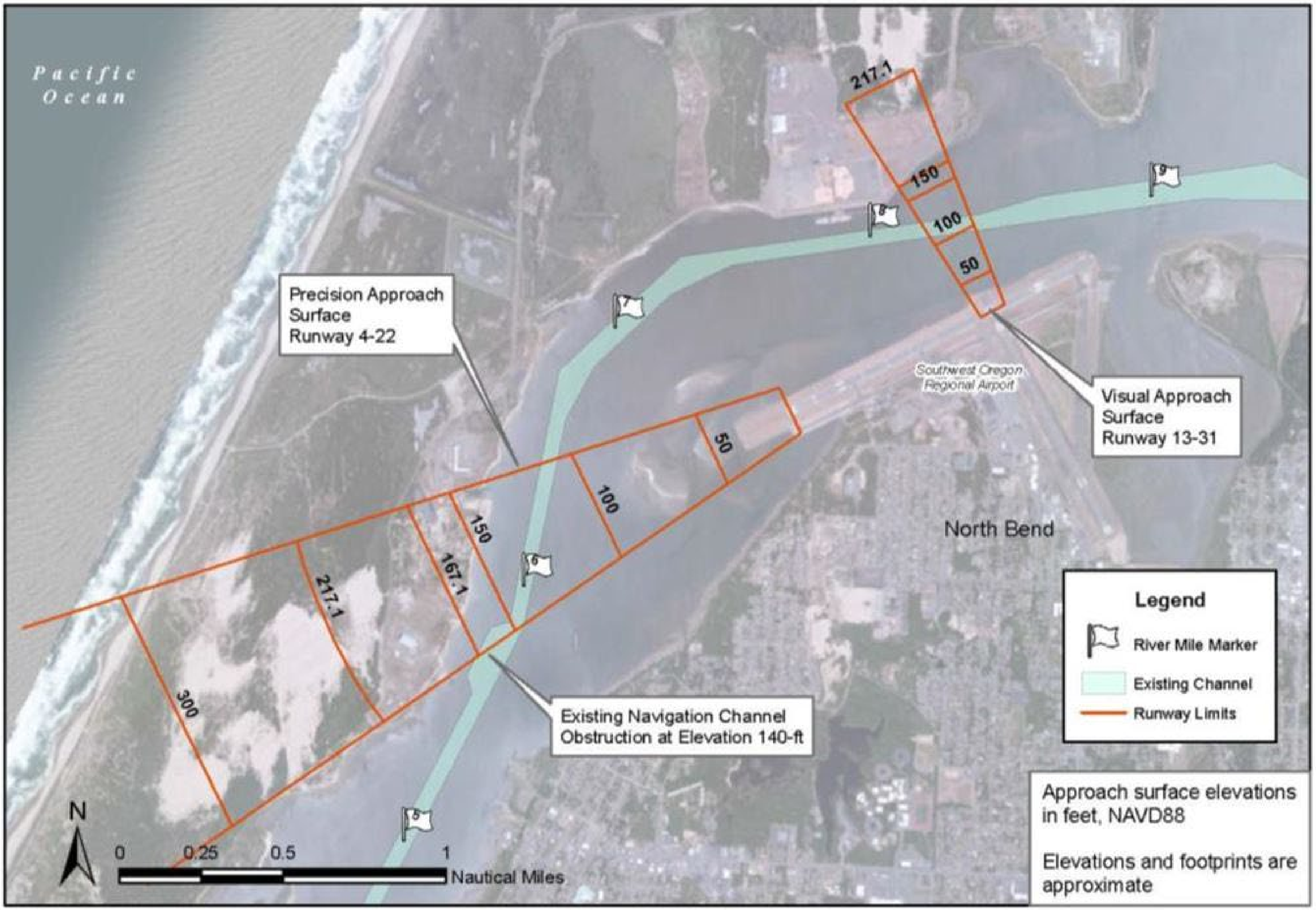


Figure 2-8: Runway Expansion at Southwest Oregon Regional Airport

2.4 Navigation Features

The Coos Bay Federal Navigation Project has authorized dimensions of 37 feet deep (at MLLW) and 300 feet wide from RM 1 to RM 9.0. Upstream of RM 9.0, the channel widens to 400 feet. The channel is wider (1,060 feet) and deeper (-47 ft MLLW) at the entrance (See Engineering Report – Engineering Report, Section 3.3).

The channel improvements under evaluation for the proposed project extend from the entrance channel to RM 8.2; therefore, descriptions of navigation features, terminals, and vessel operations are limited to this reach. Potential improvements to the channel upstream of RM 9.0 are not included in this analysis because of the narrow opening at the railroad bridge (RM 9.0), which would likely require substantial reconstruction if the channel were to be widened and/or deepened at the bridge opening. Channel improvements from the entrance to RM 8.2 would not directly affect terminal or vessel operations in the channel reach upstream from RM 8.2; however, channel improvements downstream of RM 8.2 may relieve congestion during peak high tide hours by increasing the departure window for large vessels using the upper bay.

2.4.1 Channel Dimensions

The Coos Bay Federal Navigation Project up to RM 8 consists of multiple reaches identified by the aids to navigation ranges used in each reach (see Figure 2-9 and Table 2-11: Federally Authorized Project Dimensions up to RM 9.0.

The Entrance Range and Turn into the Coos Bay Range is restrictive and typically requires tug assistance for cargo ships.[21] Currently, a ship on the Entrance Range alignment must turn 93 degrees to be on the proper alignment at the Inside Range.

Currently, channel depths restrict vessel movements through the Port. Shipping line policies are typically 10 percent of sailing draft required for under keel clearance; therefore, vessels often wait and transit the channel during high tide conditions. Because the Port of Coos Bay is largely an export port, outbound transits are typically timed with higher tide height at the entrance bar. In the bay upstream of RM 9.0, vessels leave the dock three hours before high water on the entrance bar to account for travel time through the channel. At Roseburg Forest Products (RM 7.9) vessels leave 1.5 hours before high water. The pilots prefer to not sail outbound on an ebb tide[22] to maintain vessel maneuverability.

[21] Personal communication with Captain George Wales and Captain Steve Woods, Coos Bay Pilots (28Oct13)
[22] Personal communication with Captain George Wales and Captain Steve Woods, Coos Bay Pilots (28Oct13)

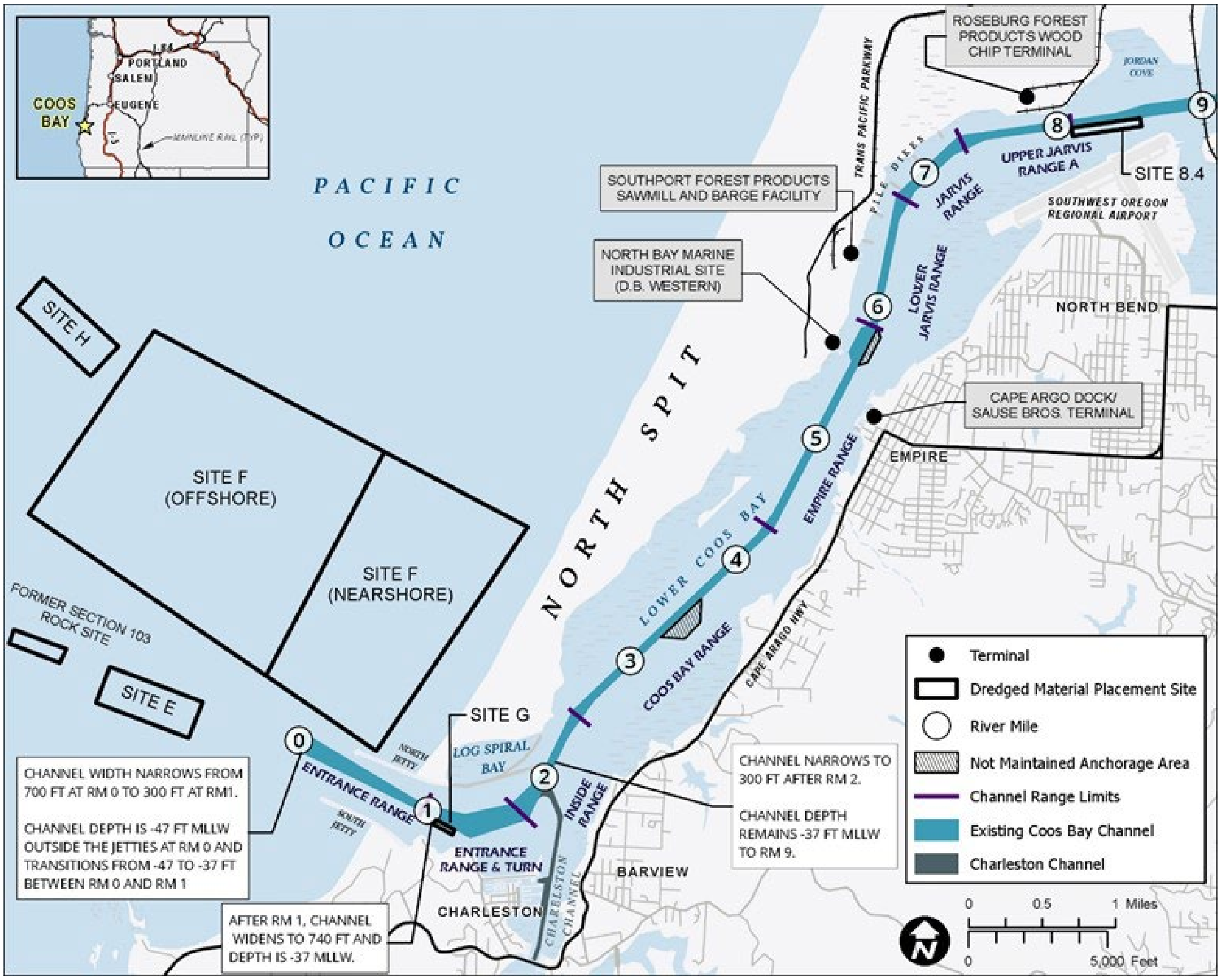


Figure 2-9: Coos Bay Federal Navigation Channel Ranges (Entrance to RM 9)

Table 2-11
Federally Authorized Project Dimensions up to RM 9.0

Project Feature	RM Range	Approximate Length	Width	Depth below MLLW	Advance Maintenance
Entrance Range – near Jetties	-1.0 – 0.9	6,260	1,060 to 600	-47	-5
Entrance Range – upstream of Jetties	0.9 – 1.7	4,740	600 to 300	-47 to -37	-5
Entrance Range and Turn	1.7 – 2.5	4,430	300 to 870	-37	-1
Inside Range	2.5 – 4.3	3,910	Narrows to 300	-37	-1
Coos Bay Range and Empire Range	4.3 – 5.7	17,820	300	-37	-1
Lower Jarvis Range	5.7 – 6.8	4,790	300	-37	-1
Jarvis Turn	6.8 – 7.3	3,010	300	-37	-1
Upper Jarvis Range	7.3 – 9.5	11,270	300	-37	-1

Project depths in feet MLLW; lengths, width, and advanced maintenance in linear feet.

2.4.2 Maintenance Dredging History

The USACE Portland District maintains the Federal channel at Coos Bay, from the entrance to RM 10, on an annual basis (Table 2-12), and to RM 12 on a semi-annual basis. Since 1998, 73-percent of the maintenance material dredged from the channel below RM 12 comes from the portion of the Federal channel from the ocean entrance to RM 1.0. and 90-percent of the maintenance material dredged from the channel below RM 12 comes from the portion of the federal channel below RM 10.1.

Table 2-12
Coos Bay Maintenance Dredging History: 1998 - 2018 (cubic yards)

Fiscal Year	Entrance	Coos Bay Ranges	Coos Bay Empire Ranges	Jarvis Ranges	North Bend Turn	North Bend Ranges	Charleston Channel	Total
	0-50 to 1+00	1+00 to 3+20	3+20 to 5+35	5+35 to 8+05	8+05 to 10+10	10+10 to 12+20		
1998	849,242			48,911			27,429	925,582
1999	697,217			71,405	83,094	818,915	51,522	1,722,153
2000	749,158	28,198	49,287	53,964	36,563		28,098	945,268
2001	569,128	16,783	16,425	99,701	27,581		53,446	783,064
2002	663,040	33,792		88,586	55,254		61,252	901,924
2003	634,039	1,226	28,954	30,408	13,667		37,026	745,320
2004	390,620	19,848	6,336	44,679	58,760		29,230	549,473
2005	442,828			51,485	36,793	35,159	44,352	610,617
2006	497,615	29,868		34,706	3,953			566,142
2007	955,967	3,922	8,804	81,063	48,651	1,004	34,072	1,133,483
2008	622,007	26,358	5,082	59,686	51,637	2,947	16,105	783,822
2009	777,472	45,171	17,336	44,681	13,198	2,028	15,243	915,129
2010	598,906	17,010	6,067	83,147	33,049		9,024	747,203
2011	645,847			115,427	10,837		55,804	827,915
2012	532,384	30,527	18,898	55,051	42,101			678,961
2013	364,343	22,412	19,693	148,032	40,948			595,428
2014	428,327	2,937	19,492	21,168	30,645		40,628	543,197
2015	589,258			59,614	21,993			670,865
2016	656,729	16,664	24,007	81,290	65,710	335,109	26,228	1,205,737
2017	732,884	14,024		79,580	27,089			853,577
2018	572,707			89,849	95,849			758,405
Average	**640,897**	**14,702**	**10,494**	**68,687**	**39,869**	**56,912**	**25,212**	**831,584**
Std Dev	**136,271**	**14,008**	**13,051**	**30,180**	**23,844**	**189,229**	**21,018**	**271,101**

Annual O&M dredging quantities fluctuate from year to year to a significant degree, based on a variety of factors including shoaling rates, weather conditions, environmental limitations, and funding levels (Table 2-13). Annual maintenance dredging from 1998-2018 in the Entrance Channel averaged 618,000 cy/yr, and from RM 1.0 to RM 10.1 averaged about 122,000 cy/yr.

Maintenance dredging in the Charleston Channel averages 35,000 cy per dredging event (the Charleston Channel has been dredged 15 of the past 21 years).

Table 2-13
Maintenance Dredging Volumes per Dredging Event (cy) 1998 - 2018

	Entrance (RM 0.5 to RM 1.0)	Inner Bay (RM1.0 to RM 10.1)	Charleston Harbor Channel*
Annual Average*	618,000	132,000	35,000
Minimum	364,000	49,000	9,000
Maximum	956,000	231,000	61,000
Standard Deviation	149,000	47,000	16,000

Source: USACE Portland District
* Charleston Harbor Channel based on 16 dredging events in 21 years, not annual

The standard deviation of annual maintenance dredging quantities is large relative to the mean value, which indicates that historical, and presumably future, annual maintenance dredging quantities vary broadly. In the entrance channel, the standard deviation is 24-percent of the annual average, therefore, for a single standard deviation from the mean (68-percent probability) annual dredging volume could either be 469,000 cy, or with equal probability, the annual dredging volume could be 767,000 (Table 2-14). Similarly, for annual maintenance dredging from RM 1 to RM 10.1, where the standard deviation is 35-percent of the annual average, maintenance dredging could be either 85,000 cy or 179,00 cy, with equal probability. The standard deviation is highest relative to the mean for the Charleston Harbor Channel (45-percent), calculated only for years when dredging occurs. At a single standard deviation from the mean (68-percent probability), maintenance dredging at the Charleston Harbor Channel could yield 19,000 cy or just as likely yield 51,000 cy. Increasing the level of certainty, to 85-percent or 95-percent as examples, further broadens the range of equivalently likely annual maintenance dredging volumes.

In years when the Charleston Harbor Channel is maintained, total maintenance dredging for the three main reaches could, with a 68-percent probability, equivalently be a low of 573,000 cy to a high of 997,000 cy (Table 2-14). This broad variability is, in part, explained by variability in equipment type, equipment availability, weather and sea conditions, and funding, all of which are beyond control of the maintenance dredging program. A detailed discussion of historical maintenance dredging is presented in Section 2 of the Engineering Appendix.

Table 2-14
Maintenance Dredging Volumes 68% Probability (1 std Deviation) Range (cy)

Channel Reach	Annual Average	Std. Dev.		Equivalent Probability Range	
				Lower Bound	Upper Bound
Entrance	618,000	149,000		469,000	767,000
Inner Bay	132,000	47,000		85,000	179,000
Charleston*	35,000	16,000		19,000	51,000
			Total	573,000	997,000

Source: USACE Portland District;* Charleston Harbor Channel based on 16 dredging events in 21 years, not annual

2.4.3 Dredged Material Placement History

Disposal of material dredged during maintenance of the Coos Bay Federal Navigation Project has been necessary since the original construction. Early records of dredge material placement are inconsistent or unavailable, but beginning in 1951, a comprehensive estimate of dredged material disposal into the offshore environment is possible.[23] From 1951 through 2017, more than 75,000,000 cubic yards of dredged material were disposed in the offshore environment with most of this material having been dredged from the channel entrance and lower navigation channel.

With Congress passing the Marine Protection, Research, and Sanctuaries Act of 1972 (the "Ocean Dumping Act"), offshore disposal of dredged materials required the formal establishment, use, and monitoring of offshore disposal sites. The earliest offshore disposal within formally-designated disposal sites began in 1977 as materials dredged from the Coos Bay project were placed in the interim-designated sites (USACE, 2012). After the formal disposal site designation was completed in 1987, more than 32 million cubic yards of material have been placed at ODMDS E, F, and H.

ODMDS F. The primary placement location for USACE maintenance material dredged from the Federal channel up to RM 12 is Site F (Table 2-15). Site F is an existing USEPA open-water placement site located approximately 0.5 nautical miles west of the Coos Bay entrance. It is the largest of the Coos Bay Ocean Dredged Material Disposal Sites (ODMDS) authorized for use by the USACE and others for the placement of coarse-grained sediment removed through maintenance dredging activities below RM 12 in the Federal channel. Site F is also used for dredged material from non-USACE projects. For example, material dredged from the Roseburg Forest Products dock has historically been disposed at Site F, and it is likely that if dredging is required at the Southport Forest Products barge slip then this material would also be disposed there. These volumes are permitted as part of the Port's Unified Dredging Permit issued by the USACE (Table 2-16).

The entire Site F is 3,075 acres in size, and the water depth varies between about -20 and -160 feet MLLW. Site management distinguishes between nearshore and offshore portions, with the boundary between the two at a water depth of -60 feet MLLW. The offshore portion of Site F

[23] 1951-1974 quantities compiled from Annual Report of the Chief of Engineers to Congress. 1975-2019 quantities from Portland District material placement records.

(Site F Offshore) is approximately 2,000 acres in size, with water depths ranging from -160 feet MLLW to -60 feet MLLW. Because of its dispersive capacity, ODMDS F has been noted as having "virtually unlimited capacity for the placement of maintenance material" (USEPA and USACE 2006). However, dispersion rates at the offshore portion (depths ranging from -160 to -60 feet) are very slow, therefore most material is disposed at Site F Nearshore. Site F Offshore is used when weather and wave conditions do not allow dredging equipment to move into the shallower portions of Site F Nearshore.

In recent years, dredged material has been disposed predominantly in ODMDS F; the annual average volume disposed in ODMDS F over the last ten years has been 700,000 cy. Approximately 500,000 cy are disposed in the nearshore (McMillan, 2018), and the remaining 200,000 cy are disposed offshore.

ODMDS E. During FYs 1976-1984 (9 years), 6.6 mcy were disposed in ODMDS E, an average of 735,000 cy/yr (USACE 2012b). However, the site experienced mounding throughout due to lower than predicted dispersion rates. ODMDS E is still open and available for use when littoral drift conditions indicate that material will not re-enter the channel (USACE 2015a). Except for 80,000 cy that was disposed in 2006 (when use of ODMDS F was being re-evaluated), ODMDS E has not been used since 1990 because material disposed in ODMDS E returns to the channel, thereby reducing the effectiveness of the USACE maintenance dredging program.

ODMDS H is currently used for placement of fine-grained material dredged from above RM 12 (USACE 2012b & USACE 2015b). Documentation provided by the USACE indicates that the site has been used three times in the ten years between 2004 and 2013, for a total volume of 1.3 mcy; the vast majority of this (1.1 mcy) was disposed in 2009. Authorization for ODMDS H resulted from the 1986 Ocean Disposal Site Designation and EIS (USEPA & USACE 1986).

The Coos Bay ODMDS are managed and monitored in accordance with the Site Management/ Monitoring Plan (SMMP) (USEPA and Corps 2006).

Table 2-15
Coos Bay ODMDS Dredged Material Placement History

Year	USACE Volumes (thousands of cubic yards)			Year	USACE Volumes (thousands of cubic yards)		
	Site E	Site F	Site H		Site E	Site F	Site H
1976	1,120.1	840.6	0	1998*	0	965.9	20
1977	847.8	405.5	0	1999#	0	774.6	836.6
1978	901.3	872.7	0	2000	0	903.8	0
1979	902.8	1,161.9	0	2001	0	789.1	127.1
1980	207.3	1,014.4	0	2002	0	1,313.9	0
1981	660.7	0	0	2003	0	768	0
1982	919.2	0	0	2004	0	425.8	0
1983	336	104.8	0	2005	0	564	262.8
1984	720.6	629.3	0	2006†	79.9	487.5	0
1985	0	0	0	2007	0	1,122.6	0
1986	309.1	1,193	413.4	2008	0	791.5	0
1987	116.4	1,033	39.9	2009	0	938.9	1,081.8
1988	0	965.8	658.1	2010	0	690.2	0
1989	127.2	440.5	0	2011	0	812.7	0
1990	25	637.7	401.7	2012	0	637.9	0
1991	0	1,247.7	21.4	2013	0	608.0	0
1992	0	742.6	757.2	2014	0	496.6	0
1993	0	719.9	898.9	2015	0	734.2	0
1994	0	722.3	401.2	2016	0	808.3	0
1995	0	686.6	545.9	2017	0	854.3	0
1996	0	1,760.1	248.9	2018	0	766.3	0
1997**	0	609.4	1,347.4				

Source: Coos Bay CY12 ODMDS Review, February 2012

Notes: **In 1997 a total of 181,090 cy of material was disposed into a disposal area known as the "19 Rock Site." This site was selected to receive rock excavated as part of the Coos Bay Channel Deepening Project.
*In 1998 a total of 90,970 cy of material was disposed under permit; 70,970 cy went to the original Site F and 20,000 cy to Site H.
#In 1999 a total of 39,610 cy of material was disposed under permit, 22,010 cy went to the original Site F and 17,600 cy to Site H.
†In 2006 the USEPA 103 designation for Site F expired. Prior to the new (expanded) Site F 103 designation, by agreement with USEPA, 79,927 cy of material was disposed in Site E and 106,507 cy of material was disposed at the former Site F. In 2006, after USEPA designated the new Site F, an additional 381,003 cy of material was disposed in the nearshore portion of the 2006 Site F, for a total of 487,510 cy disposed within the 2006 USEPA 103 Site F.

Table 2-16
Coos Bay ODMDS Dredged Material Placement History, Port of Coos Bay DA Permit[24]

Year	USACE Volumes (thousands of cubic yards)			
	Site E	Site F	Site H	Upland Disposal
2005		16.3 (1)	16.0 (2,3)	
2006				
2007				
2008				
2009		13.6 (1)	23.4 (2,4)	
2010				
2011				
2012		25.2 (1)	10.5 (2,5)	6.6 (1)
2013				0.2 (5)
2014				
2015		9.1(1)	7.8(2)	
2016				
2017		18.7(1,6)		
2018				

1. Roseburg Forest Products (RM 7.9)
2. Oregon Chip Terminal (RM 12.5)
3. Multiple Upper Bay docks:
   Citrus Dock (RM 12.9),
   Orcas Dock (RM 13.2),
   | City of Coos Bay Moorage Dock (RM 14.2)
4. Georgia Pacific (RM 14.0)
5. Ocean Terminals (RM 11.9)
6. Southport Lumber

Source: POCB 2014

Site 8.4 is a re-handling site that is used for temporary storage of material dredged by USACE's *Yaquina* hopper dredge for later ocean placement through contracted mechanical dredging.

Site G is an in-bay dredged material disposal site located just inside the Entrance Channel, on the southern edge of the entrance, between buoy 4 and 6 (at RM 1). The site is 1,000 ft by 200 ft (4.6

[24] Department of the Army (DA) permit to authorize the transportation of dredged material by vessel or other vehicle for the purpose of dumping it in ocean waters at dumping sites designated under section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 CFR 324).

acres), at a depth of -40 to -45 ft MLLW. Site G is used only when ocean conditions are too hazardous for a hopper dredge to access the ODMDS or when hydraulic cutterhead (pipeline) dredging is conducted in the Charleston Access Channel and Marina.

USACE placement history is available at Site G from 1990-2018 (Table 2-17). Maintenance material has been disposed in Site G in 17 of the last 29 years. Pipeline dredging of the Charleston Access Channel has a large influence on the amount of material disposed at Site G. Average placement per dredging year by the Hopper Dredge Yaquina is 14,100 cubic yards. Average pipeline placement for the two years that the Charleston Access Channel was dredged is 36,600. Placement in Site G has been highly variable during the last 29 years, ranging from zero in 10 years, less than 10,000 in seven years, to a maximum of 55,252 cy in 2011. The principal causes of annual variability in the use of Site G are sea conditions at the bar, which can restrict hopper dredge access to the ocean, and whether pipeline dredging of the Charleston Access Channel occurs in a given year.

Table 2-17
USACE Placement History at Site G, 1990-2018

Year	Volume (cy)	Placement Method
1990	0	n/a
1991	21,867	Yaquina (hopper)
1992	42,744	Yaquina (hopper)
1993	0	n/a
1994	20,639	Yaquina (hopper)
1995	11,446	Yaquina (hopper)
1996	0	n/a
1997	3,467	Yaquina (hopper)
1998	0	n/a
1999	19,000	Yaquina (hopper)
2000	39,603	Yaquina (hopper)
2001	1,329	Yaquina (hopper)
2002	0	n/a
2003	0	n/a
2004	0	n/a
2005	20,070	Yaquina (hopper)
2005	27,190	Contractor Pipeline
2006	0	n/a
2007	1,994	Yaquina (hopper)
2008	6,115	Yaquina (hopper)
2009	7,042	Yaquina (hopper)
2010	0	n/a
2011	9,146	Yaquina (hopper)
2011	46,106	Contractor Pipeline
2012	0	n/a
2013	17,840	Yaquina (hopper)
2014	10,313	Yaquina (hopper)
2015	1,011	Yaquina (hopper)
2016	5,982	Yaquina (hopper)
2017	0	n/a
2018	0	n/a
Maximum Annual	55,252 (2011)	Yaquina & pipeline

Site G is operated as a dispersive site, as described by the NMFS in the Biological Opinion on the Annual Maintenance dredging Program for the Oregon Coastal Projects by the USACE (USACE 2015). Site G's capacity for dispersal is based on the type and amount of material, the method of placement, and the frequency of placement. The designation as dispersive means that long-term accumulation of sediment does not occur. USACE requires that material disposed via pipeline is disposed during ebb tides to facilitate dispersal of the material to the ocean. The Biological Opinion for the Maintenance Dredging Program for the Oregon Coastal Projects (NMFS 2009) indicates that material disposed in dispersive sites is typically transported out of these locations into the littoral zone by tidal flow, and therefore contributes to the sediment budget of the Coos littoral cell.

The dispersive nature of the site is illustrated through annual surveys plotted from USACE data. Figure 2-10 shows surveyed cross sections at Station 1+04+00 (just upstream of Site G) over 9 years (this is the only cross section for which multiple years of survey data are available). During this period, approximately 98,000 cy of material was disposed at Site G. The cross sections do not show any trend of sediment accumulation; sediment does not accumulate at Site G nor does it slough to the bottom of the channel.

Figure 2-11 shows a plot for the same cross section, focusing on years 2010-2012. These three years were selected because they were years immediately preceding, and then following, placements of 9,146 cy via hopper, and 46,106 via pipeline in 2011. The figure does not show notable differences in the channel contours between 2010, 2011 or 2012, following disposal of 55,252 cy of material. This indicates that Site G has a dispersal capacity of at least 55,252 cy/yr, based on conditions existing between 2010 and 2012. It should be noted that the existing channel is offset from the channel alignment (denoted as x = 0) in Figure 2-9 and Figure 2-10.

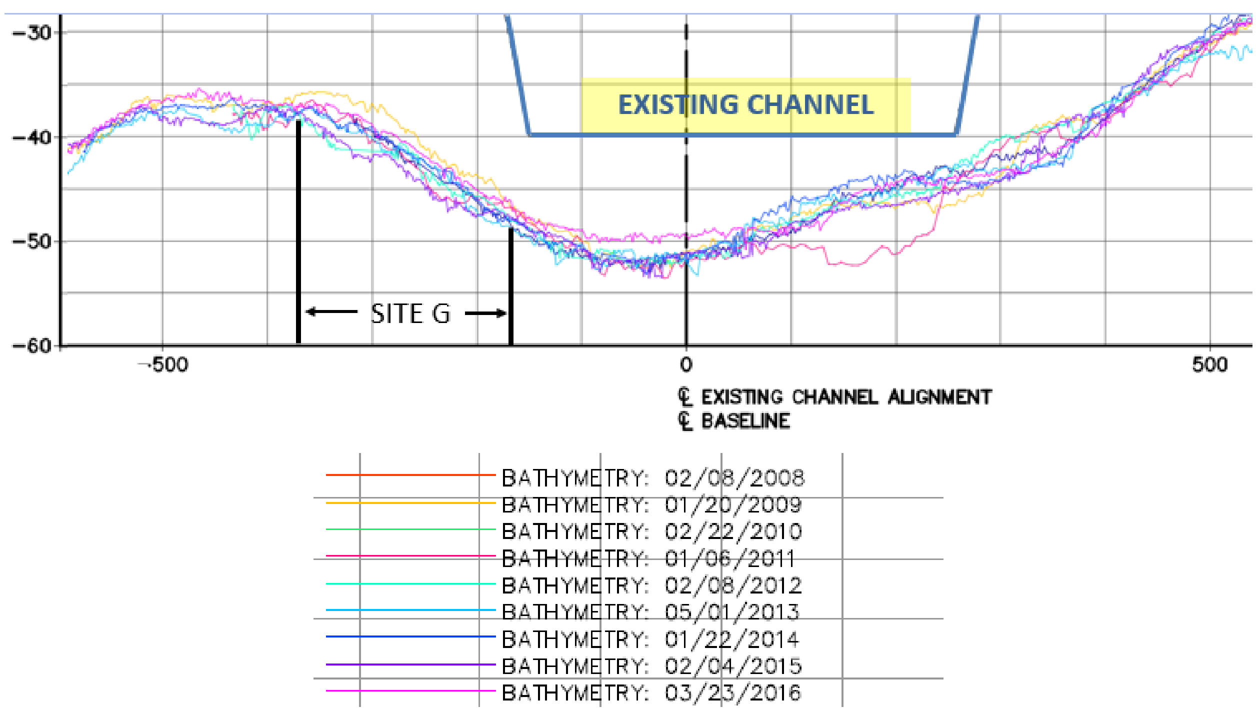


Figure 2-10: Surveyed Cross Sections at Station 1+04+00, 2008-2016

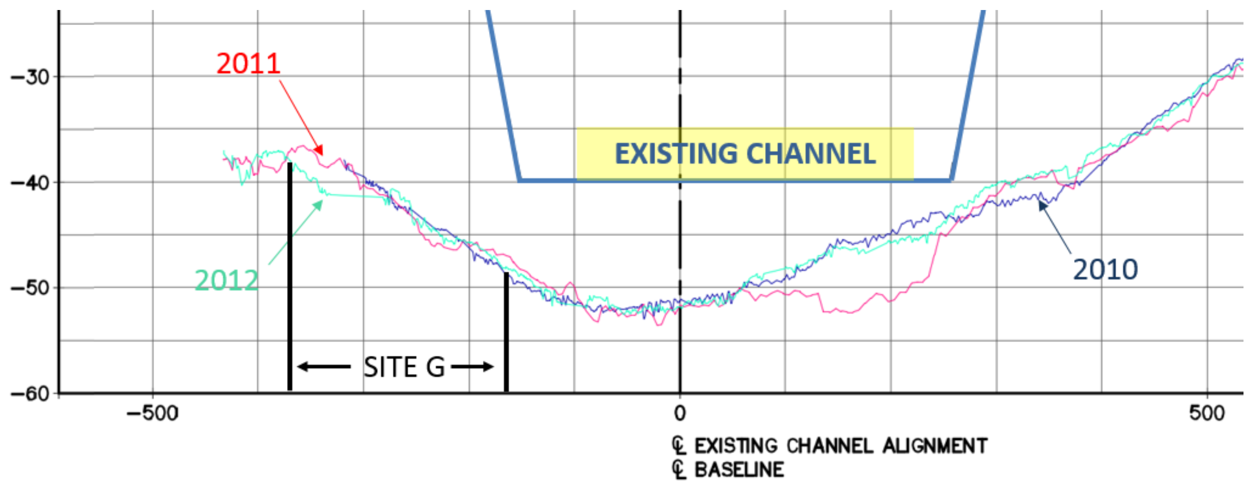


Figure 2-11: Surveyed Cross Sections at Station 1+04+00, 2010-2012

The lack of sediment accumulation at Site G or in the deepest segment of the natural bathymetry is consistent with the general hydrodynamics of the area. The natural bathymetry of the Entrance Turn is between -50 ft MLLW and -55 ft MLLW deep. This is a self-scouring area, where strong currents transport sediment elsewhere. Site G is ideally located on the outer bank of the turn, where current speeds are highest.

The fate of sediment disposed in Site G can be estimated from velocity vector plots. Figure 2-13 shows that currents at Site G run parallel to the channel; therefore, sediment is dispersed offshore during ebb tides and into the Bay during flood tides. There are no cross currents pushing sediment from Site G into the channel.

Analysis of dredged material placement data (Table 2-16 shown previously), pre- and post-placement bathymetry (Figures 2-10 and 2-11), and current direction and velocities (Figure 2-12) supports the conclusion that Site G is dispersive for the volumes of material historically placed at the site.

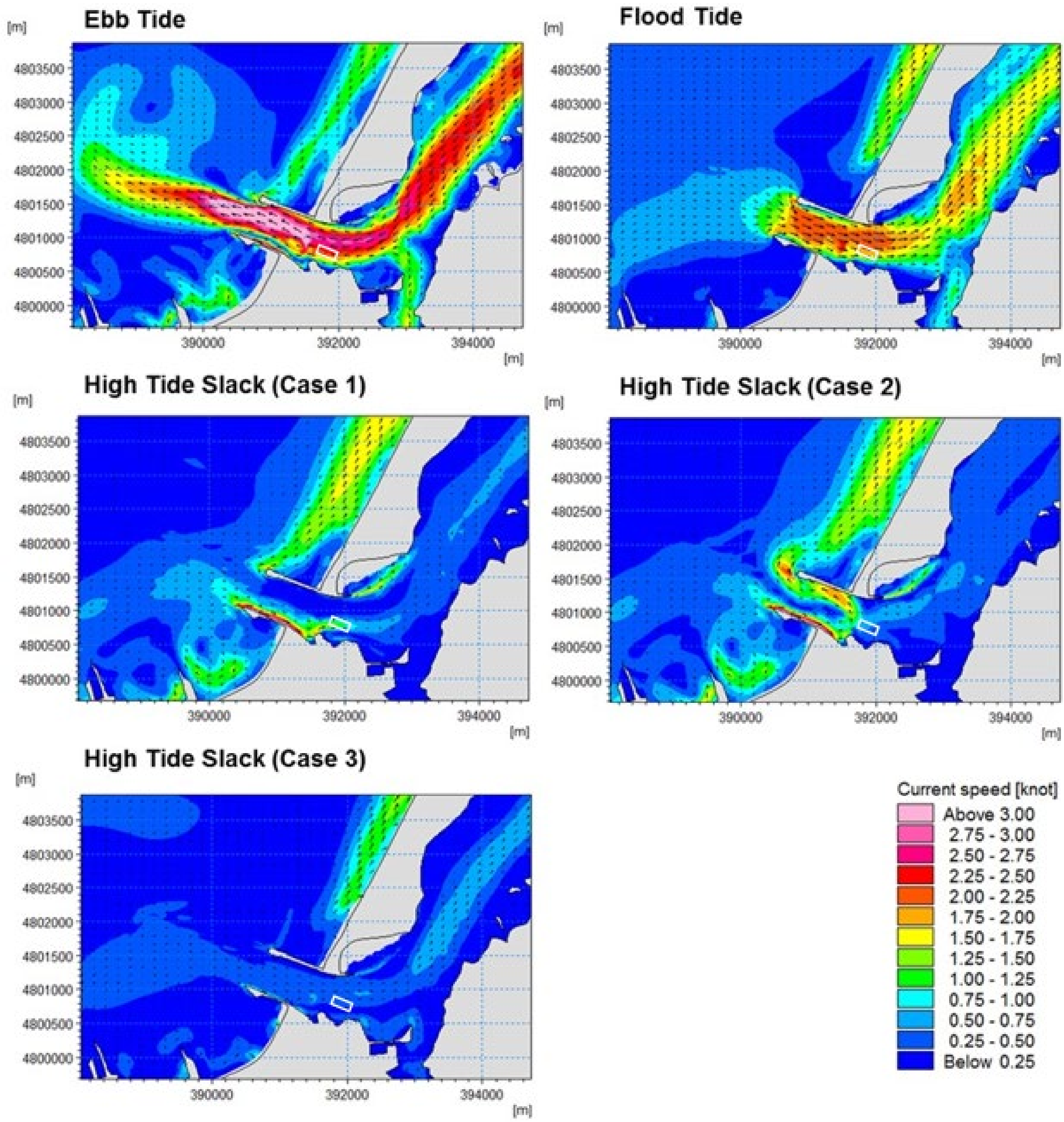


Figure 2-12: Illustrative Entrance Currents through the Tidal Cycle, Multiple High Tide Slack Cases shown to Highlight Variability, WOP Condition (Site G outlined in White)

2.4.4 Entrance Jetties

The USACE Portland District is constructing major repairs for the North Jetty, with construction tentatively scheduled for completion in December 2025. The North Jetty improvements are included in the without-project condition and are summarized in Section 3.1.3. The existing, pre-major repair, conditions of the North and South Jetties are presented below. Both jetties show varying degrees of physical deterioration along their lengths (Figure 2-13 below from USACE 2012), however current plans are for repair of the North Jetty only. Projected effects to the entrance jetties are evaluated in Section 8: Physical Effects of Final Alternative Plans.

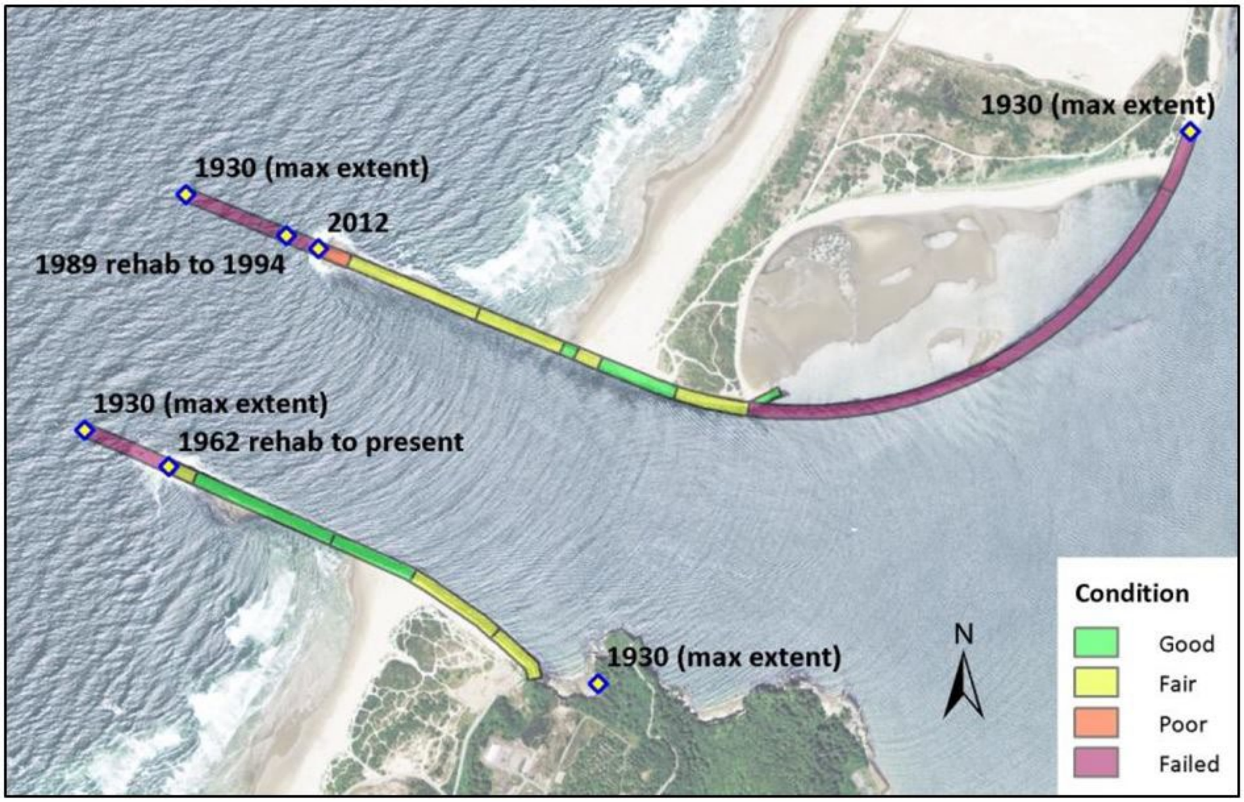


Figure 2-13: Historical Jetty Lengths and Present Condition

The jetties were evaluated in terms of their elevation deficit, which refers to the difference between the design elevation and the 2009 jetty elevation. The North Jetty deficit is most extreme at its seaward extent (Figure 2-14 below from USACE 2012). Table 2-18 presents an evaluation of the North Jetty's pre-rehabilitation condition and identifies the years in which the most recent repairs have been made for each jetty station range.

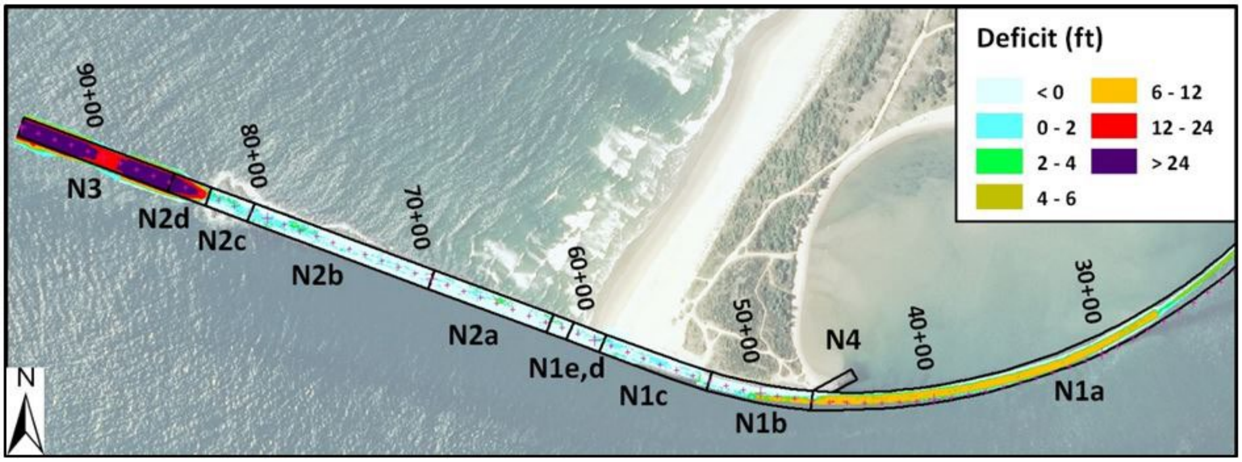


Figure 2-14: North Jetty Deficit

Table 2-18
North Jetty Design and Last Repair and Present (Pre-Repair) Condition

Station Range	Crest Width (ft)	Elevation (ft, MLLW)	Armor size (density)	Slope	Last Repair	Condition
0+21 to 26+00	10	4-6	4-10 ton (<150 pcf)	?	Original Construction	Failed, Crest Around Mean Sea Level (MSL).
26+00 to 45+50	30	10	?	?	1920s	Failed, Crest Around MSL.
45+50 to 47+00	30	16.5	6.5-12.1 ton (176-193 pcf)	1.5:1	2008	Failed, Crest Around MSL.
47+00 to 53+50	40	16-20	10 ton avg (<150 pcf)	1.5:1	1940	Fair condition, low compared to 1940 repair.
53+50 to 59+50	30	21-26	8.8-16.3 ton (176-193 pcf)	2:1	2008	Good condition, toe protection provided to avoid runnel formation and scour.
59+50 to 62+70	30	23-25	9 ton avg (165 pcf)	2:1	1970	Good condition, relatively low crest (around +20 ft MLLW).
62+70 to 63+30	30	25.5	13.5-25.1 ton (176-193 pcf)	1.5:1	2008	Fair to good condition. 50-year wave height estimated at 14.8 ft sea side, 13.8 ft channel side.
63+30 to 78+00	30	25	>12.3 ton (165 pcf)	2:1	1989	Fair to good condition. 50-year wave height estimated at 14.8-17.7 ft sea side, 13.8-17.4 ft channel side.
78+00 to 83+00	30	25	>18 ton (165 pcf)	2:1	1989	Presently acts as the jetty head. Fair condition. 50-year wave height estimated at 18-27.9 ft.
83+00 to 85+90	30	25	18 ton avg (165 pcf)	1.5:1	1970	Poor condition (failed beyond 83+60).
85+90 to 86+40	30	25	>27.5 ton (165 pcf)	2:1	1989	Failed.
86+40 to 95+07	40	12	6-25 ton (<150 pcf)	1.5:1	1930	Failed.

Source: USACE 2012

The South Jetty is generally in better condition (Figure 2-15) than the North Jetty and is not currently scheduled for repairs. In the early 1940's, the South Jetty was reconstructed as a composite concrete and rock structure: a cast-in-place monolithic concrete core was installed and protected by rock on both sides. The core is visible at low tide at some sections of the jetty. Table 2-19 presents an evaluation of the South Jetty's current deficit and identifies the years in which the most recent repairs have been made.

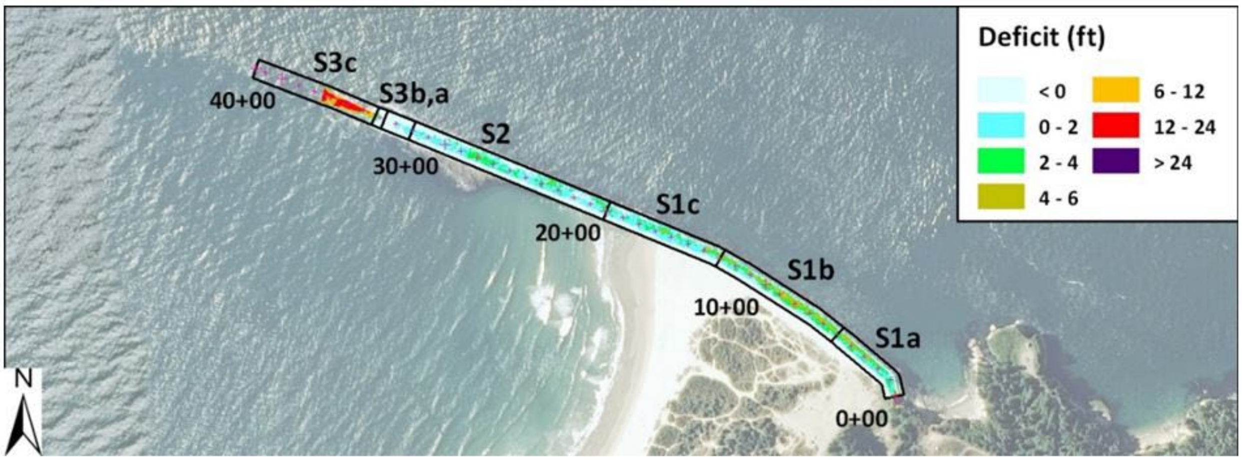


Figure 2-15: South Jetty Deficit

Table 2-19
South Jetty Design, Last Repair, and Present Condition

Station Range	Crest Width (ft)	Elevation (ft MLLW)	Armor size	Slope	Last Repair	Condition
0+00 to 15+45	30	16	4.5 ton avg (150-200 pcf)	1.5:1	1964	Fair condition. The concrete core has retained the shape of the structure, and over sloping has been observed at the rock.
15+45 to 32+73	30	16-24	11 ton avg 170 pcf	1.5:1 (2:1 above water)	1964	Good condition.
32+73 to 34+23	30	24	22 ton 170 pcf)	1.5:1 (2:1 above water)	1964	Fair condition. Despite loss of rock, concrete core remains intact.
34+23 to 41+60	N/A	0	N/A	N/A	1964	Demolished to MLLW in 1964.

2.4.5 Pile Dikes

Prior to construction of the pile dikes (Figure 2-16), the channel thalweg (deepest part of the river) was shifting northwest towards the North Spit, eroding the outer bank of the Jarvis Turn (RM 6.3 to 7.3). Directly at the pile dikes, the shoreline has been accretional. Therefore, the pile dikes have been successful in retarding erosion. It should be noted that in Figure 2-17, the pile dikes are referred to as “CB” plus their approximate RM.

The pile dikes consist of three major components: the pile dike, a pile dolphin, and a stone blanket. The wooden piles are creosote treated and about 12 inches in diameter. The dike piles extend up to +10 ft MLLW, and the dolphin piles extend 6 ft higher to +16 ft MLLW and help mark the location of the structures. Typically, the shoreward-most piles are 18 ft long and driven to -8 ft MLLW. As the structure extends further toward the channel, the length of piles and depth of driving increases to 50 ft in length and 40 ft below MLLW.

As is typical with marine pile structures of this age, most of the piles likely suffer from some amount of marine rot (soft or hollow center). During visual inspection in 2016, piles with hollowed out tops were observed, which is an indicator of marine rot. Other typical defects for structures of this age are pile splitting and piles with section loss (reduced pile width).

The armor protecting the structures includes the revetment that runs along the length of the piles in addition to the stone blanket that extends radially from the tip of the last pile. This armor stone protects the piles from undermining and current scour. Geophysical investigations of the pile dikes in 2016 identified the rock revetment along the structures’ length as well as the blanket at the tip of the structures. Along the length of the structures, much of the rock revetment remains in place. The stone blankets have appeared to spread laterally in response to scour, but generally appear to have a reasonable quantity of armor stone that remains available to protect against additional scour or side slope equilibration

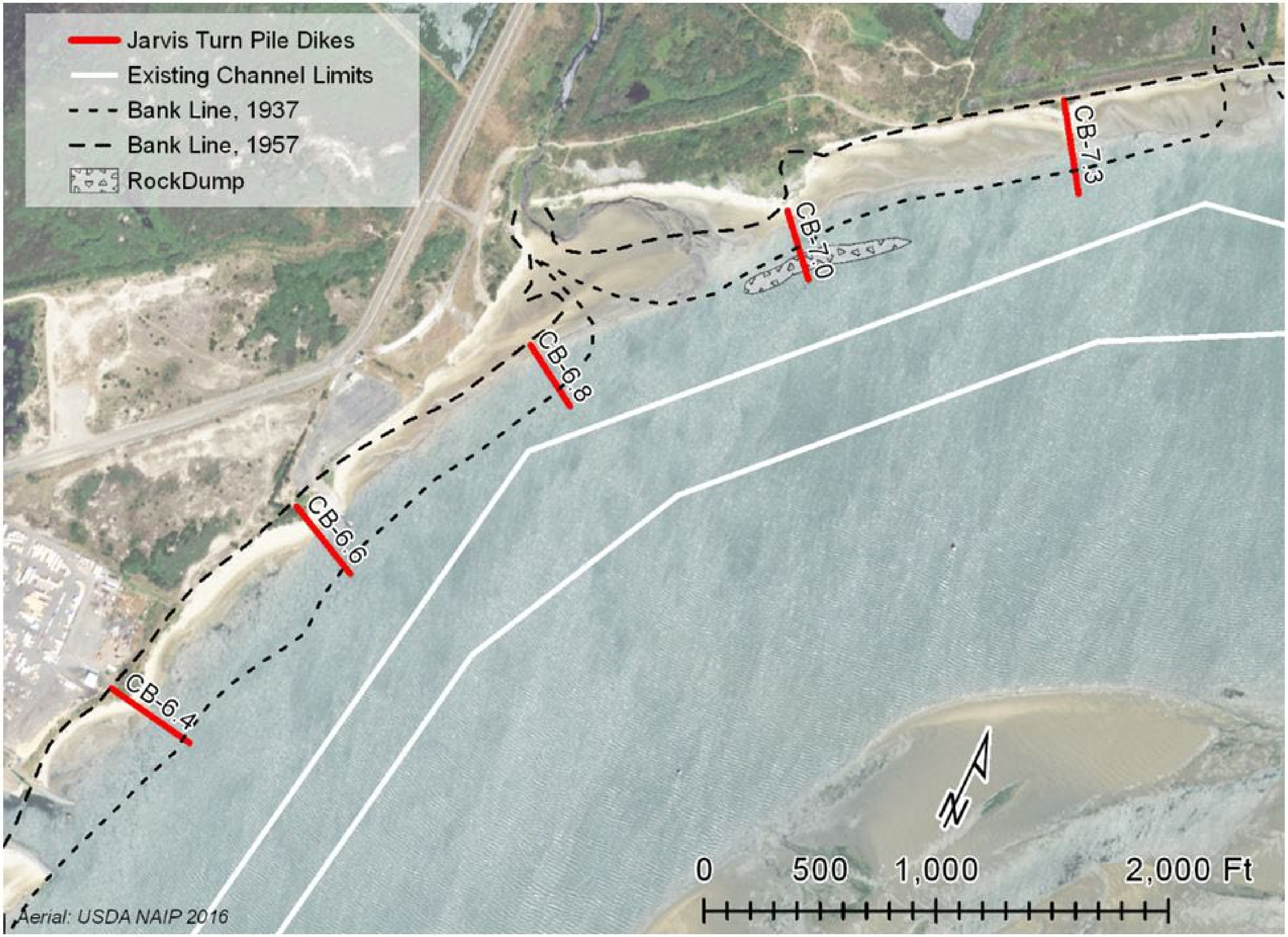


Figure 2-16: Pile Dikes and Bank Erosion from 1937 - 1957

2.4.6 Charleston Breakwater and Bulkhead

The Federal breakwater and bulkhead at Charleston provide wave protection for the Charleston Marina (see Section 2.5 Charleston Marina), which is operated by the OIPCB. The first part of the breakwater (perpendicular to the shoreline) was completed in 1956. The 800-ft breakwater extension was completed in 1979 (USACE, 1979). Figure 2-17 shows the breakwater protection at the marina, marked by a shoal at the internal corner of the breakwater. The shoal has accreted at the dogleg since the breakwater was lengthened. No existing significant structural problems with the breakwater have been identified.

Figure 2-17: Charleston Marina and Breakwater, Looking West

2.4.7 Aids to Navigation

Approximately 46 (26 lateral markers and 20 range makers) existing ATON help guide the Coos Bay Pilots from offshore up to RM 8.2. Appendix 1 details the existing ATON. The existing lateral marker system up to RM 8, consisting of 22 buoys and 4 fixed markers is shown in Figure 2-18.

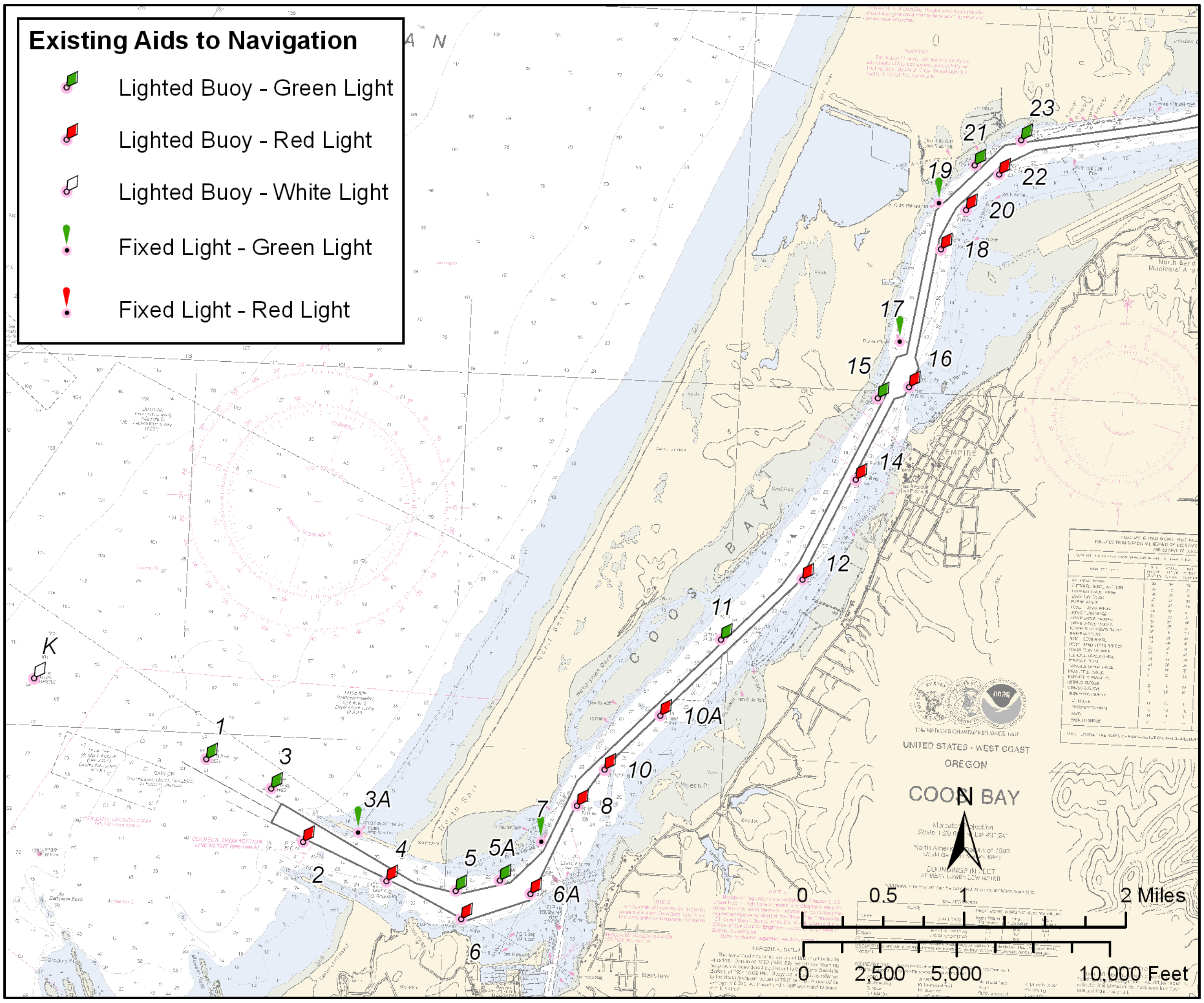


Figure 2-18: Existing Lateral Markers

The existing range marker system up to RM 8, consisting of 20 range markers (located on 17 structures), is shown in Figure 2-19.

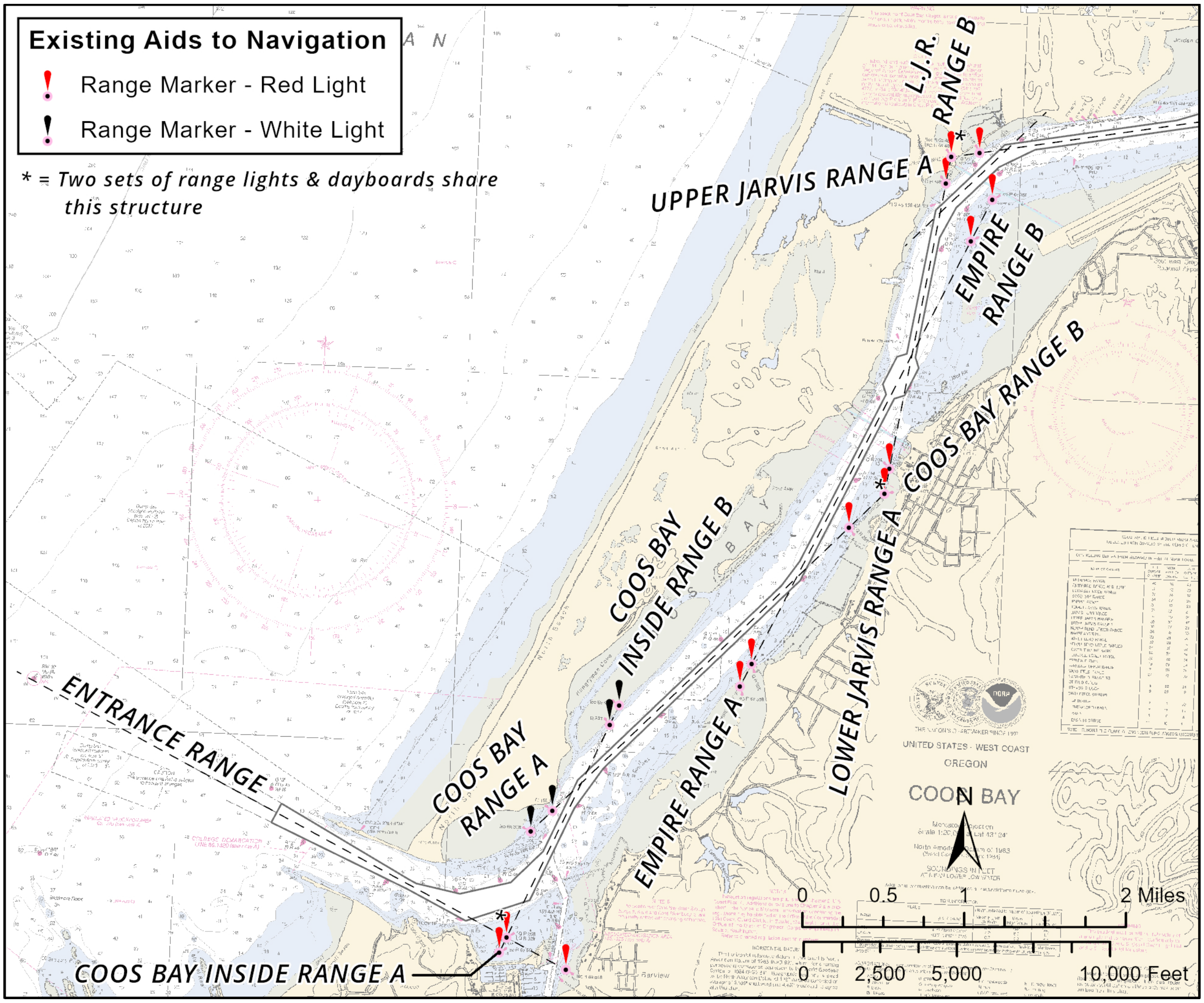


Figure 2-19: Existing Range Markers

2.5 Charleston Marina

The Charleston Marina, operated and maintained by the OIPCB, is 0.3 mi north of Charleston, across the slough from Barview (Figure 2-16 – shown previously). The basin is used by commercial and sport fishermen. The Charleston Marine is the homeport for approximately 75 commercial fishing vessels. About 500 berths with electricity, gasoline, diesel fuel, water, ice, a launching ramp, and marine supplies are available. A pump-out station and wet and dry winter boat storage are available in the basin. A repair facility at the basin has a drydock that can handle vessels to 300 tons, 90 ft long, and 30 ft wide, and a marine railway that can handle craft 70 ft long, 22 ft wide, and 6 ft draft for hull and engine repairs. Electronic repairs can also be made at the basin. Four fish piers are in the basin, and three fish packing facilities are just south of the basin on South Slough. Coos Bay Coast Guard Station is on the south side of the basin.

2.6 Terminal Facilities

OIPCB marine terminal facilities have been grouped into two categories: (1) Lower Bay terminals from the entrance up to RM 9.0 and (2) Upper Bay terminals upstream of RM 9.0 (Figure 2-20). Because the railroad swing bridge at RM 9.0 limits the size of vessels that can pass through the bridge opening to Panamax size vessels, this Section 204(f)/408 report focuses on potential Lower Bay channel improvements and terminal facilities.

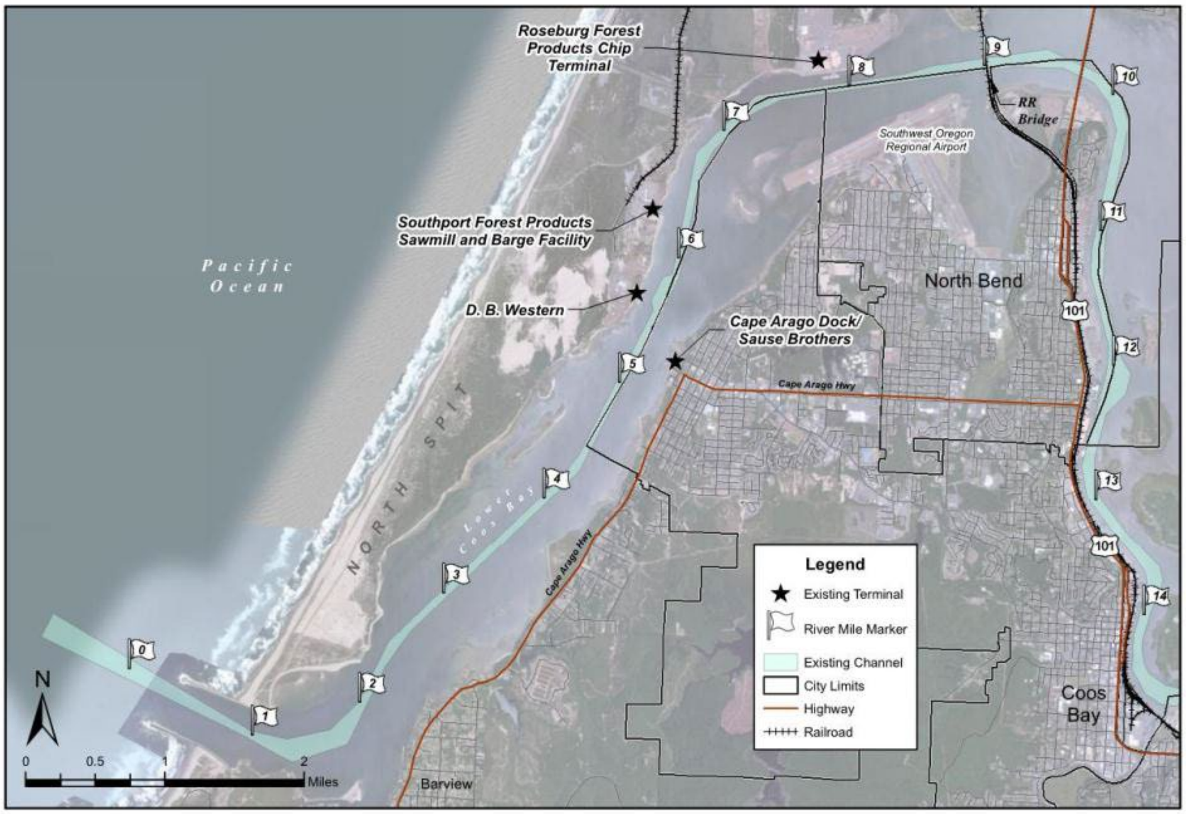


Figure 2-20: Existing Lower Bay Terminal Facilities

There are currently four operating terminals and one terminal under development located along the Federal channel between the entrance and RM 9.0. The four operating terminals are:

- Cape Arago Dock/Sause Brothers (RM 5.4)
- D. B. Western (RM 5.6)
- Southport Forest Products Sawmill and Barge Facility (RM 6.3)
- Roseburg Forest Products Chip Terminal (RM 7.9).

2.6.1 Existing Lower Bay Terminal Facilities

Cape Arago Dock/Sause Brothers is a private terminal with a single berth approximately 500 feet long on the left descending bank of the waterway. At one time, nickel ore was imported at this terminal for a smelter in Riddle, Oregon, but this traffic was short-lived and has not returned for many years. There are no current deep draft cargo operations at this facility.

The D.B. Western facility is mainly a landside operation, which designs and prefabricates components of industrial processing plants for worldwide use. The dock is currently inoperable for cargo vessels and would require substantial reconstruction to become operable.

The Southport Forest Products Sawmill and Barge Facility cuts dimensional lumber and exports residual wood chips, via barge, to pulp mills on the Columbia River. Southport Forest Products also exports logs via Ocean Terminal at RM 11.0 on the Federal channel. The Southport barge facility is in a slip configuration perpendicular to the Federal channel, dredged to -21 feet MLLW. Southport Forest Products also exports up to 200,000 tons of dry chips per year from this facility. Barges typically have a capacity of 8,000 tons. A rail spur connects the Southport Forest Products facility to the Coos Bay Rail Link.

Southport Forest Products is currently planning a deep draft dock expansion at this facility with a potential depth of as much as -45 feet and on-dock rail capability. The timing and the final design of the expansion are not reasonably foreseeable at this time. Therefore, the Southport expansion is not included in without-project or with-project future conditions.

Roseburg Forest Products operates a 25-acre wood chip terminal, which includes a rail spur to the Coos Bay Rail Line and two sidings. The facility uses a truck/rail car dumper and an on-dock 1,400 ton-per-hour vessel loader. The berth, which runs parallel to the Federal channel, is more than 1,000 feet long and is dredged to -40 feet MLLW.

Roseburg Forest Products is the largest particle board manufacturer in North America and the largest wood chip exporter in the western United States. Wood chips are an input for pulp mills in paper production. Wood chips are typically generated as a residual from the production of other lumber products. Douglas fir chips are sourced from Roseburg's own mills and other mills throughout southwestern Oregon and northern California. Douglas fir chips from west of the coast range are used in the manufacture of the highest quality paper and are exported to British Columbia by barge and to Japan by Panamax size vessels.

From 2013 through 2023, the Roseburg Forest Products terminal exported an average of 1.5 million short tons of wood chips per year in an average of 29 deep draft vessel calls per year. In addition, barge loads are exported to Canada with annual tonnage ranging from 0 to 280,000 metric tons. It is important to note that chip moisture content greatly affects chip weight per cubic foot, and therefore also affects maximum vessel draft. Chips are stored in open piles and can absorb substantial quantities of water during rainy weather. Reported tonnages are adjusted for moisture content and reflect the weight of the cargo without excess moisture. Fully loaded vessel drafts can increase by as much as four feet due to chip moisture content. Vessel outbound drafts for the deep draft vessel calls range from 28 feet to 39 feet, with most calls either requiring tidal assistance or loaded to the maximum unrestricted draft (33 feet).[25]

[25] Drafts are rounded up to the nearest foot when assessing underkeel clearances. Underkeel clearance is 10 percent of vessel draft, per pilot's standard operating practices. A vessel sailing with a 33-foot draft requires 3.3 feet of underkeel clearance for a total required depth of -36.3 feet, which rounds up to -37 feet.

2.6.2 Existing Upper Bay Terminal Facilities

There are ten terminal and dock facilities located along the federal channel from River Mile 11 to River Mile 15, although only two facilities (Ocean Terminal and Oregon Chip Terminal) handled deep draft vessels in 2023. The Ocean Terminal (RM 11) is a log export facility with a water depth of -37 feet. Ocean Terminal serviced eleven deep draft vessel calls in 2023. The Oregon Chip Terminal (RM 12.5) is a wood chip export facility with a water depth of -37 feet. The Oregon Chip Terminal serviced 16 deep draft vessel calls in 2023. The following describes the other terminal and dock facilities along the Federal channel in the upper bay:

- Tyree Oil Terminal (RM 12.4) – Tug refueling;
- Bayshore Dock/Sause Brothers (RM 12.7) – private terminal, tug moorage;
- OIPCB “Citrus Dock” (RM 12.9) – currently inactive;
- OIPCB “Dolphin Terminal” (RM 13.2) – currently inactive;
- USACE Coos Bay Moorage (RM 13.2) – government vessel moorage;
- Pierce Terminal (RM 14.8) – currently inactive;
- Georgia Pacific Chip Terminal (RM 15) – currently inactive; and
- Coos Bay Docks (RM 15) – currently inactive.

There are also two terminal/dock facilities along the Isthmus Slough, which are upstream from the terminus of the Federal channel. Coastal Fibre Barge Moorage (0.9 miles south of the Federal channel) occasionally loads wood chips onto barges and Knutson Log Yard Moorage (1.9 miles south of the Federal channel) is currently inactive.

2.7 Historical Cargo Volumes

Commercial navigation at the Port of Coos Bay dates back at least 1878. Forest products historically have been the Port’s most stable export commodity. Since 2003, forest products have accounted for between 98 percent and 100 percent of all cargo tonnage at the OIPCB. The port is one of the largest forest product export ports in the United States and is the largest wood chip export port in the nation. Forest product exports are consistently the large majority of all cargo moving through Coos Bay. Table 2-20 presents Waterborne Commerce Statistics Center historical total cargo tonnages for 2003–2022. Table 2-21 presents Waterborne Commerce Statistics Center historical foreign export cargo tonnages for 2003–2022.

Table 2-20
Port of Coos Bay Cargo Tonnage 2003-2022 (short tons)

Year	Wood Chips	Logs	Lumber	Total Forest Products	Total All Commodities	Percentage Forest Products
2003	1,404,918	336,128	122,984	1,864,030	1,883,228	99.0
2004	1,298,022	502,396	152,416	1,952,834	1,987,407	98.3
2005	1,602,673	415,663	197,783	2,219,775	2,244,032	98.9
2006	1,551,387	387,047	181,073	2,119,507	2,144,168	98.8
2007	1,474,399	322,128	122,154	1,918,681	1,934,362	99.2
2008	1,488,452	166,136	73,646	1,728,234	1,732,595	99.7
2009	1,178,680	141,105	8,555	1,328,340	1,328,340	100.0
2010	1,402,121	171,859	12,424	1,586,404	1,586,404	100.0
2011	1,537,515	539,902	252,778	2,330,195	2,331,800	99.9
2012	1,146,103	502,055	298,098	1,949,256	1,958,396	99.4
2013	1,477,000	622,000	0	2,099,000	2,106,000	99.7
2014	1,551,000	308,000	0	1,859,000	1,859,000	100.0
2015	1,471,000	284,000	0	1,755,000	1,755,000	100.0
2016	1,577,000	512,000	0	2,089,000	2,089,000	100.0
2017	1,667,000	441,000	0	2,108,000	2,108,000	100.0
2018	1,601,000	556,000	153,000	2,310,000	2,345,000	98.5
2019	1,251,000	430,000	239,000	2,020,000	2,069,000	97.6
2020	1,477,000	331,000	0	1,808,000	1,836,000	98.5
2021	2,070,000	378,000	2,000	2,460,000*	2,543,000	96.7
2022	2,083,000	553,000	0	2,664,000**	2,825,000	94.3

Source: Waterborne Commerce Statistics Center; *includes 9,000 tons fuel wood; **includes 27,000 tons fuel wood

Table 2-21:
Port of Coos Bay Export Tonnage 2003-2022 (short tons)

Year	Total All Cargo	Total Exports	Forest Product Exports	Forest Product Exports Percentage of All Cargo
2003	1,883,228	1,348,753	1,348,031	71.6
2004	1,987,407	1,228,664	1,228,306	61.8
2005	2,244,032	1,440,917	1,440,917	64.2
2006	2,144,168	1,347,519	1,347,491	62.8
2007	1,934,362	1,267,476	1,267,476	65.5
2008	1,732,595	1,394,993	1,392,463	80.4
2009	1,328,340	1,046,183	1,046,183	78.8
2010	1,586,404	1,409,295	1,409,295	88.8
2011	2,331,800	2,230,149	2,230,145	95.6
2012	1,958,396	1,949,601	1,946,256	99.4
2013	2,106,000	1,868,000	1,863,000	88.5
2014	1,859,000	1,775,000	1,775,000	95.5
2015	1,755,000	1,582,000	1,582,000	90.1
2016	2,089,000	1,872,000	1,872,000	89.6
2017	2,108,000	1,864,000	1,864,000	88.4
2018	2,345,000	2,255,000	2,255,000	96.2
2019	2,069,000	1,854,000	1,854,000	89.6
2020	1,836,000	1,667,000	1,640,000	89.3
2021	2,543,000	2,269,000	2,141,000	94.4
2022	2,825,000	2,479,000	2,276,000	91.8

Source: Waterborne Commerce Statistics Center
Note: Exports include only foreign exports; shipments to other U.S. ports not included.

2.8 Existing Cargo Fleet and Vessel Operations

The cargo fleet currently calling at Coos Bay consists of Handymax bulkers (chip carriers and log carriers), Panamax bulkers (chip carriers) and barges (chip carriers). Wood chips are loaded into covered compartments on bulk vessels. Logs are loaded into covered compartments and are also loaded on deck above the compartment hatches. Barges are typically single compartment, uncovered, open hull vessels.

Vessels carrying wood chips tend to be larger and sail with deeper departure drafts than log carriers. Chip ships load at the Roseburg Forest Products Terminal (RM 8). Vessels with drafts of 33 feet or deeper require tidal advantage. Deeply loaded vessels departing the Roseburg Forest Products Terminal leave the dock 1.5 hours before high water at the entrance bar.

Most log ships load at the Ocean Terminal (RM 11.0), which requires that vessels transit the opening at the railroad swing bridge. Deeply loaded vessels departing Ocean Terminal leave the dock up to three hours before high water at the entrance bar. Table 2-22 displays the operating characteristics of chip carriers and log carriers calling at the Port of Coos Bay from 2005–2017.

Table 2-22
Bulk Vessel Export Calls: Coos Bay 2013- 2022

Departure Draft	Number of Calls by Departure Draft
<33 feet	65
33 feet	44
34 feet	61
35 feet	69
36 feet	78
37 feet	154
38 feet	37
39 feet	2
40 feet	1
Total calls	**511**
Total calls >33 feet	402
% calls >33 feet	79%

Source: Waterborne Commerce Statistics Center

2.8.1 Cargo Fleet Operational Constraints and Tidal Advantage

Large bulk cargo vessels calling at the Port of Coos Bay must operate under a combination of constraints that affect the vessel's potential use of tidal advantage, including channel depth and channel transit schedules. The deepest operating draft approved by the Coos Bay Pilots is 38.5 feet, which requires special coordination so that the vessel departs at the appropriate time to cross the entrance bar at peak high water. Any vessel transiting the Federal navigation channel with a sailing draft of 34 feet or deeper must coordinate the transit with the rising tide, i.e., use tidal advantage. The maximum unrestricted sailing draft in the harbor is 33 feet.

As displayed by the data in Table 2-22, over 400 vessels were restricted by channel depth from 2013 through 2022 and used tidal advantage to transit the existing -37 foot Federal navigation channel at Coos Bay. A vessel departing the Port of Coos Bay with a draft of 37 feet in the -37-foot authorized channel is using four feet of tidal advantage. Figure 2-21 and Figure 2-22 identify the percentage of time that tidal advantage is available and identify the probability of wait-time for various levels of tidal advantage.

Note that tides are generally higher in March and November, as indicated in the two figures. If four feet of tidal advantage is required, then the probability that four feet would be available at any given moment is 51 percent in April through October, and 56 percent in March and November. The probability that four feet of tidal advantage would be available within three hours of any given moment is 75 percent in April through October, and 78 percent in March and November. In general, three feet of tidal advantage is nearly always available within a maximum of six hours wait time, and five feet of tidal advantage is nearly always available within a maximum of 12 hours wait time.

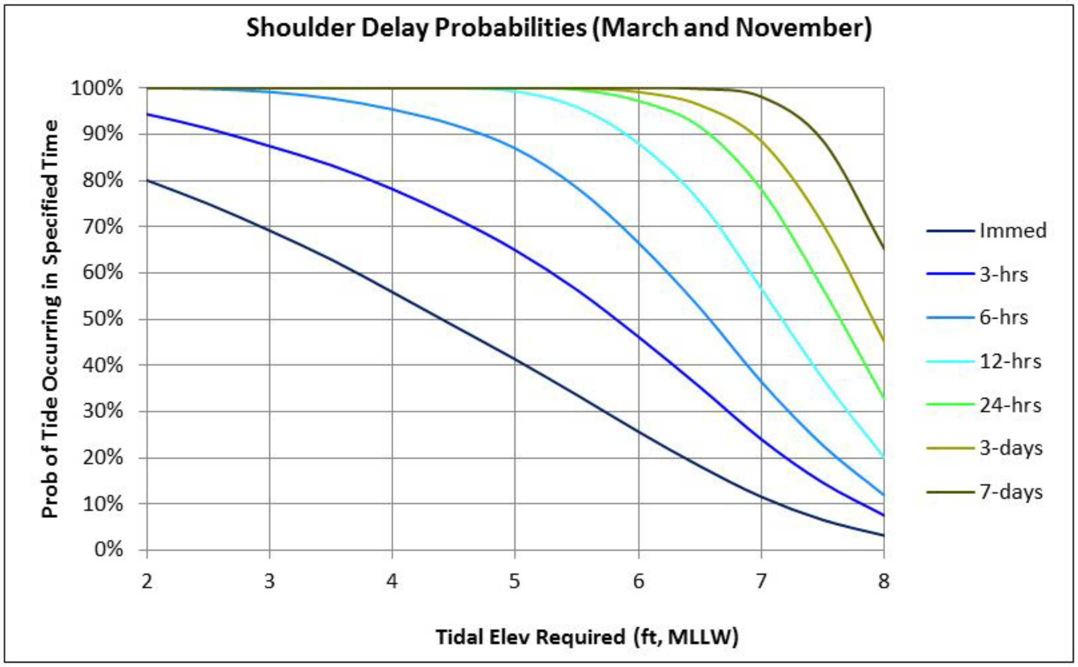


Figure 2-21: Coos Bay Tidal Advantage March and November

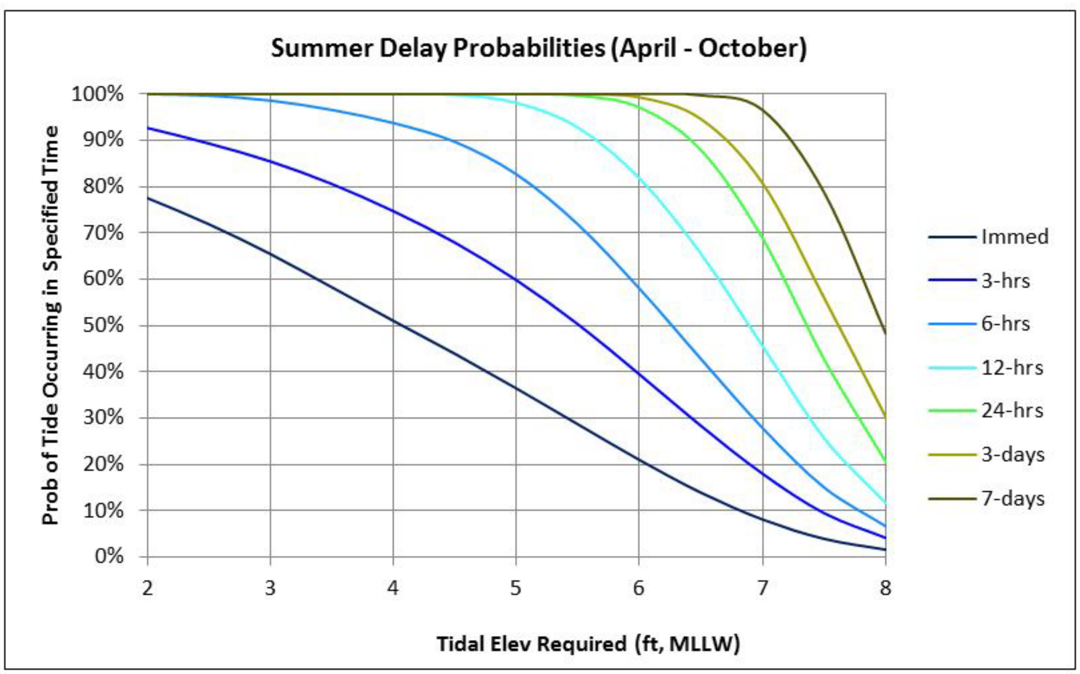


Figure 2-22: Coos Bay Tidal Advantage April through October

2.9 Land Use

Numerous federal, state, and local agencies' plans and policies regulate land use in the project area. The Coastal Zone Management Act (CZMA) is implemented at the state level by the Oregon Department of Land Conservation & Development's (DLCD) Oregon Coastal Management Program (OCMP). The OCMP applies to areas within the coastal zone that include the entire project vicinity. The OCMP is also responsible for implementing the Oregon Territorial Sea Plan (OTSP). The OTSP is implemented locally through the Coos Bay Estuary Management Plan (CBEMP, 2023), which sets policy and development standards for the Coos Bay estuary and its adjacent shorelands. The CBEMP's policies have bay-wide application and provide guidance for how land use is managed within and adjacent to the estuary. Within the CBEMP, management unit designations and management objectives identify how smaller subdivisions withing the specific area are to be managed. CBEMP policies are generally more restrictive than the permitted and conditional uses identified in the individual management units. Each jurisdiction encompassing a portion of the proposed project, including Coos County, the City of North Bend, and the City of Coos Bay, has adopted the applicable portions of the CBEMP into its comprehensive plan and development ordinances. Approvals and possibly land use zoning changes will be required from each of these jurisdictions for each of the three PCIP components (channel modification, terminal, and rail improvements.

All components of the project are required, under the Coastal Zone Management Act (CZMA), to be fully consistent with the enforceable policies of state coastal programs and local implementing plans such as the CBEMP. The project proponent will be required to submit land use permits that satisfy local land use criteria and provide the CZMA consistency certification, once issued by DLCD, to the USACE.

2.10 Visual Resources

The visual character of the project area is typical of working coastal communities along US 101. The landscape is level or gently sloped in developed areas, and views are often limited to the foreground by tall conifers or other vegetation, or by structures.

The National Park Service prepared an analysis of the visual amenities of the Coos Bay estuarine area in August 1971. While that analysis is more than 50 years old, the broad characterization of the aesthetic/visual characteristics of the Coos Bay estuarine area remains substantially the same.

The dominant element of the landscape is the extensive water area of Coos Bay. The bay itself is characterized by sloughs and channels of inflowing streams, salt marshes, and mud flats that are exposed at low tide. The lands surrounding the bay are a combination of rolling sand dunes to the north, forested sand dunes, headlands and hills to the east, disturbed and developed areas, agricultural pasture, and tidal marshland. Most of the area between the inverted "U" of Coos Bay and North Bend is urbanized. The presence of highly visible development and infrastructure features, which include industrial facilities, bridges for roads and railroads, residential and commercial buildings, municipal wastewater treatment facility, and an airport, as well as areas of mostly open lands, results in a landscape setting that has a mix of both natural and human-made elements (JCLNG, 2017).

2.11 Cultural Resources

The following cultural resources were identified within or adjacent to the proposed modification of the Federal channel:

- Eight reported archaeological sites were eligible for listing in the National Register of Historic Places (NRHP): Coos Bay North Jetty, Camp Castaway, the submerged jetty at Fossil Point, the *William T. Rossell* shipwreck, Coos Bay Pile Dikes, North Jetty, South Jetty, and the World War II bunker. No known archaeological sites were identified within offshore dump sites or proposed beneficial use disposal sites;
- 60+ reported shipwrecks: At least 60 shipwrecks have been documented at the Coos Bay bar alone, not including those within the Coos Bay navigation channel or on the North Spit;
- Two historic resources within and near the project area: The north and south jetties were identified as historic resources adjacent to the project area.

Potentially affected areas have been surveyed for existing cultural resources that could be affected by the Port's proposed project to determine their eligibility for listing in the National Register of Historic Places (NRHP) (AINW, 2019). The findings have not been described here because this information is protected from public disclosure by the Archeological Resources Protection Act (ARPA) and the National Historic Preservation Act (NHPA); in addition, this information would not be disclosed under the Freedom of Information Act (FOIA) under Exemption 3 because the information is prohibited from disclosure by another law.

As the design for the proposed Federal channel modification continues to be refined, there may be additional areas identified (e.g., staging areas, access routes) that may require additional cultural resource investigation. The EIS will include additional information concerning cultural resource investigations.

The Port coordinated with the Coquille Indian Tribe and CTCLUSI between 2011 and 2016, as documented in the project's Cultural Resources Report. During the Port's coordination effort, the Tribes raised concerns about potential sensitive resources, shoreline erosion, and potential disturbance of buried shoreline resources and other potential cultural resources. The Port's communication with local tribes was not intended to be a substitute for the formal government-government tribal consultation required for undertakings subject to Section 106 of the National Historic Preservation Act, the initiation of which is the responsibility of the USACE.

2.12 Socioeconomics

2.12.1 Demographics

The Portland State University, College of Urban and Public Affairs Population Research Center estimates the 2023 population for the State of Oregon to be 4,296,600 and the 2023 population of Coos County to be 66,945 (PSU 2024a). The Coos County population estimated by the 2020 census was 64,929. The State of Oregon has a land area of 95,988 square miles with a population density of 39.9 persons per square mile. Coos County has a land area of 1,596 square miles and a population density of 39.5 persons per square mile.

Recent historical population change for Coos County indicates a stable population (Table 2-23), with a slight (-0.24%) annualized decline in population from 2020 to 2040.

Table 2-23
Coos County Historical Population and Projections

Year	Population
1980	63,900
1990	60,400
2000	62,800
2010	63,000
2020	65,000
2030	64,500
2040	61,900
2050	58,300

Source: PSU 2024b

2.12.2 Income and Poverty

Coos County income is low relative to state and Federal levels, and poverty exceeds federal and state levels. Local per capita income is only 81% of the national per capita income and 80-percent of the State's per capita income level (Table 2-24). Coos County median household income is just 77-percent of the national median household income and 75-percent of the State's median household income level. The proportion of persons living under the poverty level in Coos County is 43-percent greater than the nation proportion and 36-percent greater than the state proportion of persons living under the poverty level.

Table 2-24
Income and Poverty, 2018 - 2022 (2022 dollars)

	United States	Oregon	Coos County
Per capita money income	$41,261	$41,805	$33,572
Median household income	$75,149	$76,632	$57,563
Persons below poverty level	11.5%	12.1%	16.5%

Source: US Census Bureau State & County QuickFacts (accessed 12Jun24)

2.12.3 Employment

Employment in Coos County has been relatively stagnant over the last decade. In Coos County, total nonfarm employment in 2014 is nearly the same as it was in 2023 (Table 2-25). Countywide employment dropped slightly between 2019 and 2020 and had recovered to its 2019 level by 2021. The industries exhibiting the strongest growth in Coos County from 2014 to 2023 are Construction (4.4-percent annual growth rate) and Leisure and Hospitality, which grew at an average annual rate of 2.5-percent. Industries exhibiting the largest declines in employment have been State Government (-8.0-percent annual growth rate) and Mining and Logging (-4.4-percent annual growth rate).

Table 2-25
Coos County Employment

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Compound Annual Growth Rate
Mining & Logging	550	540	520	470	480	440	410	410	380	350	-4.4%
Construction	730	790	820	910	960	1,030	1,030	1,020	1,040	1,120	4.4%
Manufacturing	1,700	1,750	1,740	1,710	1,730	1,700	1,620	1,570	1,520	1,480	-1.4%
Trade, Transport, & Utilities	4,140	4,210	4,270	4,330	4,290	4,250	4,170	4,270	4,390	4,350	0.5%
Information	190	190	180	170	180	180	150	130	150	140	-3.0%
Finance	730	740	760	760	800	820	820	850	860	860	1.7%
Professional & Business	2,200	2,130	2,080	1,940	2,060	2,200	2,290	2,350	2,260	2,420	1.0%
Education & Health	2,750	2,760	2,850	2,930	3,540	3,470	3,230	3,230	3,150	3,250	1.7%
Leisure & Hospitality	2,400	2,520	2,610	2,670	2,710	2,820	2,480	2,680	2,910	3,080	2.5%
Other Services	530	530	560	540	560	570	550	560	600	560	0.6%
Federal Govt	330	320	320	320	310	310	310	310	310	310	-0.6%
State Govt	1,040	1,040	1,070	1,090	470	520	470	460	420	450	-8.0%
Local Gov't	4,440	4,560	4,690	4,820	4,770	4,850	4,510	4,520	4,680	4,820	-0.8%
Totals	21,730	22,060	22,450	22,670	22,860	23,160	22,020	22,350	22,650	23,190	0.7%

Source: Oregon Employment Department QualityInfo (OEDQ) 2024

2.12.4 Environmental Justice

In 1994, President Clinton signed Executive Order (EO) 12898, "*Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations*," directing federal agencies to develop environmental justice (EJ) strategies to help federal agencies address disproportionately high and adverse human health or environmental effects of their programs on minority and low-income populations (EO, 1994). This EO was made to focus federal attention on the environmental and human health conditions of minority and low-income populations with the goal of achieving environmental protection for all communities. The Presidential Memorandum accompanying the executive order underscored certain provisions of existing law that can help ensure that all communities and persons across the nation live in a safe and healthy environment (PM, 1994).

The President's Council on Environmental Quality (CEQ), in consultation with the USEPA and other affected agencies, developed guidance for all federal agencies on the consideration of EJ in NEPA documents as required under EO 12898 (CEQ, 1997). This guidance assisted federal agencies so that EJ concerns were effectively identified and addressed in their NEPA documents. As a result of the EO, Presidential Memorandum, and CEQ guidance, federal agencies began to include the consideration of EJ in their decision making by identifying disproportionately high and adverse human health or environmental effects on minority and low-income populations. When implemented, low-income and minority populations were identified within a study area, and included community outreach activities such as stakeholder meetings with the affected population.

The CEQ is leading the efforts to secure EJ consistent with sections 219 through 223 of EO 14096, including developing the Climate and Economic Justice Screening Tool[26] and collaborating with the Office of Management and Budget (OMB) and the National Climate Advisor on implementing the Justice40 initiative, which sets a goal that 40 percent of the overall benefits of certain federal investments flow to disadvantaged communities (EO, 2021).

According to the Assistant Secretary of the Army's March 2022 Memorandum on Implementation of Environmental Justice and the Justice40 Initiative, EJ is achieved when everyone enjoys the same degree of protections and equal access to USACE programs and services to achieve a healthy environment in which to live. In studying, planning, designing, constructing, and operating USACE projects or providing assistance, USACE shall work to meet the needs of disadvantaged communities by reducing disparate environmental burdens, removing barriers to participation in decision-making, and increasing access to benefits provided by Civil Works programs to disadvantaged communities within USACE authorities (ASA(CW), 2022).

The USEPA is responsible for overseeing the EJ implementation in the federal agencies. To support agencies and communities in reaching these goals, Environmental Justice Interagency Working Group published the Community Guide to Environmental Justice and NEPA Methods (FIWG, 2019), including the development of an online mapping tool, NEPAssist,[27] that aids community engagement for environmental review and project planning.

In April 2023, President Biden issued EO 14096, "*Revitalizing Our Nation's Commitment to Environmental Justice for All*" asserting that nearly three decades after the issuance of EO 12898,

[26] CEQ, Explore the Map, Climate and Economic Justice Screening Tool, https://screeningtool.geoplatform.gov/.
[27] https://nepassisttool.epa.gov/nepassist/nepamap.aspx

the federal government must build upon and strengthen its commitment to deliver EJ to all communities across America (EO, 2023).

The Assistant Secretary of the Army for Civil Works' Memorandum for Commanding General of the U.S. Army Corps of Engineers (ASA(CW), 2023), establishes what an economically disadvantaged community is defined as meeting one or more of the following:

a. Low per capita income - The area has a per capita income of 80 percent or less of the national average;
b. Unemployment rate above national average - The area has an unemployment rate that is, for the most recent 24-month period for which data are available, at least 1 percent greater than the national average unemployment rate;
c. Indian country as defined in 18 U.S.C. 1151 or in the proximity of an Alaska Native Village;
d. U.S. Territories; or
e. Communities identified as disadvantaged by the Council on Environmental Quality's Climate and Economic Justice Screening Tool.[28]

The Bipartisan Permitting Reform Implementation Rule (CEQ, 2024) includes provisions to advance EJ and promote meaningful public input. The rule helps ensure projects are built smart from the start by promoting early and meaningful engagement with communities, fostering community buy-in, reducing or avoiding conflict, and improving project design. In addition, the rule directs agencies—consistent with current best practices—to consider EJ in environmental reviews and to encourage measures to avoid or reduce disproportionate effects on communities, including the cumulative impacts of pollution. Requires agencies to consider the needs of affected communities when developing outreach and notification strategies so communities know about and can participate in decisions that affect them. Directs agencies to identify Chief Public Engagement Officers responsible for facilitating community engagement for environmental reviews.

Table 2-26 shows the 2023 estimated ethnic mix (as a percentage) for the State of Oregon and for Coos County. Compliance with Environmental Justice requirements will be presented in the EIS.

[28] https://screeningtool.geoplatform.gov

Table 2-26
Race and Ethnicity

Ethnic Mix (2023)	Oregon	Coos County
White alone (a)	85.9%	89.9%
Black or African American alone (a)	2.3%	0.7%
American Indian and Alaska Native alone (a)	1.9%	3.0%
Asian alone (a)	5.1%	1.4%
Native Hawaiian and Other Pacific Islander alone (a)	0.5%	0.3%
Two or More Races	4.3%	4.8%
Hispanic or Latino (b)	14.4%	7.5%
White alone, not Hispanic or Latino	73.5%	83.9%

(a) Includes persons reporting only one race.
(b) Hispanics may be of any race, so also are included in applicable race categories.

Source: US Census Bureau State & County QuickFacts accessed 12Jun24

3. WITHOUT-PROJECT CONDITIONS

Most without-project conditions relating to climate, winds, waves, and currents are expected to be the same as existing conditions, with the exception of minor changes to sedimentation in the entrance channel due to USACE improvements to the North Jetty.

3.1 Navigation Features

3.1.1 Channel Conditions

Future without-project navigation channel conditions are projected to be a continuance of existing channel conditions. USACE is projected to provide regularly scheduled maintenance dragging to maintain authorized depths. Reconstruction of the North Jetty will maintain the integrity of the Entrance Channel. Figures 3-1 and 3-2 present without-project navigation features for the lower bay and upper bay, respectively.

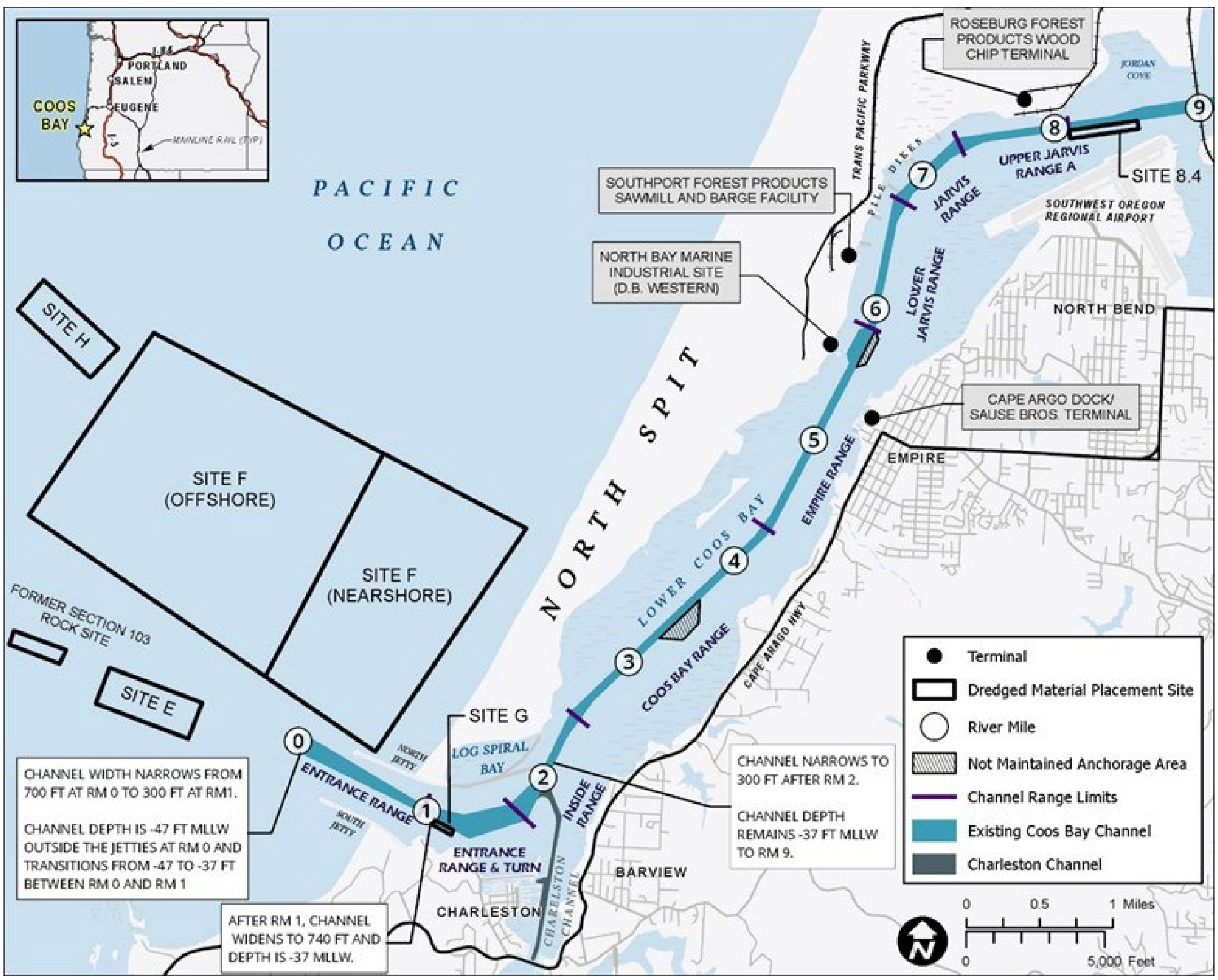


Figure 3-1: Lower Bay: Without-Project Navigation Features

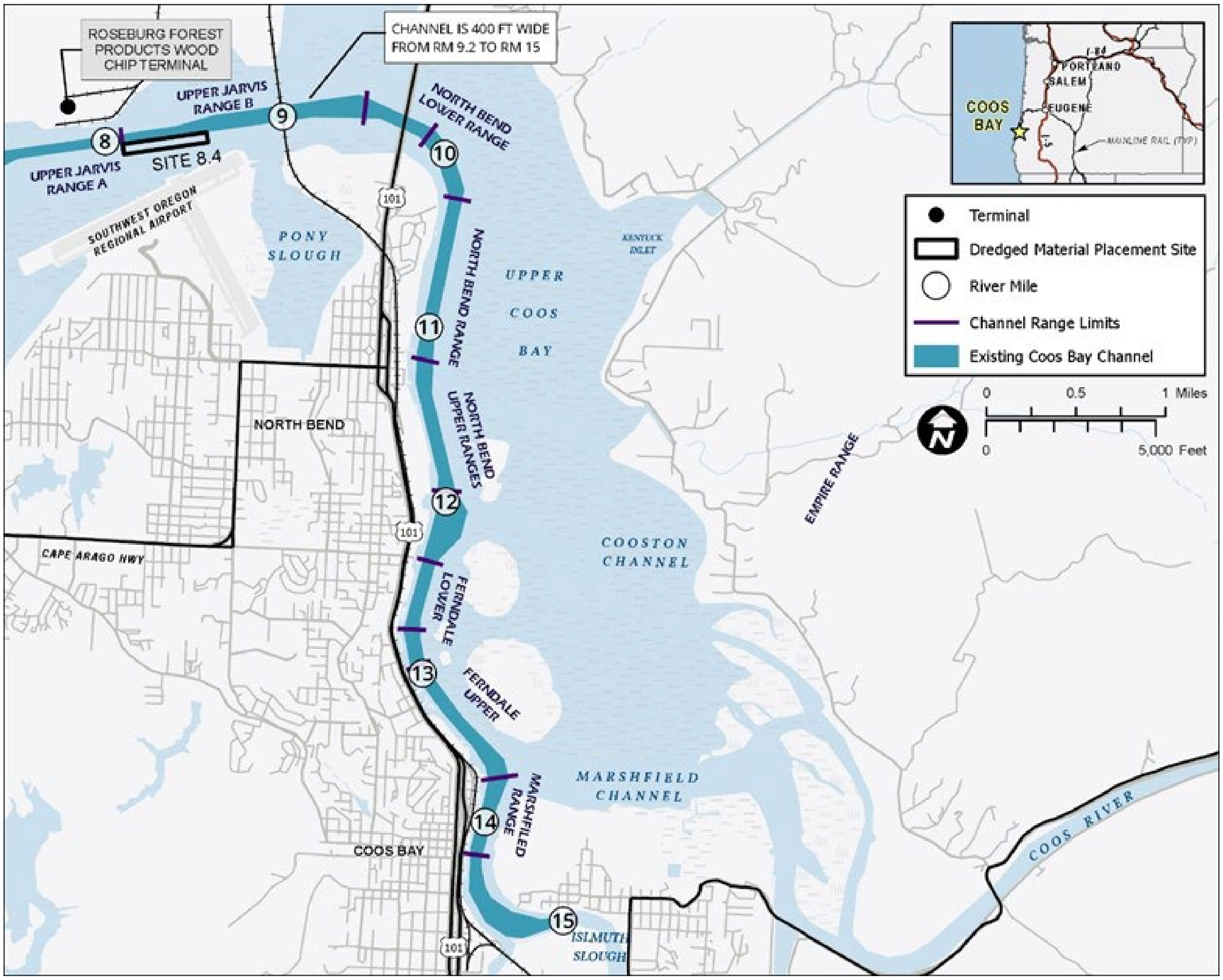


Figure 3-2: Upper Bay Without-Project Navigation Features

3.1.2 Coos Bay Ocean Dredged Material Disposal Sites

Under without-project conditions, Federal channel maintenance dredging volumes are expected to be similar to recent historical volumes, with the exception of slightly larger volumes (an additional 7,000 cubic yards annually based on sediment transport modeling of the entrance channel, see Section 5.3.1 Entrance Channel of the Engineering Appendix A) in the entrance channel due to improvements to the North Jetty. Long-term monitoring of the multiple ODMDS will continue as outlined in the Coos Bay ODMDS E, F, and H SMMP (USEPA and Corps 2006). Offshore disposal primarily at the Coos Bay ODMDS F will continue to be the long-term disposal plan for USACE maintenance dredging and for private terminal operators because it is the most cost-effective disposal alternative, consistent with engineering and environmental criteria.

Both the Southport Forest Products Sawmill and Barge Facility (RM 6.3) and the Roseburg Forest Products Chips Terminal (RM 8) are considering expansion of their docks and Southport is considering berth deepening, however, none of these improvements is included in the without-project condition because they cannot be confirmed. In addition, none of these improvements is required to realize project benefits. Current maintenance dredging requirements for the berth at the Roseburg Forest Products Chips Terminal are up to 20,000 cy every two to three years, most often in coordination with Federal channel maintenance dredging. The Southport terminal does not currently perform regular maintenance dredging.

3.1.3 Entrance Jetties

The USACE Portland District is constructing major repairs to the North Jetty that are projected to be completed by December 2025. These repairs have been incorporated into the without project condition:

- Construct a revetment at log spiral bay
- Rebuild 400 linear feet of the North Jetty root to +16 feet MLLW and re-nourish log spiral bay
- Repair a low reach of the North Jetty root to elevation +20 feet MLLW
- Repair targeted reaches of the North Jetty trunk (seaside and channel side) to design section
- Reconstruct north jetty rubble-mound head approximately 125 ft offshore of its measured 2012 location (STA 84+25)

After the major repairs are completed, it is projected that the USACE will continue to make interim and emergency repairs to the north and south jetty as needed.

3.2 Terminal Facilities

Under future without-project conditions there are no projected changes to the constriction of the navigation channel at the railroad swing bridge (RM 9.0), which limits the size of vessels that can pass through the bridge opening to Panamax size vessels. Major terminals upstream of the railroad swing bridge include:

- Ocean Terminals Dock (RM 11.0)
- K2 Terminal (RM 11.5)

- Tyree Oil (RM 12.4)
- Oregon Chip Terminal (RM 12.5)
- GMA Garnet (USA) Corp. Terminal (RM 14.8)
- Georgia-Pacific (RM 14.9).

Nine smaller and shallower terminal facilities, including a USACE vessel dock (RM 13.2), are located from RM 12.7 to RM 15.1, with two additional small facilities on the main channel of Isthmus Slough.

The bulk terminals upstream of the railroad bridge are projected to continue operations in a manner similar to existing conditions. Whatever terminal improvements may occur in the future, the size of vessels calling at terminals upstream of RM 9 are not expected to increase beyond the size of vessels operating under the existing condition.

The following discussion provides greater detail concerning the projected without-project conditions of terminal facilities downstream of the channel constriction at RM 9.

3.2.1 Bulk Cargo Terminals

Future without-project bulk cargo terminal facilities located from the entrance to RM 8 are projected to include:

- Southport Forest Products Sawmill and Barge Facility (RM 6.3); and
- Roseburg Forest Products Chip Terminal (RM 8).

The Southport Forest Products Sawmill and Barge Facility is planning to expand its dock to accommodate berth depths of as much as -45 feet (Figure 3-1). This could include the dredging of up to about 100,000 cy of material. Improvements are also projected to include heavy lift crane capability and on-dock rail, which would be linked to the Coos Bay Rail Link. These are relatively recent plans and do not rise to the level of certainty necessary to be included in the assessment of future benefits.

The Roseburg Forest Products Chips Terminal is considering dock expansion that would include two berths with the capability of mooring two Post-Panamax size bulk vessels. The dock would be constructed to accommodate berth depths of -45 feet so that the berth could be deepened to match the improved federal channel. Note that the potential dock expansion is not included in the without-project condition nor is it required for the realization of future with-project benefits. The existing dock is capable of berth dredging to -45 feet.

In addition, the D. B. Western facility (RM 5.6) is available to be developed as a marine terminal.

3.3 Commodity and Fleet Projections

Commodity projections and the number of vessel calls for terminals upstream of RM 9.0 and for commodities transported by barge are held constant at historical levels. Log ships are projected to export 225,000 metric tons of logs to China (5,200 nautical miles one way) on 8 vessel calls per year. Barges are projected to transport 250,000 metric tons of chips and lumber on 24 calls per year to British Columbia, CA (400 nautical miles). Projections for logs and barged commodities are the same under without-project and with-project conditions. Operations of these vessels are not relevant to benefits derived from channel improvements except to the extent that they could potentially affect congestion in the channel. However, channel usage at this time is sufficiently light that congestion at Coos Bay is seldom an issue, in contrast to observations reported in the 1994 Feasibility Study, which identified 333 deep draft vessel calls in 1988 (USACE 1994).

The benefit estimates presented in this analysis are based with-project transportation cost savings for 1) wood chips transported on deep draft dry bulk vessels, and 2) containerized cargo handled at the future projected PCIP. The wood chips transportation cost savings analysis is the same analysis that was performed in 2017. Little has changed since 2017 in the wood chip transport industry, as projected in the 2017 analysis. The 2017 analysis used the USACE HarborSym model run by the USACE Deep Draft Navigation Center of Planning Expertise and was reviewed and approved at that time.

Transportation cost savings for containerized cargo are based on a 5-year baseline (2018 – 2022) commodity forecast with projected future growth aggregated from eight USACE feasibility studies as discussed in detail below.

3.3.1 Wood Chip Commodity and Fleet Forecast

The annual wood chip export tonnage from Coos Bay (Table 3-1) has been very consistent with moderate annualized growth exhibited over a ten-year period (4.9%) and higher growth during the last five years (5.5%). Coos Bay wood chip exports are softwood, which is used to make high quality paper. The United States ranks third in the world, behind Brazil and Canada, in production capacity of wood pulp for paper[29]. Japan historically has been the main importer of Coos Bay wood chips. During 2013 - 2017, 164 out of 169 deep draft wood chip vessel trips have been to Japan. During that same period there have also been four trips to China and one to Turkey.

Benefit estimates for wood chips are based on a "no-growth" scenario, in which the amount of commodity transported each year is assumed to be constant for each year of the analysis. The annual tonnage of wood chips transported is based on the five-year (2013 – 2017) average tonnage for wood chip exports by deep draft vessels (1.3 million metric tons). The base-case wood chip export forecast is an annual 1.3 million metric tons exported from Coos Bay to Japan. The average one-way distance from Coos Bay to the wood chip trading partners is 4,325 nautical miles. In the base-case forecast, the annual export tonnage is constant, which represents a no-growth scenario. The no-growth scenario was selected as the base case based on the stability of wood chip exports from Coos Bay.

[29] Observatory of Economic Complexity (OEC) 2024 accessed at https://oec.world/en/profile/hs/wood-in-chips-coniferous?countryComparisonMeasureSelector=Growth+Rate&countryComparisonRankSelector=Top&countryComparisonGeoSelector=na

Table 3-1
Coos Bay Deep Draft Wood Chip Exports

Year	Short Tons	Metric Tons
2008	1,392,000	1,263,000
2009	1,046,000	949,000
2010	1,357,000	1,231,000
2011	1,476,000	1,339,000
2012	1,098,000	996,000
2013	1,244,000	1,129,000
2014	1,419,000	1,287,000
2015	1,400,000	1,270,000
2016	1,533,000	1,391,000
2017	1,609,000	1,460,000
2018	1,546,000	1,402,000
2019	1,316,000	1,194,000
2020	1,282,000	1,163,000
2021	2,028,000	1,840,000
2022	2,017,000	1,829,000

Source: WCSC

The without-project wood chip fleet is based on the recent historical deep draft fleet calling at Coos Bay. The average dead weight tonnage of chips ships calling at Coos Bay has increased from 46,300 tons in 2005 – 2007 to 49,800 tons in 2015 – 2017. The vessel used to represent the without-project chip ship fleet in HarborSym has a dead weight tonnage of 49,600 tons and a maximum operating draft of 38 feet, which is consistent with the maximum chip ship drafts at Coos Bay (see Table 2-21, shown previously).

It is important to note that the size of vessels in the chip ship fleet calling at Coos Bay under existing and without-project conditions is constrained by channel dimensions. The average DWT for the existing world chip ship fleet is 55,200 tons and the largest vessels in the existing world fleet have a DWT of more than 100,000 tons and a maximum draft of 45 feet[30]. These larger vessels would not operate efficiently at Coos Bay under existing and without-project conditions. The fleet currently calling at Coos Bay has optimized vessel size at less than 47,000 DWT (operating draft 37 feet; see Table 2-22) based on existing channel dimensions. Larger vessels can be readily leased and deployed by shipping agents to Coos Bay without any capital investment costs being incurred by Roseburg Forest Products.

HarborSym uses a mix of vessel classes and a variety of vessel loading conditions to simulate vessel operations under without-project and with-project conditions. Because HarborSym runs hundreds of iterations, vessels using the harbor are categorized into representative vessel classes, which reduces the amount of data input and computational requirements of the model. Table 3-2

[30] Lloyds List Intelligence accessed 12Jun24

presents representative vessel characteristics for the without-project condition vessel class used in the HarborSym model. The vessel class is an amalgam of multiple vessels with similar characteristics.

Table 3-2
HarborSym Model Without-Project Chip Fleet

			Design Dimensions (feet)		
Project Condition	**Vessel Class**	**DWT**	**LOA**	**Beam**	**Draft**
Without-project	Wood Chip 1	50,000	660	106	38

Wood chip vessel operations under without-project conditions are projected to be similar to existing vessel operations. Thirty-eight wood chip vessels are projected to arrive empty with drafts ranging from -22 to -29 feet. Vessels will use tug escort from the entrance channel to the berth, as is typical of existing conditions. Standard operations have vessels turned to face outbound, when brought alongside the Roseburg dock. Vessel loading takes from three to four days, although there is variability based on weather, equipment, and the size of load. Vessels are projected to depart, as they do now, with drafts ranging from -29 to -39 feet. Vessel departures from the Roseburg dock, with tug assist, will be 1.5 hours before high water at the entrance bar. Vessels do not sail outbound on the ebb tide.

Table 3-3 presents a summary of without-project condition bulk vessel operations used in the HarborSym modeling. The HarborSym model bulk vessel loading tool was used to develop loads and drafts for individual vessel calls based on input parameters including total annual tonnage, vessel dimensions, and channel dimensions. Note that wood chip loading includes vessel "topping off".

Table 3-3
Without-Project Conditions: Bulk Vessel Operations

Vessel Type	Minimum Tons (mt)	Maximum Tons (mt)	Number of Calls
Barge	5,700	9,700	24
Log Ship	22,200	27,300	8
Wood Chip Ship 1	5,500	36,900	38

Note: HarborSym loading tool results

3.4 Without-Project Containerized Commodity and Fleet Forecasts

Under without-project conditions there would be no PCIP and therefore no container terminal and no containerized cargo handled at Coos Bay. Although there would be no containerships and no containerized cargo at Coos Bay, there will be substantial containerized trade between Far East Asia and U.S. inland states. The without-project containerized commodity and fleet forecasts are presented in the context of a national transportation system that would be improved by implementation of the PCIP.

Without-project containerized commodity and fleet forecasts rely heavily on information provided in USACE navigation channel improvement feasibility studies for harbors located along the USWC and USEC. USACE feasibility studies used in this analysis are:

- 2021 Port of Long Beach Feasibility Study (Los Angeles District, USACE)
- 2022 Tacoma Harbor Feasibility Study (Seattle District, USACE)
- 2018 Seattle Harbor Feasibility Study (Seattle District, USACE)
- 2022 Oakland Harbor Feasibility Study (San Francisco District, USACE)
- 2022 New York & New Jersey Harbor Feasibility Study (New York District, USACE)
- 2018 Norfolk Harbor Feasibility Study (Norfolk District, USACE)
- 2015 Charleston Harbor Feasibility Study (Charleston District, USACE)
- 2012 Savannah Harbor Feasibility Study (Savannah District, USACE)

It is important to note that the feasibility studies and associated appendices are finalized, publicly available USACE reports recommending channel improvements that have been authorized for construction by Congress and in most cases have been constructed or are under construction. The trans-Pacific trade forecasts developed for this analysis are based on 2018 - 2022 reported cargo volumes and fleet operations projected into the future using a compilation of forecasts from the cited USACE feasibility studies.

The containerized commodity forecasts consist of a baseline developed from recent historical data, growth rates calculated from USACE feasibility studies, and projected import, export, and empty TEU estimates for five-year intervals from 2030 – 2050. Under without-project conditions, the commodity forecasts display the potential market that would be available to a fully rail intermodal container terminal at Coos Bay, including cargo origin, destination, mode of transport, and routing. Multiple forecasts are developed to provide a national perspective on the projected amount of trade and the opportunities for transportation efficiencies that would be made available by the rail intermodal container terminal at Coos Bay.

The 25 inland states (states without an ocean coastline – excluding Vermont) are depicted in orange in Figure 3-3. Origins and destinations within the 25 inland states are typically far enough away from coastal ports to make rail intermodal transport more economically efficient than trucking, if rail intermodal transport is available.

It is important to note that inland state containerized cargo that would have the highest likelihood of shifting from USEC ports to Coos Bay is the cargo that would accrue the largest transportation cost reduction. The cargo that would have the highest potential cost savings would have origins and destinations in inland states west of the Mississippi River that are farther from the USEC and closer to Coos Bay than states east of the Mississippi River.[31]

[31] The 15 western inland states are Arizona, Colorado. Idaho, Iowa, Minnesota, Missouri, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, South Dakota, Utah, and Wyoming

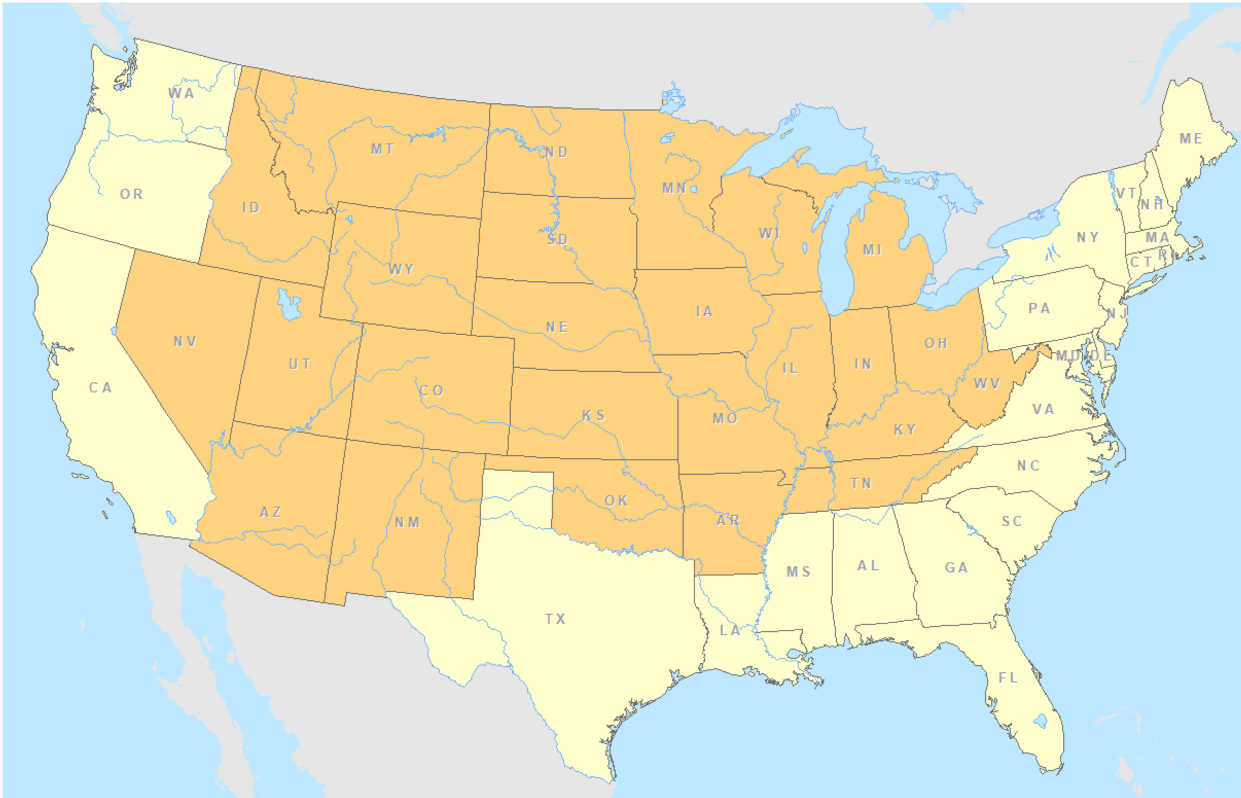


Figure 3-3
25 Inland States

Based on U.S. Census Bureau data, baseline estimates were developed for worldwide and Far East Asia containerized export and import Twenty-foot Equivalent Unit (TEU) totals for the 25 inland states and the 15 western inland states. The commodity forecast baselines are calculated as the 5-year (2018 – 2022) average number of TEUs per year. Table 3-4 presents the resultant commodity forecast baseline estimates for containerized cargo using all modes of landside transport (truck and rail).

Table 3-4
Baseline Estimates for all Inland Transport Modes (TEUs)

Trade Origins & Destinations	Imports	Exports	Total
World – 25 Inland States	11,841,000	5,138,000	16,979,000
Far East Asia – 25 Inland States	4,169,000	3,227,000	7,396,000
Far East Asia – 15 Western Inland States	1,308,000	1,162,000	2,470,000

The rail intermodal baseline (Table 3-5) is developed from 2018 – 2022 waybill data aggregated by Transearch, Inc. The data identifies the origin and destination points of the rail intermodal trip by city and state in the U.S. Cargo on rail movements from an origin within the 25 (or 15) inland states to a port city destination are identified as exports. Cargo on rail movements from a port city origin to a destination within the 25 (or 15) inland states are identified as imports.

Table 3-5
Baseline Estimates for Rail Intermodal Transport (TEUs)

Trade Origins & Destinations	Imports	Exports	Total
World – 25 Inland States	2,807,000	1,889,000	4,697,000
Far East Asia – 25 Inland States	870,000	1,209,000	2,079,000
World – 15 Western Inland States	557,000	424,000	981,000
Far East Asia – 15 Western Inland states	173,000	271,000	444,000

Table 3-6 shows the comparison of baseline estimates for inland state containerized trade using all modes of inland transport (truck and rail) to containerized trade using rail intermodal. The comparisons in Table 3 indicate that containerized cargo making the long haul between USWC and USEC ports and inland states is largely transported by truck. The predominance of long-haul cargo transported by truck causes substantial transportation inefficiencies and is an indication of limited availability of rail intermodal capacity at USWC and USEC ports. The limited availability of rail intermodal capacity is exacerbated in the without-project future condition because projected increases in containerized foreign trade for the inland states will not be met with sufficient planned increases in USWC and USEC rail intermodal capacity.

Table 3-6
5-Year Average Baseline TEUs (2018 – 2022) for All Inland Transport Modes and Rail Intermodal Transport with Calculated Non-Rail Transport

	All Transport Modes	Rail Intermodal (Ship-Rail)	Non-Rail (Ship-Truck)
Worldwide Trade with 25 Inland States	16,979,000	4,697,000	12,282,000
	100%	28%	72%
Far East Asia Trade with 25 Inland States	7,396,400	2,079,000	5,317,000
	100%	28%	72%
Far East Asia Trade with 15 Western Inland States	2,470,000	444,000	2,026,000
	100%	18%	82%

Note: Non-Rail TEUs are calculated as the difference between All Transport Modes and Rail Intermodal

The objective of projecting future growth is to estimate the future number of TEUs for trade between Far East Asia and the 25 inland states and between Far East Asia and the 15 western inland states. Growth rates calculated from the eight USACE feasibility study commodity forecasts were used to project the future TEU estimates. The TEU forecasts developed for this analysis indicate substantial increases in TEUs projected for major USWC and USEC ports (Table 3-7) and for the Far East Asia-Panama Canal-USEC route (Table 3-8).

Table 3-7
USWC and USEC Ports Total TEU Forecasts (thousands of TEUs)

USWC	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Import TEUs	15,382	19,048	23,017	27,023	30,246	33,906
Export TEUs	9,091	11,460	14,031	16,656	18,200	20,302
Total TEUs	24,473	30,508	37,048	43,679	48,446	54,208
USEC	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Import TEUs	16,291	20,990	24,216	27,539	31,916	36,160
Export TEUs	9,086	11,127	12,922	14,795	16,980	19,088
Total TEUs	25,377	32,117	37,138	42,334	48,896	55,248

Table 3-8
Far East Asia-Panama Canal-USEC Total (Loaded and Empty) TEU Forecast (thousands of TEUs)

	2025	**2030**	**2035**	**2040**	**2045**	**2050**
Import TEUs	4,342	5,934	6,854	7,792	9,269	10,729
Export TEUs	2,468	2,978	3,458	3,953	4,504	5,043
Total TEUs	6,810	8,912	10,312	11,745	13,773	15,772

Based on the USACE forecasts (Tables 3-7 & 3-8) and the detailed route specific forecasts[32] presented in the USACE feasibility studies, growth rates and projections for Far East Asia cargo and major USWC and USEC ports were developed and used to project future containerized trade between Far East Asia and the 25 and 15 western inland states (Table 3-9).

[32] Unadjusted projections for the Northeast Asia-USWC route and the adjusted projections for the Far East Asia-Panama Canal-USEC route were summed to create projections for all Far East Asia cargo.

Table 3-9
Far East Asia – Inland States Baseline and (Loaded and Empty) TEU Forecasts
(thousands of TEUs)

Baseline	2025	2030	2035	2040	2045	2050
Far East Asia – 25 Inland States						
7,396	9,533	12,006	14,245	16,549	18,768	21,178
Far East Asia – 15 Western Inland States						
2,470	3,179	3,998	4,744	5,512	6,246	7,045

Note: Baseline values previously presented in Table 3-6

Table 3-6 presented the existing condition of insufficient rail intermodal capacity for existing containerized commodity traffic between the inland states and USWC and USEC ports. In the future, the existing predominance of long-haul trucking over rail intermodal is further exacerbated by projected growth in containerized commodity traffic between the inland states and USWC and USEC ports, as presented in Table 3-9.

Projected increases in rail intermodal capacity (Table 3-10) do not keep pace with projected increases in traffic between the inland states and USWC and USEC ports. As demonstrated by the difference between the TEU Forecast row and the Rail Intermodal Capacity row in Table 3-10, under without-project conditions there is insufficient rail-intermodal capacity to fully accommodate projected Far East Asia trade with the 25 inland states.

Table 3-10
USWC Ports Rail Intermodal Capacity Shortfall
(thousands of TEUs)

Far East Asia Trade – 25 Inland States						
	2025	**2030**	**2035**	**2040**	**2045**	**2050**
TEU Forecast	9,533	12,006	14,245	16,549	18,768	21,178
Rail Intermodal Capacity	5,083	5,856	6,886	7,917	9,152	10,581
Trucking Requirement	4,450	6,150	7,359	8,632	9,616	10,597

The without-project containerized cargo fleet forecast is developed from the eight USACE feasibility studies used to develop the containerized commodity forecast. Note that under without-project conditions there are no containerships calling at the PCIP. Table 3-11 shows the USACE classification of containerships by size used in USACE Feasibility Studies and used throughout this analysis. Note that in USACE Feasibility Studies, the operating TEU capacity of a vessel is less than the nominal TEU capacity. USACE performs a load factor analysis to calculate operating TEU capacity based on historical data for factors such as average laden weight per TEU, container weight, vacant slot allotment, variable ballast, and other factors. Consistent with the practices shown in the USWC and USEC USACE Feasibility Studies cited, all calculations performed in this analysis assume that operational TEU capacity is 85% of nominal TEU capacity, consistent with USACE load factor analyses.

Table 3-11
USACE Containership Classification

Containership Size Class	Class Abbreviation	Maximum TEU Capacity	Average Operating Capacity
Sub-Panamax	SPX	2,800	2,380
Panamax	PX	5,100	4,335
Post-Panamax Generation 1	PPX1	6,700	5,695
Post-Panamax Generation 2	PPX2	8,600	7,310
Post-Panamax Generation 3	PPX3 (Neo-Panamax)	15,000	12,750
Post-Panamax Generation 4	PPX4	22,000	18,700

USACE vessel call forecasts by vessel class and by route group were compiled from each of the eight feasibility studies. The summation of projected vessel calls by vessel class presents a distribution of vessel calls by vessel class for each year. USACE forecasts of containership fleet composition by vessel size are presented in Table 3-12 for vessels from Far East Asia to US east coast ports via the Panama Canal, and in Table 3-13 for vessels from Far East Asia to US west coast ports.

Table 3-12
USACE Projected Vessel Fleet Composition Far East Asia – Panama Canal – USEC (number of vessel calls)

Vessel Class	2030	2035	2040	2045	2050
SPX	27	30	30	30	30
PX	219	237	275	316	261
PPX1	143	144	162	171	94
PPX2	248	257	273	327	396
PPX3	637	731	860	971	1,071
PPX4	60	76	93	103	114
Total	**1,334**	**1,475**	**1,693**	**1,918**	**1,966**

Table 3-13
USACE Projected Vessel Fleet Composition
Far East Asia – USWC

Vessel Class	2030	2035	2040	2045	2050
SPX	37	36	33	32	29
PX	250	192	132	76	17
PPX1	217	181	143	83	21
PPX2	497	475	456	389	322
PPX3	643	694	785	841	896
PPX4	150	265	306	422	536
Total	**1794**	**1843**	**1855**	**1843**	**1821**

4. PROBLEMS, OPPORTUNITIES, GOALS/OBJECTIVES, AND CONSTRAINTS

This section of the Section 204(f)/408 Report:

- Defines the water resource problems (i.e., negative conditions) that were addressed in the study;
- Identifies the opportunities (i.e., desirable future outcomes) that were identified during the study to resolve the problems and improve water resources conditions in the study area;
- Establishes the planning goals and objectives (i.e., desired results) that were used to guide plan formulation; and
- Identifies the constraints (i.e., conditions to avoid, things that cannot be changed) that limited the development and selection of alternative plans.

4.1 Problems

Three major problems have been identified based on the analysis of existing and without-project conditions at the OIPCB. These problems are summarized below and discussed in the following paragraphs. These problems are cited for the navigation channel from the entrance to RM 8.2. The three major problems are:

- Channel width and depth dimensions limit the size of cargo ships that are able to call at the port;
- Channel width and depth dimensions limit the efficient utilization and movement of cargo vessels that call at the port; and
- Channel width and depth dimensions are restricting the port’s ability to accommodate future demands and inhibits the ability to attract new cargo terminals that need larger vessels to operate efficiently and be competitive.

4.1.1 Problem 1: Cargo Ship Size Limitations

The channel is currently too shallow to accommodate efficiently loaded Panamax-size bulk vessels (Table 4-1), which could call today at the Roseburg Forest Products terminal if the channel were deeper. Under existing and without-project conditions these vessels must inefficiently light load to use the channel.

The large majority of containerships projected for the trans-Pacific trade (Far East Asia and US) are PPX1, PPX2, and PPX3 vessels (Tables 3-12 and 3-13). These vessels are typically too large (length, beam, and operating draft) to regularly operate in the existing and without-project condition Federal channel at Coos Bay (Table 4-1).

Table 4-1
Example Dimensions of Bulk Vessels and Containerships

Cargo	Vessel Type	Vessel Name	Average LOA[1] (ft)	Average Beam (ft)	Average Draft (ft)
Logs	Handymax	Port Phillip	590	93	33
Wood chips	Panamax	Ariso	656	106	38
Wood chips	Post Panamax	Nanging Express*	707	121	42
Wood chips	Post Panamax	Dhun*	836	141	45
Containers	PPX1	Colorado Express*	1,004	131	47
Containers	PPX2	CMA CGM Titus*	1,096	140	49
Containers	PPX3	Rome Express*	1,201	158	51

*[1]LOA= Length Overall; * too large for Without-project Condition channel dimensions*

4.1.2 Problem 2: Limited Efficiency

Existing channel dimensions also restrict the operations of the current Panamax-size bulk cargo fleet (chip carriers) and require that some vessels lightload to maintain required safety clearances. This light-loading impacts the vessel's operational efficiency, increasing the unit cost of transporting the commodity. As shown in Section 3.4 trade between Far East Asia and the inland states of the U.S. will experience continued transportation inefficiencies due to the rail intermodal capacity shortfall that necessitates long haul truck transport (Table 3-10).

4.1.3 Problem 3: Restricted Terminal Development

Limitations on vessel size and efficiency affect the competitiveness of existing Coos Bay terminals, which typically handle low-value, high-volume cargo that is highly sensitive to transportation costs. Future terminal development in Coos Bay is restricted by marine transportation inefficiencies due to existing and without-project condition channel dimensions, that reduce the economic competitiveness of the Port. For example, a container terminal at Coos Bay that could only service Sub-Panamax and Panamax containerships would not be competitive because those size vessels are the least efficient and least used vessels in the projected trans-Pacific fleet.

4.2 Opportunities

There are opportunities for the OIPCB to more effectively and efficiently meet the demand for the cargo services it provides now and is projected to provide in the future. Opportunities for improvement include:

- Allow existing and projected future cargo vessels to have less restricted access to berths and terminals, reducing delays and increasing the efficiency of port operations;
- Allow existing and projected future cargo vessels to be loaded more efficiently;
- Allow larger cargo vessels to be used that can deliver more cargo at lower unit costs; and
- Accommodate the development of more efficient berths and terminal utilization.

Widening and deepening the navigation channel would increase the efficiency of cargo vessels currently using the Port, as well as allow the use of larger, more efficient vessels in the future. This increase in efficiency will result in significant transportation cost savings compared to the expected future without-project conditions, especially as navigation traffic increases in the future (Section 3.4 Without-Project Fleet Forecast). The plan formulation section of this study presents a detailed quantitative assessment of the benefits resulting from alternative plans that support the realization of these opportunities.

4.3 Federal Objective

ER 1165-2-211, 4 February 2016, provides the Federal guidance for implementation of projects under the authority of Section 204(f) of WRDA 1986 (as amended). Section 204(f) authorizes the Secretary to be responsible, in accordance with Section 101(b) of the WRDA 1986, as amended, for operation and maintenance (O&M) of improvements carried out by non-Federal interests to a federally authorized harbor or inland harbor project when certain conditions are met. While the improvement must be to a federally authorized harbor or inland harbor project, Congressional authorization of the improvement itself is not required. Section 204(f) requires that before construction of the improvement, 1) the Secretary must determine that the improvement is economically justified, environmentally acceptable, and consistent with the purposes of Title II of WRDA 1986, and 2) the Secretary and the non-Federal interest must execute a written agreement relating to O&M of the improvement. Further, Section 204(f) requires the Secretary to certify that the improvement was constructed in accordance with applicable permits and appropriate engineering and design standards. Additionally, Section 204(f) requires that the Secretary does not find that O&M of the improvements is no longer economically justified and environmentally acceptable.

Environmental Acceptability. Since the non-Federal interest, the OIPCB will be required to obtain all necessary federal, state, and local permits (Section10/404/103) for construction of the improvement, environmental concerns will be addressed through the USACE, federal agency, and Oregon state agency permitting processes. NEPA compliance, which is being implemented concurrently with this 204(f)/408 Report will follow the process set forth in 40 CFR Parts 1500-1508 and the USACE procedures for implementing NEPA found in 33 CFR Part 230. Documentation for Section 204(f) requests do not require the same level of analysis or documentation needed for planning studies and, therefore, Appendix A of 33 CFR Part 230 and other portions of Part 230 specific to planning studies do not apply.

Economic Justification. In order to find the proposed work economically justified, it must be demonstrated that:

(1) Improvement benefits, developed consistent with the economic standards contained in the Water Resources Council's Principles and Guidelines (P&G), exceed improvement costs, including construction and O&M costs. ER 1105-2-100, Appendix E covers benefits evaluation procedures, and

(2) The improvement must be justified entirely by commercial navigation benefits.

Per P&G, the Federal objective in formulating alternative plans is based largely on contributions to National Economic Development (NED). Contributions to NED are increases in the net value of the national output of goods and services expressed in monetary units. Contributions to NED are the direct net economic benefits that accrue in the planning area and in the rest of the nation. NED benefits for deep draft navigation projects are calculated as the transportation cost savings that typically result from improvements to general navigation features, such as channels, dredged material disposal facilities, turning basins, etc. Transportation cost savings are calculated as reductions in the cost of transporting goods from their ultimate origin to their ultimate destination.

Wood chip transportation cost savings would result from more efficient use of the existing cargo fleet and from the use of larger, more efficient cargo vessels in the future. Channel improvements will result in fewer vessel calls moving the forecasted wood chip tonnage. Channel widening and deepening will allow existing bulk vessels to load more efficiently at the port, experience fewer delays, and will allow the use of fewer, larger bulk vessels in the future.

Containerized cargo transportation cost savings would result from:

- more efficient use of existing vessels (reduced ocean voyage distance and reduced operating toll costs), and
- shift in mode benefits (truck transport replaced by rail transport).

In both the without and with-project conditions, the same number of TEUs and the same vessel fleet are projected to transport cargo between the same origins and destinations (Far East Asia and U.S. inland states). The difference between the without and with-project conditions is the availability of Coos Bay as an alternative to USEC ports. Waterborne transportation cost savings are calculated as the difference between the cost of ocean transport to the USEC, by vessel class, under without-project conditions, and the cost of ocean transport to Coos Bay under with-project conditions.

In addition, passage through the Panama Canal is avoided for Far East Asia cargo that uses Coos Bay as an alternative to USEC ports. For this reason, transportation cost savings also includes the reduction in Panama Canal operating costs due to fewer vessels transiting the canal under with-project conditions.

The shift in mode benefits is based on the shift:

- from TEUs being transported by truck between USEC ports and U. S. inland states under without-project conditions, and
- to TEUs being transported by rail between Coos Bay and the U. S. inland states under with-project conditions.

Consistency with Federal Policy. O&M of the OIPCB's proposed improvements must be consistent with other Federal policies, including but not limited to the following:

(1) The Federal participation in navigation is limited to the navigable waters of the United States. Federal O&M is limited to general navigation features. General navigation features and aids to navigation are described in ER 1105-2-100, Appendix E, Section II. These features include such things as channels, jetties, breakwaters, locks and dams, harbor entrance channels and associated protective works, dredged material placement areas, mitigation features including associated lands, primary access channels to the harbor, basins, and anchorages that are needed for the transit of said channels.

(2) While facilities to serve vessels and commerce may be needed to achieve the benefits of a navigation project, O&M of these facilities are a responsibility of the non-Federal interest. This includes facilities include piers, wharves and other waterfront structures and associated local access channels, berthing, mooring, and anchorage areas and related local dredged material placement capacity. Local service facilities are described further in ER 1105-2-100, Appendix E Section II.

(3) The project must be justified entirely by commercial navigation benefits. However, there may be features of the proposed project which are intended for use by other than commercial navigation (such as recreational navigation). O&M of these features will be cost shared in accordance with cost sharing for that feature, e.g., O&M of features for recreation navigation is 100 percent non-Federal.

(4) Navigation improvements to provide navigation access to privately owned facilities or to benefit a single privately owned facility (benefit of only one owner/user) are not eligible for O&M under Section 204(f).

4.3.1 Planning Objectives

In addition to the Federal objective, project-specific planning objectives have been identified, and these objectives guided the plan formulation process in this study. Based on the problems posed by channel dimensions and the opportunities available through channel improvements (as detailed in Sections 4.1 and 4.2), the following planning objectives have been established to assist in the development of management measures and evaluation of alternative plans:

- Objective 1: For the period 2030 to 2079, reduce access restrictions for vessels calling at the OIPCB by reducing dependency on tidal advantage and allowing for use of larger vessels;
- Objective 2: Allow for more efficient vessel loading at the OIPCB from 2030 to 2079;
- Objective 3: Allow for more efficient operations through use of longer, wider, and deeper draft vessels at the OIPCB from 2030 to 2079.

4.4 Constraints

The constraints on the formulation of alternative plans include:

- Channel improvements (including side slope equilibration) must maintain appropriate clearance from the federal jetties at the entrance to the harbor so as to not reduce the integrity of the structure and to not impede future maintenance (see Engineering Report Sections 3.3 and 3.7.2). See Section 3.1.3 for timing of USACE north jetty repairs and the Port's north jetty improvements;
- Channel improvements must not affect previous mitigation projects, including the southern half of the former anchorage area at RM 5.5, which USACE does not maintain as an anchorage area as a component of environmental mitigation for the most recently completed federal navigation channel deepening (1998);
- Channel improvements must not restrict existing waterfront and land uses, including the Charleston Marina, and existing lower bay terminals;
- Channel improvements must not induce adjacent shoreline erosion (see Engineering Report Section 3.7); and
- The project must not impinge upon the functioning of the pile dikes located between RM 6.4 and RM 7.3.

The shoreline and adjacent shoals in the area of Log Spiral Bay serve as protection for the root of the North Jetty. The provision of this important function should not be diminished by the project. Existing lower bay terminals include the Cape Arago Dock, D. B. Western, Southport Forest Products, Roseburg Forest Products, and others. Induced erosion at these facilities should be avoided or minimized. Additionally, although the railroad swing bridge is upstream of the project area (RM9), induced erosion at the railroad swing bridge is to be avoided or minimized.

Although not a planning constraint, it should be noted that significant increases in maintenance requirements at Federal projects should be avoided or minimized.

5. FORMULATION AND ASSESSMENT OF PRELIMINARY ALTERNATIVE PLANS

This section of the report presents the planning process that was used to identify a Tentatively Selected Plan, (referred to hereafter using Section 408 terminology), as the Proposed Alteration (PA). This section describes the development of alternative plans and provides an overview of the preliminary screening of alternative plans, including the development of the preliminary alternative plans (Focused Array of Alternatives).

Based on the problems, opportunities, and constraints identified in the analysis, the development of alternative plans followed the standard planning model, which includes:

- Establishment of plan formulation rationale;
- Identification and screening of potential solutions, including nonstructural measures;
- Identification of the Focused Array of Alternatives;
- Evaluation of the Preliminary Alternative Plans; and
- Evaluation of the Final Alternative Plans and selection of the PA.

Based on the results of the preliminary analysis presented in this section, more detailed analyses were performed on the Final Alternative Plans. The description of these detailed analyses and their results follows this section. Detailed descriptions Final Alternative Plans are presented in Section 6: Detailed Description of the Final Alternative Plans. Detailed evaluations of the Final Alternative Plans are presented in Section 7: Economic Evaluation of the Final Alternative Plans, Section 8: Physical Effects of the Final Alternative Plans, and Section 9: Environmental Effects of the Final Alternative Plans.

USACE project planning follows the six-step process described in the Principles and Guidelines (1983), which is the basis for Federal agency water resources planning, and further elaborated in the Planning Guidance Notebook, ER 1105-2-100 (April 2000). Although presented in series, these steps are applied in an iterative process that puts emphasis on succeeding steps.

5.1 Plan Formulation Rationale

The Planning Guidance Notebook (ER 1105-2-100, dated April 22, 2000) states that "*water and related land resources project plans shall be formulated to alleviate problems and take advantage of opportunities in ways that contribute to study planning objectives and, consequently, to the Federal objective*" (page 2-1). Plan formulation has been conducted for this study with a focus on achieving the Federal objective of water and related land resources project planning, which is to contribute to National Economic Development (NED) consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements.

5.1.1 System of Accounts Framework

Plan formulation also considers all effects, beneficial or adverse, to each of the four evaluation accounts identified in the Principles and Guidelines (1983), which are National Economic Development, Environmental Quality, Regional Economic Development, and Other Social Effects. The four evaluation accounts were established by the Principles and Guidelines to facilitate evaluation and display of effects of alternative plans. To be consistent with USACE planning and environmental operating principles, and to ensure maximum participation in the planning process, this approach was also employed for this study.

Briefly, the effects considered under each of the four accounts include the following:

- The National Economic Development (NED) account displays changes in the economic value of the national output of goods and services;
- The Environmental Quality (EQ) account displays nonmonetary effects on significant natural and cultural resources;
- The Regional Economic Development (RED) account registers changes in the distribution of regional economic activity that result from each alternative plan; and
- The Other Social Effects (OSE) account registers plan effects from perspectives that are relevant to the planning process, such as: urban and community impacts; life, health, and safety factors; displacement; long-term productivity; and energy requirements and energy conservation.

5.2 Plan Formulation and Screening Criteria

Management measures and alternative plans were developed to address the problems of constrained cargo vessel size and limited efficiency at the OIPCB. Management measures were evaluated with respect to their ability to meet the planning objectives. Each alternative plan was formulated in consideration of meeting the planning objectives and in consideration of the following formulation and evaluation criteria: technical, economic, institutional, environmental, and social. They are further defined below based on the four general criteria for plan formulation that are identified in the Principles and Guidelines (1983): completeness, efficiency, effectiveness, and acceptability.

5.2.1 Technical Criteria

- Channel improvement plans must be realistic and reflect state-of-the-art measures and analysis techniques;
- The optimal scale of project development should be identified by analyzing economic, engineering, and environmental feasibility;
- The plan should accommodate vessels projected to call at the port during the planning period, based on observed industry operations and reasonable fleet forecasts;
- The plan should maintain vessel operability under various weather conditions and should withstand projected weather and sea conditions, such as storms, floods, and waves;
- The selected plan should be consistent with local, regional, and state goals for water resources development;
- Required actions and costs to ensure navigation inlet stability should be clearly outlined and explained;
- Required actions and costs to ensure shoreline stability should be clearly outlined and explained;
- The plan should ensure that federal navigation structures are stable and maintainable; and

- The plan should clearly demonstrate potential impacts to the O&M of the navigation channel as well as to other project features.

5.2.2 Economic Criteria

- Each separable unit of improvement should be optimized to ensure that each independent element of the selected plan is economically justified; and
- The principle of progressive development may apply if the last small increment of a channel serves a non-public owner. The last property owner served may be "at the end" in terms of length, depth, or width, necessitating some project investment in their service alone. This is treated as a multiple-owner situation unless a disproportionate incremental investment is required (ER 1105-2-100 Section E-8 Specific Policies).

5.2.3 Institutional Criteria

- Plans must be consistent with existing Federal, state, and local laws;
- Approval for Federal assumption of maintenance must be received from the ASA(CW) before project construction is initiated. Initiation of construction is currently defined by the ASA(CW) as occurring at the solicitation of the first construction contract (US Code 2232 (f)(2)). Therefore, no construction contract solicitation will be made by OIPCB until approval for Federal assumption of maintenance is received from the ASA(CW). In addition, physical construction cannot commence until the approval of the 33 U.S.C. 408 permit, the Section 10/404 (CWA) permit, and the Section 103 MPSRA site selection by USACE with concurrence from USEPA, and a Record of Decision under NEPA.

5.2.4 Environmental Criteria

- Plans should minimize the commitment of natural resources, whether they are marine bottom-lands, wetlands, other coastal zones, inland environments, or under the Endangered Species Act;
- Plans should avoid or minimize environmental impacts and maximize environmental quality in the project area to the extent practicable considering environmental, economic, and engineering criteria;
- Available sources of expertise should be used to identify environmental resources that might be endangered, damaged, or impacted by plan implementation. These would include the United States Fish and Wildlife Service (USFWS), USEPA, NMFS, and appropriate Oregon state agencies, such as the Oregon Department of Environmental Quality, Department of Fish and Wildlife, and Department of State Lands; and
- Measures should be incorporated into plans to protect, preserve, or restore environmental quality in the project area.

5.2.5 Social Criteria

- Plans should be consistent with Environmental Justice initiatives;
- Plans should be capable of being integrated into local or regional planning for water and air pollution abatement, transportation, recreation, and land use;

- As much as possible, plans should minimize noise, dust, odor, unsightliness, and potential health risks;
- Plans should meet existing public health and environmental control standards;
- Plans should not displace, devalue, or destroy important historical and cultural landmarks or sites; and
- Adverse impacts on area recreation resources should be avoided or minimized.

5.3 Management Measures

Management measures are the general categories of actions that are the basis for the development of alternative plans. The management measures used in this study were developed through discussions and interviews with OIPCB operations and management personnel, Coos Bay pilots, longshoremen representatives, and terminal operators. Management measures identified to address the navigation-related problems at the port include:

Operational (i.e., nonstructural) measures;

- Reduce vessel speed in the channel;
- Increase vessel speed in the channel;
- Provide additional aids to navigation;
- Provide additional tug assistance; and
- Use tidal advantage.

Changes to local service facilities not involving the Federal navigation channel;

- Deepen berths at terminals;
- Improve moorings at terminals; and
- Relocate terminals.

Structural modifications to the Federal navigation channel;

- Widen the navigation channel; and
- Deepen the navigation channel.

Note that modification of the Federal jetties is not included as a management measure that would improve transportation efficiency in the Federal navigation channel. Repairs to the Federal jetties are being constructed independently by USACE and are included in the without project condition. Optimization of the design of the jetties to minimize future O&M costs is an analysis that would be in the purview of the Federal government should it wish to analyze it as an option to reduce long term Federal O&M costs. However, reduction of future O&M costs is not part of the Section 204(f) project purpose or an OIPCB responsibility under Section 408, and therefore is not included in this investigation.

The following describes each of the measures considered to meet the project objectives.

Reduce vessel speed in the channel: Reducing vessel speed while transiting the channel will reduce the amount of squat affecting the vessel. Reducing vessel squat would allow the vessel to ride higher in the water, thereby marginally reducing the vessel's draft while transiting the channel. Reducing vessel speed in the channel could potentially allow the existing fleet to load more deeply and allow for larger vessels to operate in the channel.

Increase vessel speed in the channel: During conditions with high winds, increasing vessel speed can reduce the vessel's crab angle as it transits the channel. As a general rule of thumb, a 4° crab angle increases the effective beam of the vessel by 50% and an 8° crab angle increases the effective beam of the vessel by 100%. The crab angle and the effective beam of the vessel can be reduced by increasing vessel speed, thereby allowing marginally longer and wider vessels to navigate the channel. However, this would cause the vessels to squat more deeply in the channel thereby increasing vessel draft.

Provide additional aids to navigation: The channel is currently marked with a combination of buoys and range markers. Additional aids to navigation may provide additional information which might allow vessels to more efficiently navigate the channels turns and bends.

Increase tug assistance: Tugs are used to improve the maneuverability of vessels that have slowed during channel transits, to turn vessels, and to dock vessels.

Use of tidal advantage: Using the high tide for additional underkeel clearance, which allows the vessel to transit the channel with deeper drafts, is a common practice that is projected to continue in the future.

Berth deepening: Increasing berth dimensions could allow larger vessels to use the berth and allow for deeper and more efficient loading of vessels. Berth deepening could potentially increase operational efficiency at the berth. Note that berth deepening would be a local, not a federal, responsibility.

Terminal improvements: Terminal improvements such as increased mooring capability or increased vessel loading capability could potentially allow for larger vessels to use a terminal thereby increasing terminal efficiency. Note that terminal improvements would be a local, not a federal, responsibility.

Terminal relocation: Relocation of terminals closer to the ocean would reduce channel transit times and improve transportation efficiency. Relocation of the proposed PCIP to another harbor may provide greater net NED benefits than the Coos Bay location. Note that terminal relocation would be a local, not a federal, responsibility.

Channel widening: Channel widening would allow wider and longer vessels to use the channel, which could potentially result in larger loads per vessel call and increases in transportation efficiency.

Channel deepening: Channel deepening would allow for the existing fleet to load more deeply and for larger vessels to call at the port. The use of larger and more deeply loaded vessels would potentially improve transportation efficiency.

5.3.1 Screening of Measures

The management measures identified in this section were screened for potential inclusion in preliminary alternative plans based on the screening criteria identified in Section 5.2 and the measures' ability to contribute to one or more of the planning objectives identified in Section 4.3.1, Planning Objectives.

- Objective 1: For the period 2030 to 2079, reduce access restrictions for vessels calling at the OIPCB by reducing dependency on tidal advantage and allowing for use of larger vessels;
- Objective 2: Allow for more efficient vessel loading at the OIPCB from 2030 to 2079;
- Objective 3: Allow for more efficient operations through use of longer, wider, and deeper draft vessels at the OIPCB from 2030 to 2079.

Each measure was considered for its potential as a stand-alone alternative, and also for its potential to be used in combination with other measures. Table 5-1 shows the potential for each management measure to contribute to one or more of the study objectives. Table 5-2 presents the results of the measure screening conducted for this analysis.

Table 5-1
Objectives - Measures Matrix

Measure		Meets Objectives		
		1	2	3
Operational Measures				
1	Reduce vessel speed	No	No	No
2	Increase vessel speed	No	No	No
3	Additional aids to navigation	No	No	No
4	Additional tug assistance	No	No	No
5	Tidal advantage	No	Yes	Yes
Locally Implementable Measures				
6	Berth deepening	No	Yes	Yes
7	Mooring conditions improvements	No	No	No
8	Relocate cargo terminals	No	No	No
Structural Modification Measures				
9	Channel widening	Yes	No	Yes
10	Channel deepening	Yes	Yes	Yes

Table 5-2
Measure Screening

Measure		Carry Forward	Exclude
No Action		√	
Operational Measures			
1	Reduce vessel speed		√
2	Increase vessel speed		√
3	Additional aids to navigation		√
4	Additional tug assistance		√
5	Tidal assistance	√	
Locally Implementable Measures			
6	Berth deepening	√	
7	Mooring conditions improvements		√
8	Relocate cargo terminals		√
Structural Modification Measures			
9	Channel widening	√	
10	Channel deepening	√	

5.3.1.1 Screening of Operational Measures

The use of tidal advantage is the single operational measure carried forward for further analysis. The use of tidal advantage is a standard operating practice at Coos Bay, and this practice is projected to continue in the without-project and the with-project conditions. Note that bulk cargo vessels typically arrive in ballast condition (i.e., without cargo) and are turned prior to docking; therefore, turning bulk cargo vessels in ballast condition is a standard operating practice, which is projected to continue in the without-project condition. Turning in ballast condition is not applicable to containerships, which are projected to unload and load cargo during each vessel call at Coos Bay.

Four operational measures were excluded from further analysis in the preliminary screening process (Table 5-3): reducing vessel speed, increasing vessel speed, additional aids to navigation, and use of additional tugs.

Reducing vessel speed could benefit deeply laden cargo vessels because reducing vessel speed would also reduce the vessel's amount of squat, which in turn would reduce the vessel's effective draft. However, this measure would not be practical, because vessels need to time the channel transit (departure from the dock and vessel transit speed) so that the vessel arrives at the entrance bar at high water. Pilots are currently making the trade-off among vessel speed, maneuverability, effective draft, and arrival time at the entrance bar. Further reducing speeds would reduce vessel maneuverability, which is unacceptable given the turns in the channel. Reducing speeds below current piloting practices would increase transit time through the channel and may cause vessels to arrive at the bar at less than the highest available tide. Therefore, this measure is eliminated from further consideration.

Increasing the speed of a vessel as it transits the channel would reduce the vessel's crab angle and effective beam, thereby maximizing use of the available channel width. However, increasing ship speed within the channel is not feasible due to the numerous turns in the navigation channel from the entrance to the terminals. The pilots already increase speed, when absolutely necessary, in order to transit the channel under high wind conditions. The use of increased speed on a regular basis would increase the risk of operating outside the navigation channel boundaries. Therefore, this measure is eliminated from further consideration.

The Coos Bay Federal Navigation Project is marked with ranges at all turns. These ranges are used as a part of the pilot's standard operating procedures. Additional aids to navigation, absent changes to channel dimensions, would make no improvement to vessel operations in an already marked channel, and are therefore eliminated from further consideration.

Tug assistance for cargo vessels transiting the channel is already part of current port operations. The use of additional tug assist under high wind conditions would conceivably allow the vessel to maintain a safe speed at a reduced crab angle within the confines of the port's existing channel. Historical data indicates that wind speeds of 25 knots blowing perpendicular to the channel occur for approximately 144 hours per year[33] or approximately 1.6-percent of the time. Given that vessels transit with tidal advantage, the occurrence of high-wind conditions coincident with high tide would be even less frequent. As such, it would be economically infeasible to station a fourth tug at Coos Bay because it would be used so infrequently. Therefore, additional tug assistance is not carried forward as a component of alternative plans.

5.3.1.2 Screening of Locally Implementable Measures

Three locally implementable structural measures were evaluated: relocating cargo terminal facilities, improving mooring conditions, and berth deepening. There is no practical relocation of cargo terminals that would reduce channel constraints or their impacts to facilities located from the entrance channel up to RM 8.2 because channel dimension constraints are continuous from the entrance to RM 8.2. In general, the cargo facilities that require the deepest drafts at Coos Bay are already closest to the sea. Currently, the facilities that need the least water depth (i.e., chip terminals that typically use barges and log terminals) are already located farthest from open water, upstream of the railroad bridge (at RM 9) that provides a constraint to large vessel movements (see Section 1.4.6). Terminal improvements included in the without-project condition may induce some log export activities to relocate from existing terminals above RM 9 to improved terminals below RM 8.2. However, this relocation would be included in the without-project condition and therefore would not be available as a locally implementable measure. For these reasons, relocating cargo terminal facilities and improving mooring facilities (other than already planned improvements discussed below) were eliminated from further consideration.

Relocation of the proposed PCIP to another harbor is not feasible because the OIPCB owns the land where the terminal will be located and owns the rail line connecting the terminal to the

[33] See Engineering Report for wind speed and direction analysis

national Class I rail system. The OIPCB, as an Oregon state entity, has no jurisdiction outside the Coos Bay watershed to purchase land or infrastructure[34].

Currently, Southport Forest Products and Roseburg Forest Products are the only two active terminals on the federal navigation channel below RM 9 that might benefit from improved channel conditions. Planned improvements to mooring facilities at the Roseburg and Southport terminal facilities including dock strengthening and lengthening and berth deepening would allow for the use of larger vessels. These planned improvements are not included in the without-project condition because of uncertainty associated with the implementation of these plans. Note that the potential dock expansion at the Roseburg facility is not included in the without-project condition nor is it required for the realization of future with-project benefits. The existing Roseburg dock is capable of berth dredging to -45 feet. Therefore, mooring facilities are not a constraint to using larger, more efficient vessels at Roseburg. For these reasons, improvements to mooring facilities were eliminated from further consideration.

The only locally implementable structural measure that is carried through the screening process and included for further analysis is berth deepening. Note that berth deepening is not a federal responsibility, but the cost of deepening would be considered an associated cost of a proposed project. Increasing water depths at cargo berths would allow vessels to be loaded more deeply and would be required as a locally funded component of any alternative plan that includes channel deepening. Any berth deepening required for the realization of project benefits would be included as a part of total project costs. Although a necessary component of a channel deepening plan, berth deepening alone is not a viable solution to channel depth constraints, since it would not allow deeper or more fully laden vessels to navigate the Federal channel. The existing berth at the Roseburg Forest Products terminal is capable of being dredged to depths commensurate with potential future channel deepening. The wharf at the Southport terminal would likely require improvements if the berth were to be deepened so that vessels could load more deeply than existing conditions.

5.3.1.3 Screening of Structural Modifications to the Federal Channel

Two structural modifications to the Federal channel system—channel deepening and channel widening—were included for more detailed analysis. These measures are technically feasible and institutionally and publicly acceptable and may be implemented in conjunction with other measures. These two measures are the basis of the alternative plans described below and presented in detail in the Engineering Report – Engineering Report, Section 3.3.

The Economic and Environmental Principles for Water and Related Land Resources Implementation Studies (Principles and Guidelines, 1983), paragraph 5, states that "*various alternative plans are to be formulated in a systematic manner to ensure that all reasonable alternatives are evaluated*." In order to systematically assess structural modifications to the federal channel, major channel segments and features are identified according to their navigational function in the harbor.

The federal navigation channel up to the swing-span railroad bridge at RM 9 is divided into 12 reaches identified as ranges. Each range identifies a location along the channel relative to the channel bends and associated navigation ranges. The deep draft cargo berths at Coos Bay that

[34] Oregon Revised Statutes Vol. 19 Title 58 Chap. 777 Ports Generally Section 777.010 https://oregon.public.law/statutes/ors_777.010 accessed 21Jun24

would benefit from channel improvements, including the proposed PCIP, are configured along the Federal navigation channel at RM 5 and RM 8. Channel improvements are not being considered upstream of RM 8.2 because the swing-span railroad bridge at RM 9 is a navigation constraint.

The following discussion describes the channel layout along each range for existing (and without-project) conditions and for three alternative widening plans: 350-foot Channel Alternative[35], 400-foot Channel Alternative, and 450-foot Channel Alternative.

The deepening alternatives may be combined with each of the widening alternatives.

5.4 No Action Alternative

Under the no action alternative, none of the operational measures, locally implementable measures, or the structural modifications to the Federal channel would be conducted. The result of the no action alternative plan would be constrained vessel operations in the OIPCB (as described in Section 3, Without-Project Conditions), and restricted vessel operations would continue throughout the period of analysis. Under the no action alternative, the PCIP would not be constructed and there would be no future containerized cargo movements at Coos Bay. The no action alternative is the without-project condition, which is used as the basis of comparison for all other alternative plans.

5.5 Development of Preliminary Alternative Plans

None of the four measures carried forward (Table 5-2) to more detailed analysis meets all the planning objectives as a stand-alone alternative plan. As described in the previous section, berth deepening by itself does not fully address the navigational constraints and associated problems at the port. Each of the structural measures applied to the Federal channel requires berth deepening to fully address the navigational constraints and problems. Widening the channel, which would allow larger cargo ships to more safely and efficiently use the cargo terminals, would require berth and channel deepening for efficient vessel loading. Similarly, channel deepening requires associated berth deepening, so that the benefits of channel deepening can be realized. Berth deepening would be carried out by terminal operators seeking to realize the benefits of an improved channel. Dredged material resulting from berth deepening would be disposed of in accordance with the DA permit. Berth deepening costs are included in total project costs and future maintenance is a non-federal cost. Use of tidal advantage is projected to continue as a standard practice under each alternative.

Channel widening and channel deepening are separable measures. Channel widening alone would likely reduce cargo vessel delays during periods of high winds and allow longer and wider vessels to use the channel. Channel deepening would benefit cargo vessel operations by allowing vessels to load more deeply and by allowing vessels with deeper operating drafts to use the channel. The formulation of alternative plans therefore develops incremental widening and incremental deepening with berth deepening as separate plans as well as in combination.

Alternative plans for incremental channel widening of the existing 300-foot-wide channel were preliminarily formulated in three increments (Table 5-3): 350-foot, 400-foot, and 450-foot channel

[35] Note that the 350-foot Channel Alternative includes areas that are wider than 350 feet to accommodate bends in the channel. Similarly, the 400-foot and 450-foot Channel Alternatives include areas that are wider than 400 feet and 450 feet respectively (see Channel Widening Alternatives).

widths. The 50-foot increment between channel widening measures was identified by the pilots as the minimum width necessary to affect vessel operations. Note that after more detailed analysis by the Pilots, it was determined that the first 50-foot increment would not be sufficient to substantially affect navigation and therefore the 350-foot widening plan was subsequently dropped from the more detailed alternatives analysis since it would generate no benefits to commercial navigation.

A turning basin at the upper extent of channel improvements (RM 8) is included in all three channel widening alternatives. The turning basin at RM 8 need not be as deep as the channel, because deep draft bulk vessels typically arrive at the Roseburg Terminal in ballast condition and turn prior to loading. A turning basin between RM 4.7 and RM 5.6 is required for containerships using the PCIP. The containership turning basin would need to be the same depth as the navigation channel because containerships may arrive and depart deeply loaded.

Table 5-3
Preliminary Channel Widening Measures (feet)

Range / Location	No Action	300-foot Channel	400-foot Channel	450-foot Channel
Channel Start (approx. RM -1)	1,060	1,060	1,240	1,340
Guano Rock	300	300	450	450
Entrance Range and Turn	740	740	n/c	n/c
Inside Range	300	300	450	500
Turn: Inside Range to Coos Bay Range	450	450	600	650
Coos Bay Range	300	300	400	450
Turn: Coos Bay Range to Empire Range	390	390	540	590
Empire Range	300	300	400	450
Lower Jarvis Range	300	300	400	450
Jarvis Turn	400	400	500	550
Upper Jarvis Range to RM 8	300	300	400	450
Turning Basin RM 4.7 to 5.6	None	1,450 x 1,850	1,450 x 1,850	1,450 x 1,850
Turning Basin RM 7.6 to 8.0	None	1,000 x 1,400	1,000 x 1,400	1,000 x 1,400

Note: n/c indicates no change

Preliminary measures for incremental deepening were formulated in 1-foot increments from the authorized existing channel depth of -37 feet. The common practice of the USACE of first evaluating a 2-foot depth increment and then 1-foot depth increments was followed (e.g., starting from the existing Federal channel depth of -37 feet,[36] the first evaluated increment is -39 feet, then

[36] Note all depths are relative to Mean Lower Low Water (MLLW).

the analysis continues at 1-foot increments thereafter through -45 feet). Deepening was considered only from the ocean entrance to RM 8.2, due to the swing bridge constraint at RM 9.

Widening the channel to less than a nominal 400 feet was not included for further consideration, because, based on the expertise of the Coos Bay Pilots' Association (Pilots), it would not sufficiently improve the conditions in which different vessels could navigate the channel to result in measurable benefits to commercial navigation. The addition of a containership turning basin to the otherwise without-project condition channel was included in the preliminary alternatives.

Widening the channel greater than a nominal 450 feet in width was not included in the preliminary formulation, because containerships from Panamax to PPX3 size operate at other harbors with a channel width of 450 feet and bulk vessels projected to use the OIPCB in the future do not require a channel wider than 450 feet for one-way traffic. A two-way channel was not considered for Coos Bay, because restricted vessel meeting is projected to occur too infrequently to generate measurable benefits for a two-way channel.

5.5.1 Measures Included in the Preliminary Array of Alternatives

The following measures were included in the Preliminary Array of Alternatives and carried forward for more detailed analysis:

- Channel widening to a nominal 400 feet from the entrance (approximately RM-1) to RM 8.2;
- Channel widening to a nominal 450 feet from the entrance (approximately RM-1) to RM 8.2;
- Addition of a containership turning basin between RM 4.7 and RM 5.6;
- Addition of a Capesize Bulker turning basin between RM 7.6 and 8.0; and
- Channel deepening from the entrance (approximately RM-1) to RM 8.2. The without-project depth of the channel is -47 feet at the entrance from the ocean and -37 feet upstream of the entrance. Each depth increment being assessed includes commensurate additional deepening of the entrance channel and a transitional gradient from the entrance channel depth to the inner channel depth. Any necessary berth deepening is also included as an element of the associated facilities for each of the deepening alternatives. Incremental depths of -41, -42, and -45 feet were included in the preliminary array of alternatives.

5.6 Evaluation of Preliminary Alternative Plans and Plan Selection

The preliminary alternative plans are evaluated in terms of navigability, safety, and potential benefits. Navigability and safety were evaluated through ship simulations performed in phases as described in Engineering Sub-Appendix 7 Full Ship Simulation. Potential benefits were evaluated by the USACE DDNPCX using HarborSym modeling (OIPCB 2019).

5.6.1 Preliminary Alternative Plan Navigability and Safety

Ship simulation results were used to evaluate the preliminary alternatives. Ship simulation analysis was performed using a traveling simulator at the OIPCB offices and followed up by real-time vessel simulations performed at the Maritime Institute of Technical and Graduate Studies (MITAGS) in Linthicum, Maryland (Engineering Sub-Appendix 7 Ship Simulation).

Simulations using the traveling simulator and the real-time full bridge simulations confirmed that the 450-foot wide, 45-foot deep channel with a 1,000 x 1,400-foot turning basin between RM 7.6 and 8.0 was sufficient for safe transit of a Capesize bulker to and from the Roseburg facility.

Simulations using the traveling simulator and the real-time full bridge simulations confirmed that the existing federal channel with the single modification of a new 1,450 x 1,850-foot turning basin between RM 4.7 and RM 5.6, is sufficient to allow a Panamax class containership to transit to the proposed container facility.

Simulations using the traveling simulator indicated that a PPX2 size containership would be the largest containership that could transit the 450 x 45-foot channel to and from the container terminal. The design vessel for the container terminal is a PPX3 vessel, which was unable to safely transit the 450 x 45-foot channel to the container terminal in simulations. Without PPX3 vessels in the with-project containership fleet, the container terminal's performance would be substantially impacted, and the terminal would not be constructed.

5.6.2 Preliminary Alternative Plan Benefits

Alternative plan benefits are based on reduced transportation costs for vessels operating at the Roseburg Forest Products terminal. The reduction in transportation costs is due to the more efficient loading of the existing fleet and the transition to larger, more efficient vessels under with-project conditions. None of the preliminary plan alternatives provide sufficient access to the proposed container terminal and therefore there are no containerized cargo benefits resulting from these alternative plans.

5.6.2.1 With-Project Fleet

Under with-project conditions, larger wood chip vessels are projected to be employed to take advantage of the wider and deeper channel. It is a common occurrence for wood chip vessels to leave the port fully loaded and sail at their design draft, using tidal advantage. For wood chip vessels, only the tonnage carried on vessels that are constrained under existing conditions[37] is allocated to deeper and/or larger vessels under with-project conditions. Based on the maneuverability constraints of tug-assisted wood chip vessels in the channel, widening the channel allows for wider and longer wood chip vessels to use the improved channel under with-project conditions. Additionally, deepening the channel allows the wood chip fleet to load more deeply. Table 5-4 presents the dimensions of the vessels used in the without-project and with-project wood chip fleet.

[37] Wood chip vessels requiring tidal advantage to exit the harbor are considered constrained by channel dimensions.

Table 5-4
Preliminary Analysis Coos Bay Deep Draft Wood Chip Fleet
(Representative Vessels)

		Design Dimensions (feet)			
Project Condition	**Vessel Name**	**DWT**	**LOA**	**Beam**	**Draft**
With-project	*Dhun*	107,000	836	141	45
With-project	*Nanging Express*	71,000	706	121	42
With-project	*Nine Frontier*	65,000	690	121	40
With-project	*Yozan*	64,000	690	121	39
Without-project	*Glorious Lotus*	50,000	660	106	38

5.6.2.2 With-Project Wood Chip Vessel Operations and Vessel Fleet Shift

Note that current vessel operations, including extensive use of tidal advantage, are projected to continue under without-project and with-project conditions. Fleet shifts for the wood chip fleet are characterized by the inclusion of a smaller number of vessel calls by successively larger vessels. Wood chip vessels are projected to shift to larger vessels to take advantage of the cost efficiencies offered by the larger with-project channel width and depth dimensions. At the without-project channel width and a with-project depth of 39 feet (2 feet deeper), the largest vessels in the wood chip fleet are projected to switch to *Yozan* size vessels; and projected to shift again to *Nine Frontier* size vessels at a with-project depth of 40 feet (3 foot deepening). There are no other wood chip vessel shifts at the without-project width regardless of channel depth.

Under a nominal 400-foot wide channel (100-foot widening), the largest vessels in the wood chip fleet are projected to switch to the *Yozan* at a channel depth of 39 feet, to the *Nine Frontier* at a channel depth of 40 feet, and to the *Nanging Express* at a channel depth of 41 feet. Under a nominal 150-foot with-project increase in channel width (450-foot channel), the largest vessels in the wood chip fleet are projected to switch to the *Yozan* at a channel depth of 39 feet, to the *Nine Frontier* at a channel depth of 40 feet, and to the *Dhun* at a channel depth of 42 feet.

5.6.2.3 Preliminary Transportation Cost Savings

Preliminary transportation cost savings have been calculated by the USACE Deep Draft Navigation Center of Expertise in Mobile, Alabama using the HarborSym model (OIPCB 2019), USACE only certified model for calculated deep draft navigation benefits. Model inputs were provided by OIPCB. During the initial plan formulation phase, HarborSym was run for four alternative plans, which illustrated the incremental benefits of widening and deepening:

- The without-project condition (300 feet by -37 feet);
- An intermediate plan with only channel deepening (300 feet by -40 feet);
- An intermediate plan with widening and further deepening (400 feet by -42 feet); and

- The largest plan under consideration by the OIPCB (450 feet by -45 feet).

The transportation costs and cost savings (FY 2019 dollars) presented below (Table 5-5) are the results of preliminary HarborSym model runs. The transportation costs and cost savings presented below include only vessels affected by the channel modification project and do not include transportation costs for shallow draft log ships and barges, which are not restricted in the existing channel and therefore would not be affected by the project. Transportation cost savings for wood chip vessels are calculated as a reduction in the number of vessel calls needed to carry the same projected amount of annual tonnage as under without project conditions.

Transportation cost savings for wood chip vessels also include reductions in the delays that are caused by waiting for sufficient tidal advantage for entering or exiting the harbor. The HarborSym results identified in Table 5-7 are denoted as example results because HarborSym runs numerous simulations, which vary based on the probabilistic vessel loading and arrival parameters used in the model.

Table 5-5
Preliminary Alternatives HarborSym Results:
Example Annual Number of Vessel Calls and Transportation Costs

	300 ft x -37 ft*	300 ft x -40 ft	400 ft x -42 ft	450 ft x -45 ft
Wood Chip Vessel Calls	30	27	25	23
Wood Chip Vessel Transportation Costs	$12,377,354	$11,945,492	$11,865,890	$11,679,953

*Denotes the without-project condition.

6. DETAILED DESCRIPTION OF FINAL ALTERNATIVE PLANS

Guidance concerning plan selection for a Section 204(f) project is provided by ER 1165-2-211, which requires that the selected plan be:

- Economically justified (i.e., project benefits exceed project costs);
- Environmentally acceptable; and
- Consistent with federal policy, including the policy that project benefits do not accrue to a single privately owned facility.

Section 204(f) guidance does not require the project proponent to select the NED plan, since this is the standard for Federal investment and 204(f) projects are 100% non-Federally financed. On Federal projects, non-Federal sponsors are (with the approval of the Assistant Secretary of the Army (Civil Works)) permitted to "buy up" to a plan in excess of NED, so long as they agree to provide for 100% of the implementation cost difference between the NED and the Locally Preferred Plan. That same policy logic is applied to Section 204(f) projects, allowing non-Federal entities to select their own preferred alternative plan, so long as it meets the 3 criteria cited above. In addition, WRDA 2020 revised US Code 2232 so that the Secretary may be responsible for all operations and maintenance costs of improvements that deviate from the NED Plan, including costs in excess of the costs of the NED Plan, provided other conditions are met (US Code 2232 (f)(2)). Therefore, the NED Plan is not a decision criterion in this analysis.

This section describes final alternative plans to deepen and widen portions of the main channel of the Coos Bay Federal Navigation Project downstream of RM 8.2. As described below, the Final Alternative plans are the Without-Project Condition, the Proposed Alteration (PA), and an Abbreviated Proposed Alteration (APA). The PA widens and deepens the channel sufficiently to allow PPX3 vessels access to the proposed PCIP and Capesize bulkers access to the Roseburg Forest Product Terminal. The APA widens and deepens the channel sufficiently to allow PPX3 vessels access to the proposed PCIP but does not continue channel improvements any farther than RM 6.

6.1 Elements of the Final Alternative Plans

The differences in the elements of the PA and the APA, as described below, are largely

- channel improvements for the APA do not extend past RM 6;
- the APA does not include a new turning basin at RM 7.3 to 7.8; and
- The APA in situ dredging volume includes 2.72 mcy less dredged material (sand) than the PA.

The PA consists of the following elements:

- ***Dredging the Coos Bay navigation channel*** from the offshore extent of the improved channel at RM -1 to approximately RM 8.2. The PA has a width of 1,180 ft and a depth of -57 ft MLLW at its offshore entrance. The channel width decreases continuously to a width of 600 ft at RM 0.3. The Entrance Channel has a 600-ft width from RM 0.3 through RM 1. Upstream of RM 1, the PA tapers down to a nominal width of 450 ft and a depth of -45 ft MLLW. The PA offshore daylight point is RM -1.0. Proposed channel modifications does not extend upstream of RM 8.2.

- ***The total volume of material*** dredged under the PA is expected to be about 20.28 million cubic yards (mcy) *in situ*, of which 13.93 mcy is sand and 6.34 mcy is rock.
- ***Post Panamax Generation 3 Containership Turning Basin*** *at* RM 5.0. A turning basin at the proposed container facility is needed to accommodate the PPX3 containership. Based on the design vessel, the proposed turning basin is 2,000 feet long (parallel to the channel) and 1,600 feet wide.
- ***Creation of a Cape Size Vessel Turning Basin*** extending from RM 7.3 to RM 7.8. At its full width, the proposed vessel-turning basin is 1,400 ft long and 1,025 ft wide, with a depth of -37 ft MLLW (only inbound empty vessels will use the turning basin). The portion of the PA channel that intersects this turning basin has a depth of -45 ft MLLW.
- ***Dredged material placement.*** Capital dredging material will be placed within disposal sites created for this project. Dredged sediment is expected to primarily include fine- to medium-grained sand with trace amounts of fines. Dredged rock is expected to be siltstone and sandstone (sedimentary rock). As much of the dredged sediment as possible will be placed in a nearshore Beneficial Use Site. The remainder of the capital dredging material will be placed within a new one-time-use ocean dredged material disposal site designated specifically for this project (proposed ODMDS Site L) and approved by the Portland District Commander and U.S. Environmental Protection Agency (USEPA) per Section 103 of the Marine Protection, Research, and Sanctuaries Act. After completion of initial construction, the additional increment of O&M dredging material produced in subsequent years by the PA will be placed in ODMDS F, where annual maintenance material from the existing channel is currently being placed.
- ***Protective measures for the North Jetty*** to alleviate potential impacts from the Entrance Channel widening and deepening. A rock apron at the toe of the North Jetty will be constructed to protect against any potential impacts of side slope equilibration and scour from currents. The rock apron will extend from the relic jetty head through a portion of the jetty trunk.
- ***Relocation of aids to navigation (ATON).*** The revised channel shifts the centerline alignment of every reach from the Entrance Range through the Jarvis Turn, which will require relocating existing range markers. Channel widening will require relocation of the majority of the fixed and floating channel markers, and the addition of new ATON.
- ***Advance Maintenance Dredging (AMD).*** AMD will be increased to 6 ft in the Entrance Channel from RM -1 to RM 0.7, and 1 ft upstream from RM 0.7. An additional rock buffer is proposed in areas where rock is present, including near Guano Rock (50 ft width and 1 ft depth) and RM 2.0 through RM 6.3 (25 ft width and 1 ft depth).

The APA consists of the following elements:

- ***Dredging the Coos Bay navigation channel*** from the offshore extent of the improved channel at RM -1 to approximately RM 6.0. The APA has a width of 1,180 ft and a depth of -57 ft MLLW at its offshore entrance. The channel width decreases continuously to a width of 600 ft at RM 0.3. The Entrance Channel has a 600-ft width from RM 0.3 through RM 1. Upstream of RM 1, the APA tapers down to a nominal width of 450 ft and a depth of -45 ft MLLW. The APA offshore daylight point is RM -1.0. The APA does not extend upstream of RM 6.0.

- ***The total volume of material*** dredged under the APA is expected to be about 17.56 million cubic yards (mcy) *in situ*, of which 11.21 mcy is sand and 6.34 mcy is rock.
- ***Post Panamax Generation 3 Containership Turning Basin*** *at* RM 5.0. A turning basin at the proposed container facility is needed to accommodate the PPX3 containership. Based on the design vessel, the proposed turning basin is 2,000 feet long (parallel to the channel) and 1,600 feet wide.
- ***Dredged material placement.*** Capital dredging material will be placed within disposal sites created for this project. Dredged sediment is expected to primarily include fine- to medium-grained sand with trace amounts of fines. Dredged rock is expected to be siltstone and sandstone (sedimentary rock). As much of the dredged sediment as possible will be placed in a nearshore Beneficial Use Site. The remainder of the capital dredging material will be placed within a new one-time-use ocean dredged material disposal site designated specifically for this project (proposed ODMDS Site L) and approved by the Portland District Commander and U.S. Environmental Protection Agency (USEPA) per Section 103 of the Marine Protection, Research, and Sanctuaries Act. After completion of initial construction, the additional increment of O&M dredging material produced in subsequent years by the PA will be placed in ODMDS F, where annual maintenance material from the existing channel is currently being placed.
- ***Protective measures for the North Jetty*** to alleviate potential impacts from the Entrance Channel widening and deepening. A rock apron at the toe of the North Jetty will be constructed to protect against any potential impacts of side slope equilibration and scour from currents. The rock apron will extend from the relic jetty head through a portion of the jetty trunk.
- ***Relocation of aids to navigation (ATON).*** The revised channel shifts the centerline alignment of every reach from the Entrance Range through the Jarvis Turn, which will require relocating existing range markers. Channel widening will require relocation of the majority of the fixed and floating channel markers, and the addition of new ATON.
- ***Advance Maintenance Dredging (AMD).*** AMD is increased to 6 ft in the Entrance Channel from RM -1 to RM 0.7, and 1 ft upstream from RM 0.7. An additional rock buffer is proposed in areas where rock is present, including near Guano Rock (50 ft width and 1 ft depth) and RM 2.0 through RM 6.3 (25 ft width and 1 ft depth).

The above modifications are shown in Table 6-1 and Table 6-2. There is no dredging proposed beyond the boundaries in these tables with the exception of berth dredging that is a non-federal responsibility and an associated cost of the PA and APA. The project vicinity is represented graphically in Figure 6-1. In this figure, the channel is labeled by RM. Figure 6-1 also shows the location of the adjacent federal infrastructure: the two jetties that run parallel to the channel from RM 0 to RM 1 and the pile dikes located along the north bank of the channel from RM 6.4 to RM 7.5.

The WOP Condition consists of the existing channel plus the completed USACE repairs to the North Jetty.

Table 6-1
Channel Widths for Existing Project, APA, and PA

Range(s) and RM	Existing Authorized Project	APA	PA
Longitudinal Extent			
Offshore Limit including AMD Dredging	RM -0.55[1]	RM -1	RM -1
Offshore Limit of Navigation Channel	RM 0[1]	RM -0.9	RM -0.9
Channel Width (feet)			
Offshore Inlet Offshore Limit of Navigation Channel to RM 0.3	700 narrowing to 550	1,280 narrowing to 600	1,280 narrowing to 600
Entrance Range RM 0.3 to 1.0	550 narrowing to 300	600	600
Entrance Range RM 1.0 to 2.0 and Turn	Varies up to 740	Varies up to 1,140	Varies up to 1,140
Inside Range RM 2.0 to 2.5	300	650 narrowing to 550	650 narrowing to 550
Coos Bay Range RM 2.5 to 4.3	300	450	450
Empire Range RM 4.3 to 5.9	300	450	450
PPX 3 Turning Basin RM 4.7 to 5.6	None	2,000 x 1,600	2,000 x 1,600
Lower Jarvis Range RM 5.9 to 6.8	300	300	450
Jarvis Turn RM 6.8 to 7.3	400	400	500
Upper Jarvis Range RM 7.3 to 8.2	300[2]	300[3]	450
Turning Basin RM 7.3 to 7.8	None[4]	None	1,400×1,025

Notes:

1: The authorized FNC starts at RM 0. However, AMD occurs further offshore, typically from the channel entrance to RM -0.55. The channel width at RM -0.55 is approximately 960 ft.

2: The upstream limit of the main channel is at RM 15. The channel width increases to 400 ft above Upper Jarvis Range.

3: The upstream limit of the channel modification is at RM 8.2.

4: Existing vessels that visit RFP turn in this location, which is presently about 40 ft deep. However, in the Existing Condition and the WOP Condition, there is no formal turning basin below the railroad bridge.

Table 6-2
Channel Depths for Existing Project, APA, and PA

Range(s) and RM	Navigation Depth (ft, MLLW)			Advance Maintenance Dredging[1] (ft)		
	Existing Condition	APA	PA	Existing Condition	APA	PA
Offshore Inlet Offshore Limit of Navigation Channel to RM 0.3	-47	-53	-57	5	6	6
Entrance Range RM 0.3 to 1.0	-47 decreasing to -37[2]	-53 decreasing to -45[3]	-57 decreasing to -45[3]	Varies 5 to 3[4]	Varies 1 or 6[5]	Varies 1 or 6[5]
Entrance Range and Turn RM 1.0 to 2.0	-37	-45	-45	1	1	1
Inside Range RM 2.0 to 2.5	-37	-45	-45	1	1	1
Coos Bay Range RM 2.5 to 4.3	-37	-45	-45	1	1	1
Empire Range RM 4.3 to 5.9	-37	-45	-45	1	1	1
PPX Turning Basin RM 4.4 to 5.6	None	-45	-45	None	1	1
Lower Jarvis Range RM 5.9 to 6.8	-37	-37	-45	1	1	1
Jarvis Turn RM 6.8 to 7.3	-37	-37	-45	1	1	1
Upper Jarvis Range RM 7.3 to 8.2	-37	-37	-45	1	1	1
Capesize Turning Basin RM 7.6 to 8.0	None[6]	None[6]	-45[6]	None	1	1

Notes:

1: Capital dredging consists of the navigation depth plus AMD.

2: For the existing channel, the navigation depth decreases from a depth of 47 to 37 ft MLLW between RM 0.4 and RM 0.7. The channel is dredged further offshore to allow for AMD.

3: For the PA, the navigation depth decreases by 12 ft between RM 0.3 (depth of 57 ft MLLW) and RM 1.0 (depth of 45 ft MLLW).

4: AMD of 5 ft starts at the offshore daylight line, approximately RM -0.6, and continues to RM 0.7.

5: AMD of 6 ft starts at the offshore daylight line. The AMD will be 1 ft in areas where Guano Rock is present (RM 0.7 to RM 1).

6: Under the Existing Condition, there is no formal turning basin; vessels that visit RFP turn in existing deeper water at this location. Under the PA, incoming vessels will enter the channel and turn under ballast load, so it is not necessary to dredge the turning basin beyond -37 ft MLLW, but the channel running through the turning basin will be dredged to -45 ft MLLW.

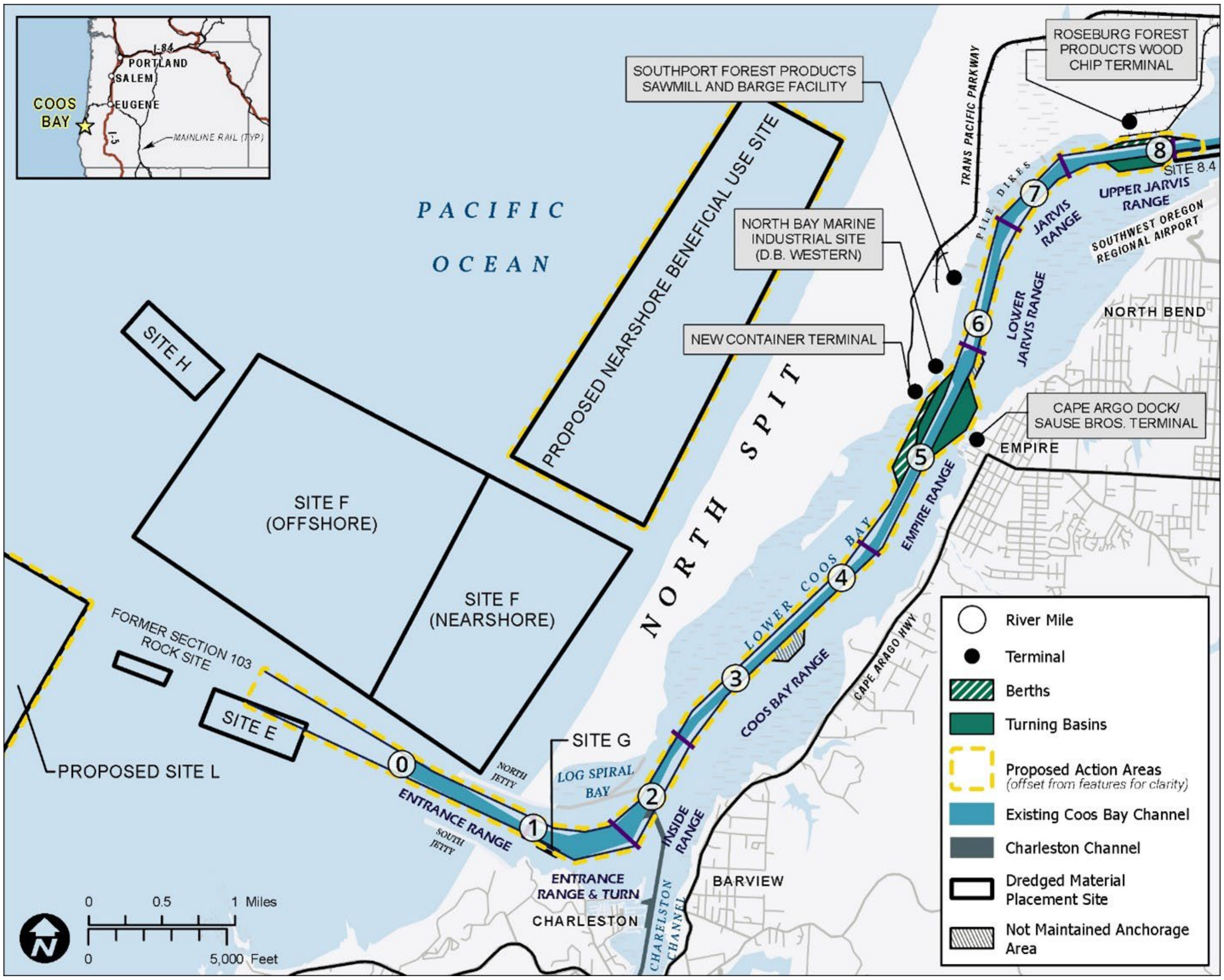


Figure 6-1: Summary of Proposed Alteration (PA)

6.2 Dredged Material Characteristics

Physical and chemical dredged material characteristics are important factors in determining dredging and placement methods and in identifying suitable disposal sites. The material to be dredged for the PA or the APA is predominantly sand and marine sedimentary rock, which do not accumulate contaminants in the marine estuarine environment (OIPCB, 2018).

6.2.1 Physical Characteristics

Dredged material characteristics, both physical and chemical, are an important factor in determining dredging, disposal and placement methods and in identifying suitable disposal and beneficial placement sites for the material.

6.2.1.1 Surface Sediment

The Coos Bay Federal Navigation Channel and Charleston Channel were previously characterized in 1980, 1989, 1994, 1995, 1998, 1999, 2004, 2005, 2007, 2009, 2011, and 2021 (PSET 2019, OIPCB 2017c, Anamar 2021). Sediment grain size within the FNC varies depending on location in the estuary: 1) the entrance channel is sand; 2) in-bay sediments from RM 1 to 12 are mixed sand; 3) sediments in the upper reaches, RM 12 to 15 are predominantly fine-grained; and 4) sediments in Charleston Channel have been sand.

In December 2023 and January 2024, the features of the PA were characterized per the Sediment Evaluation Framework for the Pacific Northwest (NWRSET, 2009). The proposed turning basin and container terminal berth and access channel near RM 5 were sampled and physical and chemical parameters were analyzed to characterize 9 dredged material management units (DMMUs). Grain size analysis of these features indicates that sediments in the area are predominantly coarse-grained, containing less than 5% fines content. Samples from the 4 DMMUs at the Roseberg Berth Pocket and proposed Cape-sized turning basin near RM 7.8 were also analyzed for both physical and chemical parameters. Grain size analysis revealed approximately 95% coarse-grained sediments with less than 5% fine grained sediment. These grain size analyses are summarized in the Sediment Characterization Report (GRI, 2024).

6.2.1.2 Underlying Channel Rock

Geotechnical investigations were performed in support of the 1978 and 1996 channel deepening projects. In addition, other geotechnical investigations concerning rock depth and location were performed in 1989, 1996, 2002, 2007, 2010, 2016, 2017, and 2023. These analyses were used to develop estimated elevations of the rock surface throughout the channel (Figure 6-2). Detailed descriptions of the geophysical and geotechnical investigations performed, and Rock Hardness Designations and Characteristics for the Project are contained in the Engineering Appendix.

Most rock underlying the channel, excluding rock in the vicinity of Guano Rock, can be divided into three distinct sections:

- The first, stretching from approximately RM 0.8 to RM 3.9, is an extremely soft to soft sandstone composed of rock from the Empire Formation. Investigation and testing indicate its unconfined compressive strength ranges from 23 to 1,816 pounds per square inch (psi);
- The second section, a portion of the Bastendorff Formation, extends from RM 3.9 to RM 5.8 and is composed of an extremely soft to very soft siltstone, with unconfined compressive strengths ranging from 180 to 912 psi; and

- The third section of rock begins at RM 5.8 and continues through the end of the planned dredging. This sandstone is part of the Coaledo Formation and has unconfined compressive strengths ranging from 1,150 to 11,361 psi.

Figure 6-2 shows that in the offshore end of the entrance channel, the known rock slope is extrapolated out to the end of the proposed channel, with rock depths well below the PA deepening. In the upstream portion of the Entrance Channel (RM 0.7 to RM 0.9), the top of the rock (Guano Rock in this location) is located within 5 to 10 ft of the authorized depth of the existing channel. Construction dredging side slope equilibration may be somewhat limited in this area. The rock surface is well below channel depth at the Entrance Turn at approximately RM 0.9 before rising up to the existing channel bottom at approximately RM 2. Between RM 5.5 and RM 6.5, while rock is present, it is deeper than the authorized channel depth, and side slope adjustment of the sediment would likely occur.

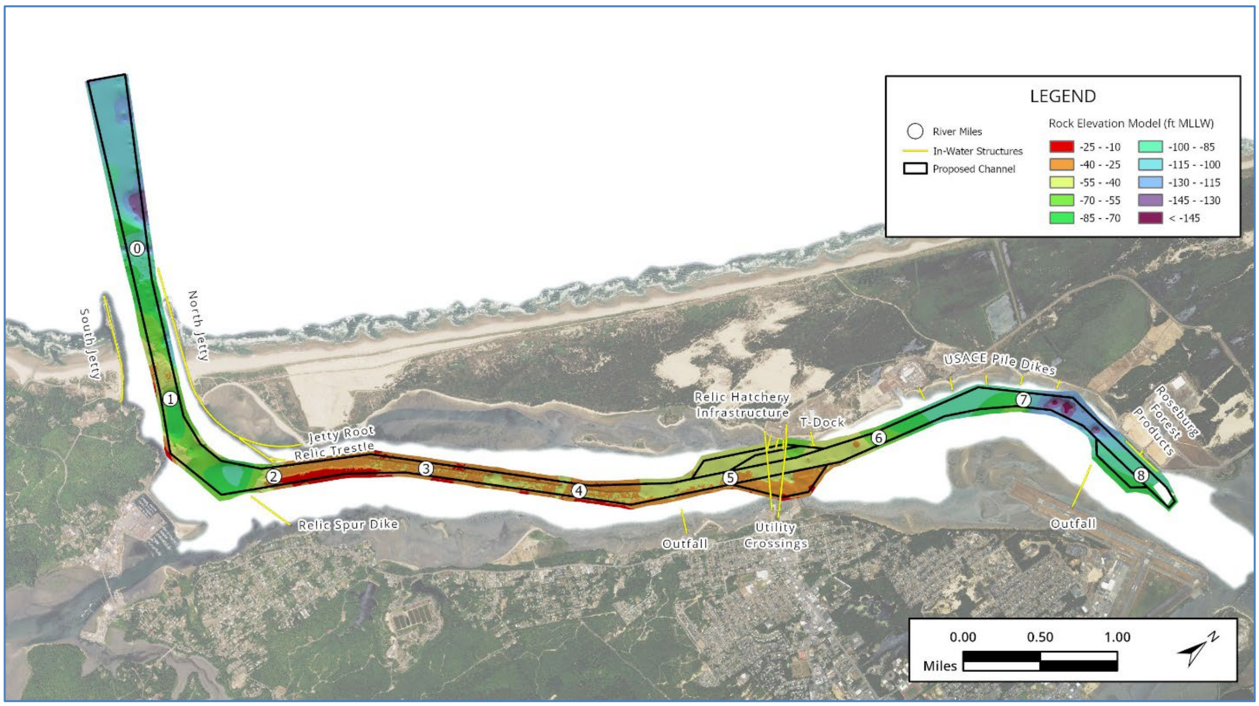


Figure 6-2: Depth to Rock in Coos Bay Navigation Channel

6.2.2 Chemical Characteristics

Sediment sampling is routinely performed by the USACE as part of their maintenance dredging program. The USACE follows national guidelines and adheres to regional Screening Levels (SL) that have been adopted by the Northwest Regional Sediment Evaluation Framework (SEF)[38]

[38] The SEF is a regional framework, first published in 2006 by the Northwest Regional Sediment Evaluation Team (NWRSET) and recently revised in 2018. The SEF is used to evaluate the suitability of dredged material for unconfined, aquatic disposal. The NWRSET agencies include USACE and USEPA (co-leads), USFWS, NMFS, Oregon DEQ, Idaho DEQ, Washington Dept. of Ecology, and Washington DNR. The Portland Sediment Evaluation Team implements the SEF guidance in the Portland District and evaluates both federal navigation projects and

(USACE et al., 2006). Chemical evaluation, along with physical evaluation has been obtained from sampling performed at Coos Bay since the 1980s, most recently in 2024.

In 2021, USACE sampled the federal navigation channel for maintenance dredging (Anamar, 2021). Based on prior characterization of the project sediments, USACE recommended a "Very Low" management area rank for the main channel from the Entrance to Sta. 12+00 (RM 12), and a "low" rank for the Charleston Side Channel. Consistent with historical precedence, test results showed the dredged material to be clean and not polluted with contaminants and would be suitable for unconfined, aquatic disposal.

In 2024, chemical analyses of samples taken from the proposed turning basin and container terminal berth and access channel near RM 5 indicated that concentrations of the analyzed SEF contaminants of concern were below their respective benthic toxicity screening levels (SLs). Samples from the Roseberg Berth Pocket and proposed Cape-sized turning basin near RM 7.8 were also analyzed. Concentrations of the analyzed SEF contaminants of concern were below their respective benthic toxicity SLs in all but one DMMU. One sample (CDP-D1) in DMMU D1, located in the Roseburg Forest Products berth pocket, was found to contain benzyl alcohol at a concentration of 150 mg/kg, which is greater than the Screening Level 1 detection limit of 57 mg/kg and Screening Level 2 threshold of 73 mg/kg. No other analyte was detected above the method detection limit. Additional analyses of samples taken from DMMU D1 are being conducted at the time of writing.

Core grab samples were collected from the side slopes of the federal navigation channel in 2024 (GRI, 2024). Levels of metals were consistent with historical values and did not approach the SEF SLs. All the standard chemicals of concern were either not detected or were below the SEF SLs. These results of the chemical analyses of samples obtained in 2024 are summarized in the Sediment Characterization Report (GRI, 2024).

The results of these studies have found that materials sampled from the federal navigation channel are clean and generally not polluted with contaminants (OIPCB, 2023). The sand and marine sedimentary rock, which will be dredged for the PA or the APA, do not accumulate contaminants in the marine estuarine environment (OIPCB, 2023). The Level 1 Site History prepared in 2023 by the OIPCB (OIPCB, 2023) at the request of the interagency Portland Sediment Evaluation Team (PSET) found no new contaminant sources since the 2014 sampling documented in the USACE 2015 sediment characterization report (USACE, 2015).

At the time of writing, the PSET has not yet published a Suitability Determination Memo, wherein the materials from both the dredge prism (proposed dredged material from the federal navigation channel and proposed turning basins) and the post-dredge surface will be characterized for their suitability for unconfined, aquatic exposure. Should the PSET determine that sediment in DMMU D1 of the Roseburg Forest Products berth pocket be unsuitable for unconfined, aquatic exposure, materials dredged at this location will be disposed of in an upland disposal site already owned and operated by Roseburg Forest Products.

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dredging projects permitted by the Regulatory Program. The PSET is staffed by representatives from USACE, USEPA, NMFS, USFWS, ODEQ, and Washington Dept of Ecology.

6.3 Dredged Material Quantities

Dredging quantities were calculated based on the channel configurations detailed in Section 6.9 of the *Engineering Appendix.* Dredging *in-situ* volumes are based on the required dredge depth and a portion of the Overdepth/Dredge Tolerance, each of which varies along the channel. The required dredge depth consists of the proposed channel dimensions, a rock buffer, and AMD. Two feet of allowable overdepth has been included in the project (1 paid, 1 unpaid). Volume estimates were computed by the project dredge estimating program that incorporates industry experience with dredge tolerance for various equipment types. The dredge estimating program calculated an average of 1 ft (sand)/1.7 ft (rock) of the allowable overdepth will actually be removed during capital dredging.

The estimated dredge volumes over the 3-year Project construction period also includes maintenance dredging during construction along with future equilibrium side slope equilibration volumes.

The construction dredging volume was determined based on 3D modeling using AutoCAD Civil 3D software. The software was used to generate a surface representing the PA channel, including the AMD and rock buffer previously shown in Table 6-2. This surface uses side slopes reflecting the construction condition (1:1 in rock and 3:1 to 5:1 in sand) and is called the "construction surface." The software compared this surface to the surface representing the existing bathymetry and computed the difference in volume. The resulting volume represents the *in-situ* capital dredge volume.

Navigation channel side slopes will continue to evolve after completion of capital dredging, flattening to more stable slope angles, and allowing sedimentation patterns to reach an equilibrium state. Estimating the expected side slopes is critical for the purpose of predicting the total dredge volumes that may result from channel equilibration process and for the purpose of estimating potential effects to federal infrastructure and other resources. This analysis recognizes the inherent uncertainty in predicting the future equilibrium side slope, and therefore predicts a range of side slope outcomes. Three side slope conditions were estimate and applied for various applications as follows:

- For an assessment of existing (without project) conditions, channel side slopes were based on the *Median Measured* side slope.
- For an assessment of future (with project) conditions, channel side slopes were based on an estimated *Future Equilibrium* condition. Capital dredge volumes and costs were predicted based on variety of analyses, and the morphologic processes specific to each reach. In order to predict project impacts to adjacent infrastructure and future increased O&M volumes, a more conservative future equilibrium condition was based on the median measured side slope, assumed to originate at the toe of the dredged channel slope (rather than from the current channel bottom, which in many reaches where sediment deposition occurs is a shoaled condition that is above the toe of the existing channel).
- The *Constructed Condition* refers to the immediate, post-construction condition.

Total estimated dredging includes volumes for construction dredging[39], maintenance during construction, and future equilibrium side slope conditions (Table 6-3). It should be noted that maintenance during construction quantified in Table 6-3 includes only the portion dredged by the OIPCB contractor, not the portion that would be dredged by USACE during Phase 1 of construction in reaches where OIPCB capital dredging has not yet occurred.

Table 6-3 presents the quantities of rock and sand to be removed from the channel (*in-situ* volumes). *In situ* volumes are presented throughout this report. Detailed tables identifying rock and sand construction volumes by river mile segment are presented in Section 6.9 of the Engineering Appendix.

Table 6-3
Dredge Material Construction Volumes (cy)

Material	**In-Situ Volumes**	
	PA	**APA**
Rock	6,340,000	6,340,000
Sand – required dredge prism	10,810,000	8,420,000
Sand - maintenance during construction	1,680,000	1,490,000
Sand - side slope equilibration	1,440,000	1,290,000
Sand Total	13,930,000	11,200,000
Total	**20,280,000**	**17,560,000**

6.4 Dredging Methods

The dredging equipment and methods presented in this section of the report are considered a likely representative dredging method for the Project. However, market forces at the time of contract, equipment and labor resources available to different contractor(s), together with their experience, will affect the selected contractor(s)' final means and methods and ultimately the schedule and contract prices.

It is anticipated that the surface sediments (sand) overlying the rock will be dredged by a hopper dredge and transported to offshore placement. Several methods are anticipated for rock removal. Some rock areas will be dredged, without pre-treatment, by a mechanical dredge placing material in material transport scows. Other rock areas will be dredged by a cutter suction dredge pumping directly to material transport scows via a spider barge. The scows will discharge the material through the split-hull and then return to the dredge site. The hardest rock would likely require a cutter suction dredge for pre-treatment followed by a mechanical dredge to excavate the rock.

[39] Includes non-federal dredging

Based on the assumed dredging methodology and the limited window of time to perform the work, it is anticipated that one large hopper dredge of approximately 7,600 cy capacity will be required to complete the sand dredging work and one 25 cy backhoe dredge, equipped with a 12 cy rock bucket, will be required to complete most of the rock dredging work. Mechanical dredges are typically listed by the largest bucket they can use, which would correspond to the lightest material it can dredge. The backhoe dredge to be used in construction is anticipated to have a 25 cy bucket capacity, but due to the heavy weight of the rock and the need for a more robust (heavier) bucket to dredge the rock, it is anticipated that a bucket with a capacity of 12 cy will be used.

6.4.1 Pre-treatment Methods

Based on the available rock quality designation (RQD) and hardness characteristics of rock within the channel, it is expected that some rock areas will need pre-treatment prior to excavation. There are several methods by which this can be accomplished, and the final means and methods will depend on the equipment available to the winning contractor(s) and the contractor(s)' experience.

Based on extensive analyses (Engineering Appendix Section 4.5 Geotechnical Evaluations), the rock portion of the dredge prism should be removed with mechanical means only; there is no expected need to pre-treat (i.e., fracture) rock using confined underwater blasting.

A cutter suction dredge can be used for both dredging and rock pre-treatment. A cutter section dredge used for rock pre-treatment would be followed by excavation via mechanical dredging. Generally, it is more efficient to use hydraulic dredging with a cutter suction dredge, without pre-treatment, to avoid double-handling material. However, pre-treatment with a cutter suction dredge followed by mechanical excavation may be necessary in siltstone so that overflow from the dump scow does not exceed turbidity limits.

6.4.1.1 Viable Methods for Different Rock Characteristics

The determination of which equipment to use for different rock characteristics is described in this section. Prior to rock dredging, it is anticipated that the contractor will remove sand and loose over burden material to top of rock using a hopper dredge.

Different equipment is anticipated for the various rock characteristics and based on the contractor(s)' available dredging equipment. Rock removal methods have been estimated for five categories of rock, labeled "No Pre-Treat" for areas that are not anticipated to require pre-treatment, and P1-P4, representing different categories of rock that will require some type of pre-treatment (Table 6-4).

For the "No Pre-Treat" category, it is anticipated that for sandstone (RM 3.2 to 3.75), a cutter suction dredge will be used to hydraulically remove the material and directly load scows, while mechanical dredging will be used for siltstone (RM 5- 5.75) due to the potential for turbidity issues with a cutter suction dredge loading pulverized/ground siltstone directly into scows. For the P1 rock, which is entirely siltstone, it is anticipated that a cutter suction dredge will be used to only pre-treat the material, again due the potential for turbidity issues with directly loading scows. After pre-treatment, a mechanical dredge will load rock to dump scows. For the P2 rock, which is entirely sandstone, it is anticipated that the Contractor(s) will use a cutter suction dredge to hydraulically dredge the material and directly load dump scows. For the P2 rock and harder, the portion of the rock that can be dredged depends on the size of the cutterhead; a large cutterhead will be able to dredge all of this material, while a smaller cutterhead may be able to dredge a portion or none of the material.

Within the P2 rock, 50-percent of the borings had a rock hardness under 1,500 psi (Engineering Sub-appendix 5 Geophysical Data Report). The cost estimate and construction schedule assume that all of this material can be dredged or pre-treated with a large cutter suction dredge. There is only one sample within the geotechnical data that represents P4 material. This sample indicates 11,000 psi rock. This P4 material will likely require a cutter suction dredge with a milling cutterhead, after which the broken rock will be dredged by a mechanical dredge.

Table 6-4
Removal Methods for Different Rock Characteristics

Rock Category	Rock Characteristics	Viable Removal Method	Contractors that could Remove Rock	Quantity
No Pre-Treat	0 - 500 PSI 500 - 1,000 PSI & RQD < 50	Mechanical (Bucket/Backhoe) or Cutter Suction Dredge	GLDD, Weeks, Manson, Cashman, Dutra, Donjon, Norfolk	3.3 mcy, 8.1 million sq ft
P1	500 - 1,000 PSI & RQD > 50	Cutter Suction Dredge or Pre-Treatment with Cutter Suction Dredge	GLDD, Weeks, Manson, Callan	1.4 mcy, 4.0 million sq ft
P2	1,000 - 2,000 PSI	Cutter Suction Dredge or Pre-Treatment with Cutter Suction Dredge	GLDD, Weeks, Manson*, Callan	1.6 mcy, 3.5 million sq ft
P3	2,000 - 4,000 PSI	Pre-Treatment with Cutter Suction Dredge	GLDD, Weeks	(None)
P4	> 4,000 PSI	Pre-Treatment with Cutter Suction Dredge – Milling Cutter	GLDD	0.1 mcy, 0.3 million sq ft

* Manson's cutter suction dredge has 1,500 horsepower and can remove the lower end of this range

6.5 North Jetty Rock Apron Construction

A rock apron will be constructed under both the PA or the APA to protect the toe of the North Jetty against potential side slope equilibration and accelerated scour from currents. The rock apron has a total length of approximately 4,850 ft, extending from North Jetty Station 86+50 through Station 48+00 (Engineering Appendix Section 6.10).

Construction of the rock apron will entail placing armor stone at the toe of the jetty. Due to the distance between the crest and toe of the North Jetty (over 200 ft horizontally and 65 ft vertically), it is assumed that placement of the apron rock takes place from a marine-based plant, such as crane barges.

6.6 Aids to Navigation

The PA and the APA will both require temporary relocation of buoys during construction and the permanent relocation of buoys and range markers after construction. Existing ATON within 50 ft of the PA or APA channel will be temporarily relocated during dredging and re-installed in their existing locations after the localized dredging is complete. Range marker relocation will take place on OIPCB property (Appendix D Real Estate). The contractor will remove the buoys and sinker one day prior to dredging and replace it in its original location no more than one day after dredging is complete. Final buoy relocation will occur during year 3 of capital dredging. Permanent ATON relocation will take place during Phase 3 of the Project and will be coordinated with the USCG, the Port, and the Coos Bay Pilots Association. The federally operated ATON may be installed by the Port based on specifications provided by USCG. The installed ATON could then be transferred to the USCG at a mutually agreeable time, likely during Phase 3 of the contract (Engineering Appendix, Sub-Appendix 1: *Aids to Navigation*). All in-water ATON relocation will be conducted with a crane barge and supporting plant.

6.7 Dredged Material Management

A Dredged Material Management Plan (DMMP) (see Appendix B to the Main Report) was developed in accordance with USACE guidance (USACE, 2000a). Dredged material management measures evaluated in the DMMP include dredged material volume reduction measures, operational measures, and placement measures. Alternative plans were developed from measures that were advanced through preliminary screening. The recommended plan provides more than sufficient capacity for the non-federal sponsor and USACE to place construction and maintenance dredging material generated by either the PA or the APA throughout the 20-year planning period, including future equilibrium side slope equilibration volumes (see Appendix B: Dredged Material Management Plan). Adequate dredged material placement capacity has also been identified for future maintenance dredging of the federal navigation project at Coos Bay that is not modified by the Section 204 (f) project (i.e., River Miles 8.2 to 15), and for projected future non-Federal maintenance dredging operations expected to be performed under the OIPCB Unified Dredging Permit.

All material dredged by the OIPCB contractor(s) during construction will be either placed at the proposed North Spit Nearshore Littoral Placement Beneficial Use Site (sand only) or disposed at the proposed ODMDS L (a Section 103 disposal area for rock and the remaining sand that cannot be placed at the beneficial use site). All post-construction maintenance material will be disposed at ODMDS F. The recommended dredged material management plan is the Federal Standard, and environmentally acceptable (Figure 6-3), and consists of:

- Establishment of proposed ODMDS L for disposal of mixed (sand and rock) construction material;
- Beneficial placement of construction material (sand) in the Proposed North Spit Nearshore Littoral Placement Site; and
- Continuance of existing maintenance operations, which include, beneficial placement of maintenance material (sand) in the existing nearshore section of ODMDS F to supplement the littoral system.

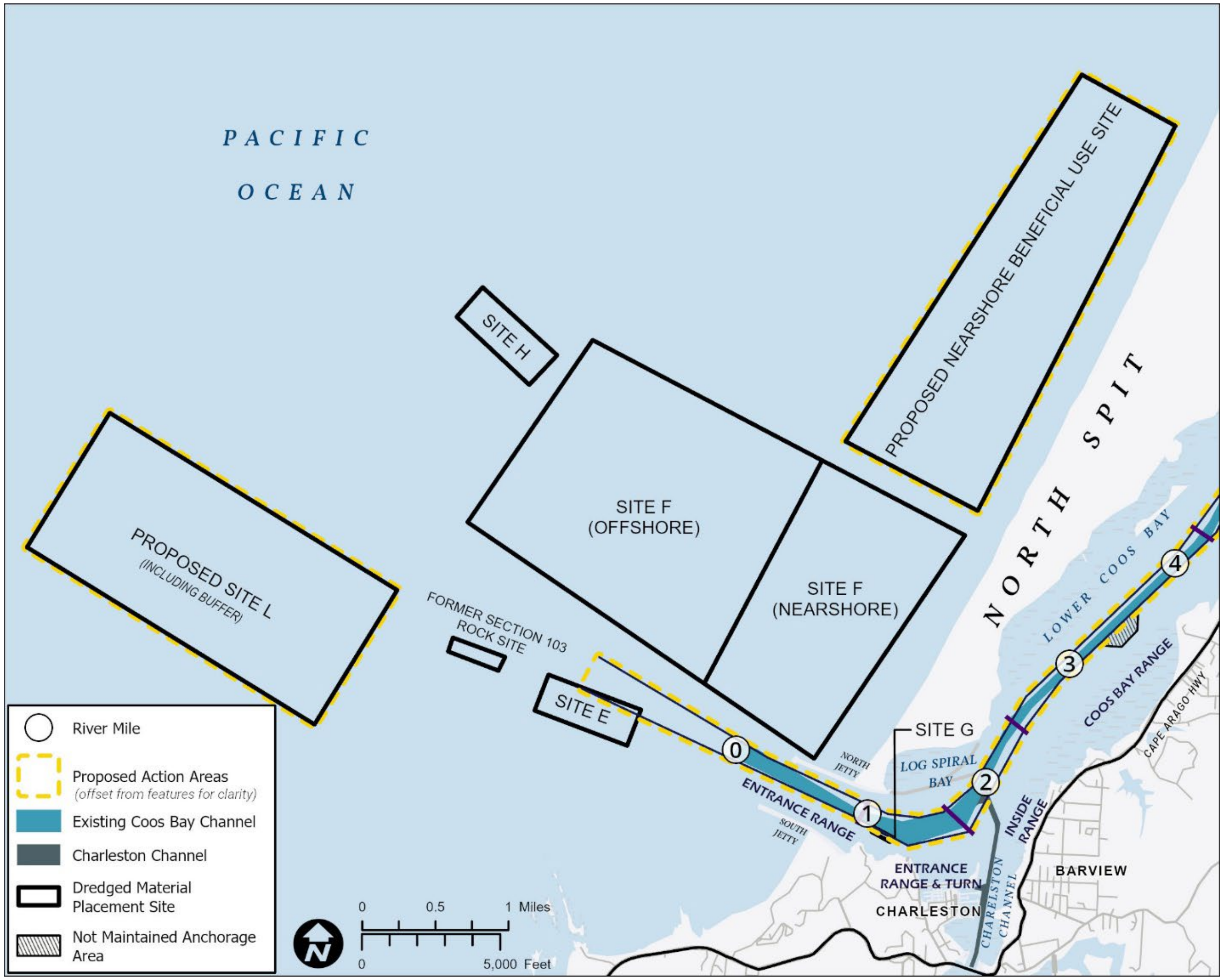

Figure 6-3: Dredged Material Disposal Sites

6.7.1 Beneficial Use of Dredged Material

Littoral nourishment can be performed by the same hopper dredge plant that has been selected as the most effective and efficient type of equipment to be used for construction dredging of sandy sediments. Littoral nourishment will be implemented at the proposed North Spit Nearshore Littoral Placement Site (Figure 6-4), which will be located 500 feet from the northern boundary of the existing ODMDS F Nearshore site. ODMDS F Nearshore has been used by the Portland District for the placement of dredged material into the littoral system with an average placement of 495,000 cy per year from 2006 – 2015 (McMillan, 2018). Depths at the North Spit Nearshore Littoral Placement Site range from -40 to -70 MLLW, which is consistent with USACE analyses concerning the location of the active littoral zone (USACE, 1994). The proposed North Spit Nearshore Littoral Placement Site would be approximately 1,000 acres situated north of the existing ODMDS Nearshore F site and south of the Oregon International Port of Coos Bay ocean outfall (Figure 6-4). The ocean outfall requires a 500-foot buffer to the south and to the north. The 1,000-acre site is estimated to have an annual capacity of 3.3 million cubic yards for each of the three years of construction (Engineering Appendix Section 7 Dredged Material Management)[40].

[40] Annual capacity is based on a total static capacity of 7.3 million cubic yards (assuming an accumulated thickness of 10% of existing depth and side slopes at 65:1) and an annual dispersal of 30%.

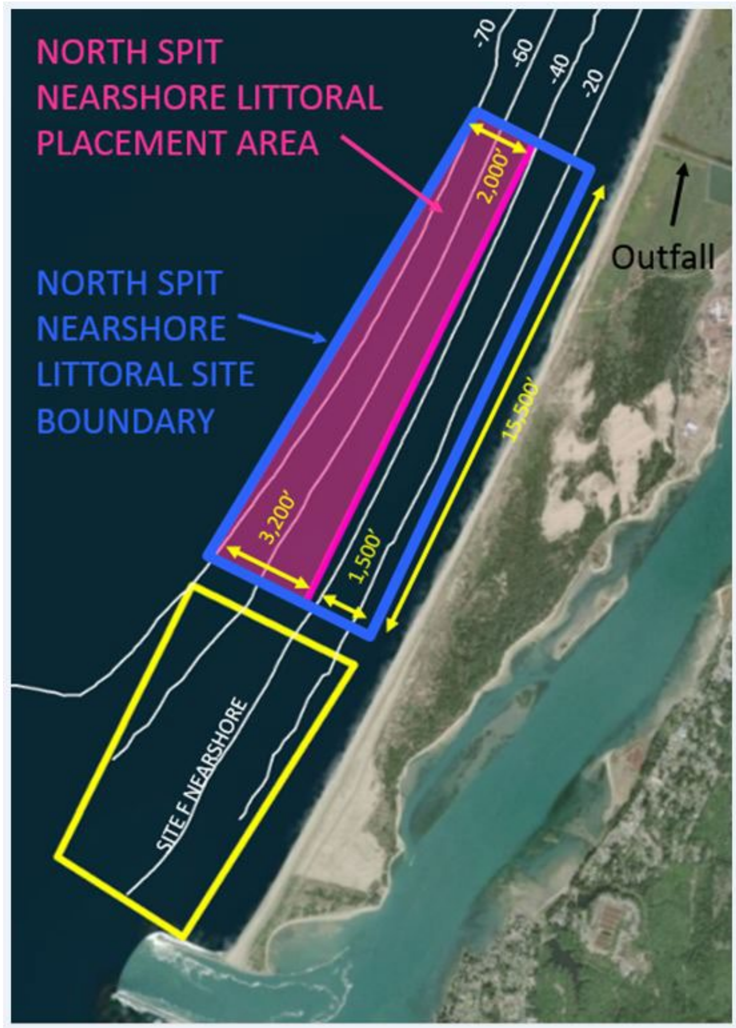

Figure 6-4: North Spit Nearshore Littoral Placement Site Boundary and Placement Area

As shown in Table 6-3, there is an estimated *in-situ* total of 13.9 million cubic yards of sand for the PA and 11.2 million cubic yards of sand for the APA, which are projected to be dredged during the three-year construction time period. This total includes construction material, equilibration material, and maintenance material that will be dredged during construction. Based on the sediment analysis performed for this dredging project and on historical sediment analyses, it is assumed that most, if not all, of this sandy material will be suitable for nearshore littoral placement (Engineering Appendix, Sub-Appendix 5: *Geotechnical Data Report*).

There are three major constraints that affect placement operations at the proposed North Spit Nearshore Littoral Placement Site: environmental restrictions, weather, and the crabbing season. The environmental work window for USACE dredging is June 15th through February 15th, as a protective measure for spawning salmonids[41]. The weather constraint is safety related and is based on the size of waves occurring at the North Spit Nearshore Littoral Placement Site throughout the

[41] The work window for non-USACE dredging is October 15th through February 15th

dredging season. The large hopper dredges (7,600 cy capacity) that are projected to perform dredging and placement at the North Spit Nearshore Littoral Placement Site are restricted to placement operations in waves of less than six feet. This restriction typically precludes placement from November through April, although opportunities may arise during breaks of calmer weather during this time. The six-foot wave height restriction was confirmed with discussions with dredgers and is consistent with USACE Portland District operations at ODMDS F Nearshore site and at the Mouth of the Columbia River.

Commercial fishermen historically utilize the area that will be designated as the North Spit Nearshore Littoral Placement Site during the Dungeness crab season. The season runs from as early as December 1st and through August 15th with far fewer pots in the water during June through August. Coordination with crabbers will be necessary to facilitate placement during the crabbing season. Video analysis of nearshore littoral placement at the Mouth of the Columbia River placement site indicates that crabs are resilient and tolerant of thin layer placement (Norton, et al., 2018).

The environmental restrictions on when sand dredging can occur, weather restrictions at the placement area, and crabbing season constraints are projected to restrict beneficial use placement at the North Spit Nearshore Littoral Placement Site to mid-June through the end of October, with sporadic opportunities during breaks of calm weather between November and mid-February. Therefore, beneficial use placement at the North Spit Nearshore Littoral Placement Site is available for approximately 75% of the total projected hopper dredge operational days during June through October[42].

The amount of beneficial use material that can be placed at the proposed North Spit Nearshore Littoral Placement Site for the PA and the APA is determined by the capacity of the site (3.3 million cubic yards per year of construction), and the operational feasibility of placing material at the site. Operational feasibility is based on the operational constraints described above for environmental restrictions, weather, and the crabbing season.

The amount of beneficial use material that can be placed in the North Spit Nearshore Littoral Placement Site is based on the:

- Total volume of beneficial use material available (bulked volume[43] without contingency): 19.3 million cubic yards for the PA and 14.1 million cubic yards for the APA;
- Construction schedule and operational constraints: beneficial use placement during June 15 through October 31 and waves no greater than 6 feet;
- Large hopper capacity: 7,600cy (bulked);
- Dredge/dump cycle duration: and
- Number of dumps during each construction season;

Table 6-5 presents the maximum annual volume of beneficial use material that could be placed each year to the proposed North Spit Nearshore Littoral Placement Site south of the outfall. In

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[42] This value was calculated by using wave modeling to determine the offshore wave conditions that would produce waves greater than 6 feet at the proposed North Spit Nearshore Littoral Placement Site and analyzing the occurrence of these waves from June through October of 2002-2016. It was found that a 7.5 feet offshore wave would result in a 6 feet nearshore wave; and that offshore wave heights are less than 7.5 feet approximately 75% of the time.

[43] *In situ* volumes are presented throughout this report, however, a bulking factor of 35% was applied to rock and 10% was applied to sand in the determination of equipment types, disposal area size and disposal area capacity. Placement volumes also include side slope equilibrium and overdepth volumes.

each year, the amount of construction material, which can be beneficially used for littoral nourishment, is a portion of the total amount of sand dredged. Note that there is sufficient material under both the PA and the APA to achieve the maximum annual volume of beneficial use material, provided conditions are favorable. Based on this annual volume, 6.6 million cubic yards is the maximum total volume of sand that is available for placement in the North Spit Nearshore Littoral Placement Site during the three years of construction. Note that the maximum amount of beneficial use material that can be placed at the site in any of the construction years (2.6 mcy) is less than the annual capacity of the site (3.3 mcy), i.e., the 1000-acre site is more than adequately sized to accommodate all the material that can be practicably placed there. Note that placement of 6.3 mcy in North Spit Nearshore Littoral Placement Site is conditional based on favorable assumptions concerning environmental restrictions, weather, and crabbing season constraints.

Table 6-5
Maximum Placement at Proposed North Spit Nearshore Littoral Placement Site

Year	Source Location	One-way Distance	Bulked Volume
			PA & APA
1	RM 0.7 to 8.2 (PA) RM 0.7 to 6.0 (APA)	5 - 12 miles	2.0 mcy
2	RM -1 to 1 (PA and APA) RM 6 to 7 (PA)	3 – 12 miles	2.6 mcy
3	RM -1 to 8.2 (PA) RM-1 to 6 (APA)	3 – 12 miles	1.7 mcy
		Total	6.3 mcy

Note: In year 2, RM-1 to 1 is construction dredging and RM 1 to 8.2 is maintenance & equilibration dredging of what was construction dredged in year 1.

Increasing the size of the proposed North Spit Nearshore Littoral Placement Site by adding the area north of the outfall or shifting the site northward is both unnecessary from a capacity requirement standpoint and would not provide any additional benefit. Shifting or increasing the size of the site would reduce the total volume of material placed in any year at the proposed North Spit Nearshore Littoral Placement Site by increasing hauling distance and cycle time. The total amount of material placed would be reduced because the distance travelled and the dredge/dump cycle duration would be greater, thereby reducing the number of beneficial use dumps that could be accomplished during the dredging season. Placing material north of the outfall would also increase the cost of beneficial use placement by approximately 5% per trip (Appendix B DMMP).

Overall, the evaluation for the North Spit Nearshore Littoral Placement Site indicates that the optimal size and location that produces the most environmental benefit (puts the most material into the active littoral zone), at the least cost, and with no adverse environmental effect is the placement site bounded by the existing ODMDS Nearshore F site at the south and bounded by the OIPCB's ocean outfall to the north.

The Proposed North Spit Nearshore Littoral Placement Site can be used at no additional incremental cost and energy expenditure, provides environmental benefits by replenishing material in the nearshore littoral system, can be managed in a way to avoid impacts to navigation and to fisheries, and reduces the volume of material to be disposed at an ODMDS. This site is also the most effective beneficial use site in terms of the volume of material it can accommodate.

6.7.2 Offshore Disposal of Dredged Material

The disposal of 32.7 mcy for the PA and 26.5 mcy for the APA (including bulking factors and contingency) during the three years of construction (Engineering Appendix Table 7-1) exceeds the capacity of the existing sites as described in the Coos Bay Site Management/Monitoring Plan (USEPA, 2006). In addition, none of the existing dredged material placement areas have been designated for disposal of consolidated (mixed sand and rock) material. Also, under current operating practices, USACE reserves ODMDS F for the disposal of maintenance material. These conditions necessitated identifying and establishing new sites for disposal of capital construction volumes as a component of the proposed action.

Section 103 of the MPRSA requires that projects use existing and permitted dredged material disposal sites designated by the USEPA to the maximum extent feasible before requesting that a new site be permitted (40CFR part 227.16; Section 102 of the Marine Protection Research and Sanctuaries Act of 1972). If a USEPA-designated site does not exist or is not available for use, it authorizes the Secretary of the Army, with the concurrence of USEPA, to select a new site and issue a permit for a one-time action or project disposal as a short-term solution. Dredged material disposal must meet the environmental criteria established by the USEPA[44].

Due to the unavailability of the existing ODMDS for disposing of new construction material, a MPSRA Section 103 ODMDS (Proposed Site L) is being evaluated for open ocean disposal of PA or APA construction material that is not suitable for beneficial use placement. The existing ODMDS are evaluated for open ocean disposal of post-construction, maintenance material.

6.7.2.1 Proposed Site L

A new open-water placement site has been designed and will be designated and its use permitted to accommodate all the construction dredge volumes for the PA or APA. The site will be able to accept all materials (sand and rock) including, the side slope equilibration volumes, and maintenance dredging material during construction. The proposed site L is located offshore from the Entrance Channel at a location with the appropriate bathymetry and as close to the federal navigation channel as possible without conflicting with existing dredging and disposal operations, navigation, protected habitats, and other uses. Proximity to the federal navigation channel is an important consideration for dredging operation efficiency and makes site monitoring feasible in typical sea conditions. The proposed location and dimensions of ODMDS L are shown in Figure 6-5. The final location and dimensions of ODMDS L will be decided through the MPRSA Section 103 application and permitting process, which takes place concurrently with the Section 10/404 approval process. If permitted, proposed Site L could be available for up to five years after the start of construction, with a second five-year extension a possibility. A Section 103 DA permit would be limited to three years (33 CR 325.6(c)), so any disposal by the OIPCB in the site beyond

[44] A Zone of Siting Feasibility (ZSF) Report has been developed under Section 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA) that provides the regulatory considerations as well as the need, design, cost and logistic constraints, and environmental considerations, reviewed in evaluating where an offshore dredge material disposal site could be placed. The ZSF Report is contained in Appendix B.

three years would require re-approval. This has been an important consideration in developing a 3-year construction schedule.

ODMDS L would be a site selected specifically for the channel improvement project. Post-construction maintenance material is assumed to be disposed in existing ODMDS consistent with current practice and SMMP requirements.

ODMDS L would be selected as a non-dispersive site, with disposal at a depth that would avoid adversely affecting the existing wave climate, as wave interaction could mobilize sediments. It is assumed that a minimal water depth of -150 feet MLLW would be required for the site, with a maximum height of disposed dredged material no more than 10% of the water depth, for a maximum depth of 15 feet in the shallowest portions of the site. The site would be configured in a rectangular shape typical for an ODMDS, in order to facilitate efficient material placement.

ODMDS L is sized for the entire volume of construction material because of the conditional nature of beneficial use placement at the Proposed North Spit Nearshore Littoral Placement Site due to environmental, weather, and fishing season constraints. Material to be disposed at Site L may include side slope equilibration material, maintenance material dredged during construction, and construction material. A total of up to 32.7 million cubic yards of material is projected to be disposed at Site L for the PA and 26.5 million cubic yards for the PA (bulked volumes including contingency). The site will be conservatively designed to allow for placement of all dredged materials because the volumes projected to be placed at the Proposed North Spit Nearshore Littoral Placement Site may be overestimated due to weather and environmental conditions at the time of dredging.

The size of Site L (Figures 6-5 and 6-6) is based on design parameters including, a water depth of -150 feet MLLW, a maximum disposed material height of 15 feet or 10% of water depth, and placement site side slopes (for both rock and sand) of 65:1[45].

For the PA, a total area of 1,450 acres would be required for disposal of 32.7 million cubic yards of material. Site dimensions for the PA are estimated as 10,500 feet long by 6,000 feet wide. For the APA, up to 26.5 million cubic yards would be disposed in Site L, requiring an estimated area of 1,180 acres.

[45] H:V identifies the slope (horizontal feet to vertical feet)

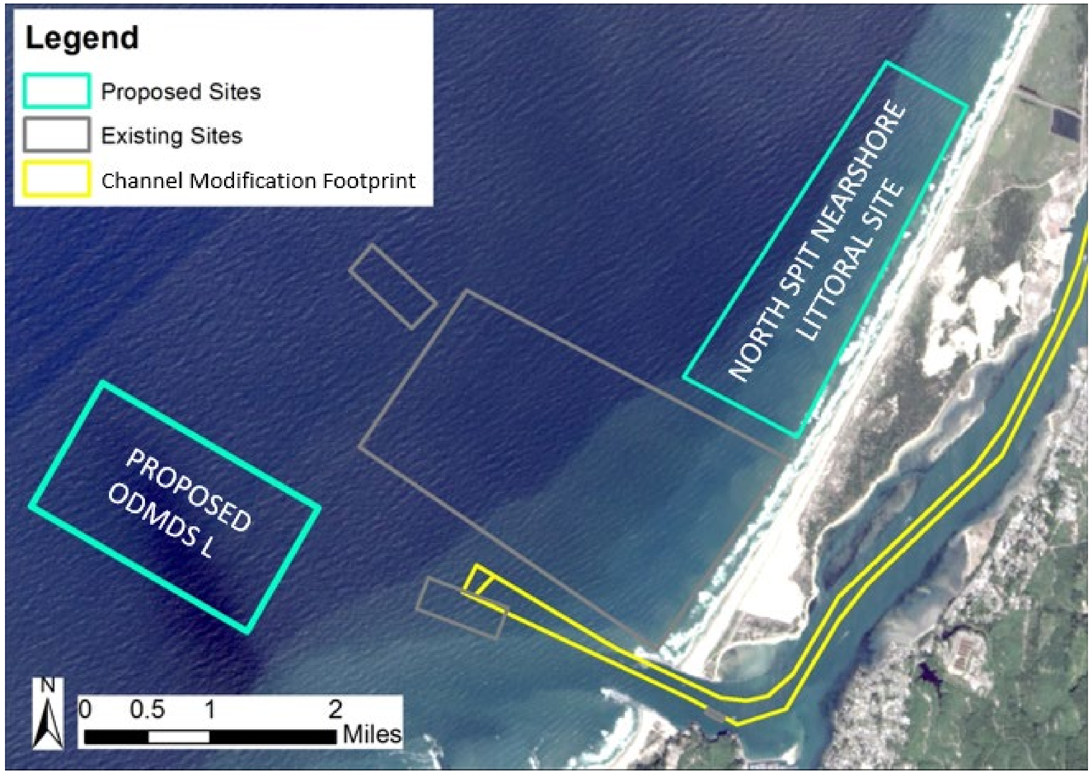

Figure 6-5: Proposed Site L and North Spit Nearshore Littoral Site, PA

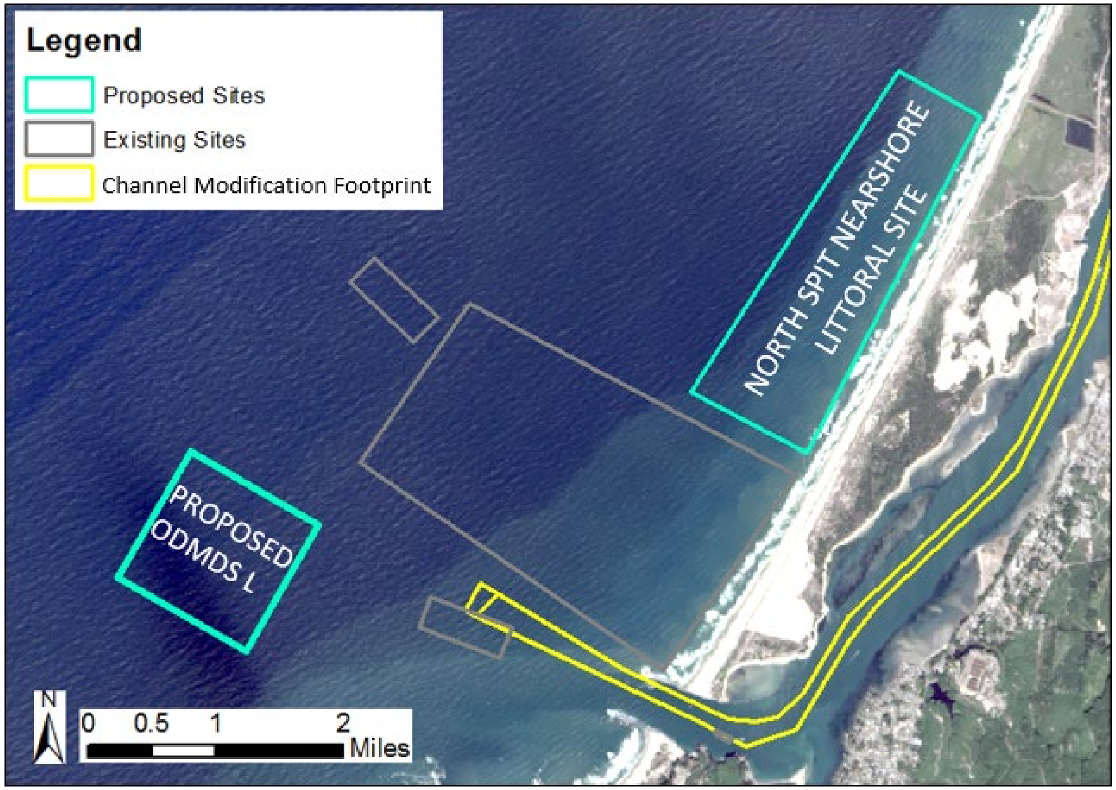

Figure 6-6: Proposed Site L and North Spit Nearshore Littoral Site, APA

6.8 Operations and Maintenance During Construction

Annual maintenance and side slope equilibration volumes are presented in Table 6-6 for the duration of construction (Years 1 – 3) and for post construction years 4 -10, which marks the end of projected side slope equilibration for the last reach to equilibrate. Side slope equilibration is projected to start immediately after dredging commences at each RM segment. Side slope equilibration volumes used to calculate increased maintenance for Years 1 – 10 are based on future equilibrium side slope estimates[46], which provides a high-end volume estimate to ensure that placement volumes are not under-estimated. The detailed side slope equilibration analysis is provided in the Engineering Appendix, Sub-Appendix 9 (*Side Slope Analysis*).

Table 6-6
Maintenance Dredging Volumes: Years 1-10 (cy)

Year	PA			APA		
	Without-Project Condition	O&M - Increase	Side Slope Equilibration	Without-Project Condition	O&M - Increase	Side Slope Equilibration
1	832,000	0	0	832,000	0	0
2	832,000	47,000	647,000	832,000	25,000	311,000
3	832,000	333,000	863,000	832,000	311,000	587,000
4	832,000	334,000	1,997,000	832,000	312,000	1,520,000
5	832,000	334,000	488,000	832,000	312,000	126,000
6	832,000	334,000	326,000	832,000	312,000	78,000
7	832,000	334,000	198,000	832,000	312,000	41,000
8	832,000	334,000	109,000	832,000	312,000	20,000
9	832,000	334,000	55,000	832,000	312,000	8,000
10	832,000	334,000	26,000	832,000	312,000	0
Total	**8,323,000**	**2,718,000**	**4,709,000**	**8,323,000**	**2,520,000**	**2,691,000**

Overall, it is assumed that the OIPCB contractor will perform the O&M dredging in reaches where the contractor's plant is conducting construction dredging and will continue to maintain the PA or APA dimensions in those reaches until the entire 204(f)/408 Project is certified as complete. OIPCB will also dredge side slope equilibration material that has sloughed into the channel during

[46] The volume associated with the constructed condition side slope (Table 6-6) was calculated as the volume difference between the surface that incorporated the existing side slopes and the construction surface, which is based on expected side slopes reflecting the construction condition (1:1 in rock and 3:1 to 5:1 in sand). This volume was used for construction dredging estimates. A conservative side slope angle was estimated throughout the channel. The conservative slope angle refers to the flattest likely side slope within the range of potential equilibrium side slopes and defines the future equilibrium condition. Future equilibrium side slopes were used to calculate annual maintenance volumes for Years 1 - 10.

the construction period. It is assumed that the USACE will be responsible for maintenance dredging in reaches where OIPCB's construction dredging has not yet commenced. The contractor will be required to coordinate with the Port, the USCG, and USACE to avoid conflicts between the contractor's dredging operations, ongoing USACE maintenance dredging, and marine traffic.

Table 6-7 summarizes the source contributions of O&M dredging and the assumptions concerning maintenance dredging responsibilities during construction. The general assumption is that OIPCB will assume maintenance responsibility during construction for all areas of the channel where a construction dredge has dredged or is active. Similarly, OIPCB will be responsible for maintaining the PA or APA depth until the Project has been certified as complete and accepted by the ASA(CW). During construction, USACE shall be responsible for maintaining areas that have not yet been dredged and other non-project areas of the channel (RM 8.2 to 15 (PA), RM 6 to 15 (APA), and Charleston Channel) to the existing authorized navigation depth. After construction is certified as complete, the USACE will be responsible for all future maintenance dredging of the improved federal navigation channel under either the PA or APA.

Table 6-7
Summary of USACE and OIPCB Maintenance Dredging Responsibilities

Year	USACE Responsibility	OIPCB Responsibility	Assumptions
Year 1 (start of construction)	Shoaling in RM -1 to 1 Shoaling in RM 8.2-12 (PA) RM 6 -12 (APA)	Shoaling in RM 1-8.2 (PA) RM 1-6 (APA)	OIPCB contractor widening and deepening RM 1-2 (PA & APA), RM 4-5 (PA & APA) and RM 6-8.2 (PA) and widening RM 3-4 (PA & APA) and RM 5-6 (PA & APA). The contractor will also dredge Guano Rock (PA & APA). Contractor will perform O&M where capital dredging is active.
Year 2	Shoaling in RM 8.2-12 (PA) RM 6 -12 (APA)	Shoaling in RM 1-8.2 (PA) RM 1-6 (APA) Side slope equilibration of RM 1-8.2 (PA) RM 1-6 (APA)	OIPCB contractor widening and deepening RM -1 to 1 and RM 2-3. Contractor will perform O&M through RM 8.2. (PA) or through RM 6 (APA)
Year 3 (final year of construction)	Shoaling in RM 8.2-12 (PA) RM 6 -12 (APA)	Shoaling in RM 1-8.2 (PA) RM 1-6 (APA) Side slope equilibration in RM 1-8.2 (PA) RM 1-6 (APA)	OIPCB contractor deepening RM 3-4 and 5-6 (PA and APA). Contractor will perform O&M to AM dimensions throughout entire channel.
Year 4 (capital dredging complete)	Shoaling in entire FNC	Side slope equilibration	OIPCB contractor has demobilized and left Coos Bay (to be determined). Side slope equilibration decreasing annually through end of equilibration period.

6.9 Construction Schedule

Construction schedules for the PA and the APA have been developed based on equipment types, production rates, and dredging windows. The construction schedules demonstrated viable means of constructing the Project within a 3-year construction period. The actual construction phasing will be determined by the selected contractor based on their plant and equipment. These construction schedules assume that dredging would only occur from June 15-February 15. The construction schedule for both the PA and APA is presented below (Table 6-8).

The schedule is representative of a typical plan in that it uses the most likely equipment and maximizes dredge efficiency. It should be noted that this schedule will not be a requirement of the Contract (i.e., it represents one possible plan, but is not necessarily *the* plan). However, the contract will require completion within a maximum 3-year period.

This schedule assumes that one hopper dredge, one cutterhead suction dredge loading scows, and one mechanical dredge will be working in the channel for the June 15 – February 15 window over the entirety of the 3 years (Table 6-8). The cutter suction dredge performing pre-treatment is anticipated to work within the channel only during the first two years year of the Project. It should be noted that this schedule includes contingency volumes for sand and for mechanical dredging of rock. The phasing plan does not explicitly call out survey work. However, the contractor will perform pre-and post-dredge surveys before for all sand and rock dredging (not shown in schedule) for payment purposes.

Table 6-8
PA and APA Construction Schedules

Equipment Type	Year 1	Year 2	Year 3
Hopper Dredges	Guano Rock RM 1.0 – 7.0 (PA) RM 1.0 – 6.0 (APA)	RM -1 – RM1 (PA and APA)	Maintenance Dredging (PA and APA) RM 7.0 – 8.2 (PA)
Cutterhead Suction Dredge Loading Scows	RM 3.0 – 4.0 (PA and APA)	RM 2.0 – 4.0 (PA and APA)	RM 2.0 – 3.0 (PA and APA)
Cutterhead Suction Dredge Pre-treatment	RM 0.0 – 1.0 RM 4.0 – 6.0 (PA and APA)	RM 0.0 – 1.0 RM 4.0 – 5.0 (PA and APA)	
Mechanical Dredging Pre-treated Rock	RM 0.0 – 1.0 RM 4.0 – 6.0 (PA and APA)	RM 0.0 – 1.0 RM 4.0 – 5.0 (PA and APA)	RM 4.0 – 5.0 (PA and APA)
Mechanical Dredging Un-treated Rock	RM 5 – 5.75 (PA and APA)	RM 5 – 5.75 (PA and APA)	RM 5 – 5.75 (PA and APA)

7. ECONOMIC EVALUATION OF FINAL ALTERNATIVE PLANS

The economic evaluations of the PA and the APA include investigations into alternative plan costs, benefits, and net benefits. The major difference between the PA and the APA is that the APA does not extend channel improvements beyond RM 6 and therefore there are no benefits to the wood chip trade under the APA. Channel improvements from the entrance to RM 6 are identical for the PA and the APA and therefore containerized cargo benefits are also identical.

Note that realizing containerized cargo benefits requires that all aspects of the PCIP be operational. The construction and operations and maintenance costs of the channel improvement, container terminal, and improved rail line are included in the benefit-cost analysis.

7.1 Final Alternative Plan Costs

Channel improvement alternative plan costs include pre-construction costs, construction support costs, construction costs, opportunity costs (interest during construction), and associated costs, which are local facility costs needed to realize project benefits (typically terminal berth dredging). The sum of pre-construction costs, construction support costs, construction costs and contingencies are identified as the Project First Cost. Annualized project costs used to estimate annualized net benefits also include operations and maintenance costs. Detailed information concerning the development of alternative plan costs is presented in the Basis of Estimate Appendix.

Pre-construction costs include:

- Project management and coordination;
- Pre-construction borings;
- Plans and specifications;
- Pre-construction engineering;
- Monitoring and compliance; and
- Construction contracting supervision and administration.

Construction support costs include:

- Project management and coordination;
- Pre and post-dredging multibeam surveys;
- Plans and specifications;
- Engineering during construction;
- Monitoring and compliance; and
- Construction contracting supervision and administration.

Estimated pre-construction and construction support costs are presented in Table 7-1.

Table 7-1
Pre-Construction and Construction Support Costs (FY24$)

Cost Item	PA			APA		
	Channel & Turning Basins	Terminals	Total	Channel & Turning Basin	Terminals	Total
Pre- and Post- Dredge Multibeam Surveys	$500,000	$100,000	$600,000	$476,000	$50,000	$526,000
Project Management and Coordination	$4,000,000	$500,000	$4,500,000	$3,811,000	$250,000	$4,061,000
Plans and Specifications	$500,000	$100,000	$600,000	$476,000	$50,000	$526,000
Engineering During Construction	$1,000,000	$200,000	$1,200,000	$953,000	$100,000	$1,053,000
Monitoring and Environmental Compliance	$5,000,000	$1,000,000	$6,000,000	$4,763,000	$500,000	$5,263,000
Construction Contracting, Supervision and Administration	$5,000,000	$500,000	$5,500,000	$4,763,000	$250,000	$5,013,000
Total	$16,000,000	$2,400,000	$18,400,000	$15,242,000	$1,200,000	$16,442,000

Construction costs (Table 7-2) include:

- Mobilization and Demobilization;
- Sand Dredging with placement at ODMDS L and the North Spit Littoral Nourishment Site[47];
- Rock Dredging with placement at ODMDS L;
- North Jetty rock apron construction;
- Pre and Post-dredging hydrographic surveys; and
- Aids to navigation relocation, demolition, and construction.

[47] Note that there were no appreciable differences in cost per cubic yard between disposal at ODMDS L and placement at the North Spit Littoral Nourishment Site.

Table 7-2
Total Project Construction Costs (FY$)

Cost Item	PA	APA
Mob and Demob	$73,387,000	$62,746,000
Sand Dredging	$83,300,000	$71,221,000
Rock Dredging	$329,657,000	$329,657,000
North Jetty Rock Apron	$11,644,000	$11,644,000
Hydrographic Surveys	$1,183,000	$1,011,000
Aids to Navigation	$7,644,000	$6,536,000
Compensatory Mitigation	TBD	TBD
Construction sub-total (rounded)	$506,820,000	$482,820,000
Contingency (10%)	$50,682,000	$48,282,000
Construction Total	$557,502,000	$531,102,000
Pre-Construction & Support	$16,000,000	$15,242,000
Project First Cost	$573,502,000	$546,344,000

Associated costs are the costs of local service facilities needed to realize the benefits of the project. Berth dredging at the PCIP and Roseburg Forest Products to with-project depth, is an associated cost of the project. Berth dredging costs for the PA are $81,345,000 and $80,345,000 for the APA.

Interest during construction represents the opportunity cost of money spent on Project First Costs and associated costs, which have not yet produced economic benefits. Interest during construction is calculated monthly for the elements that comprise the project using the FY24 Federal discount rate of 2.75%. Interest during construction for the PA is $183,763,000. Interest during construction for the APA is $182,497,000.

Average annual equivalent costs (AAEQ) are used to develop benefit/cost ratios and to calculate average annual net benefits. AAEQ costs are based on the sum of project first costs, associated costs, and interest during construction. AAEQ costs are calculated using the FY24 Federal interest rate (2.75%) over the 50-year planning period (Table 7-3).

Table 7-3 presents project costs that will be used in the benefit-cost analysis. An additional contingency of 25% of the sub-total of costs including design, permitting, construction, and interest during construction was included to account for uncertainty.

Table 7-3
PA and APA Costs

Cost Item	PA	APA
Design & Permitting Year-1	$70,722,000	$70,722,000
Design & Permitting Year-2	$30,000,000	$30,000,000
Rail Segment 1	$274,796,000	$274,796,000
Rail Segment 2	$1,019,922,000	$1,019,922,000
Container Terminal	$1,254,025,000	$1,254,025,000
Eugene Railyard	$104,489,000	$104,489,000
Navigation Channel	$573,502,000	$546,344,000
Sub-Total	**$3,327,455,000**	**$3,300,297,000**
Interest During Construction	$183,763,000	$182,497,000
Sub-Total	**$3,511,218,000**	**$3,482,794,000**
Contingency (25%)	$877,804,000	$870,699,000
Total Costs	**$4,389,022,000**	**$4,353,493,000**

Note: IDC calculated at the FY24 federal discount rate of 2.75%

Total O&M costs include the incremental increase in federal O&M dredging costs of the navigation channel, container terminal operations and maintenance, including berth dredging, and increased operations and maintenance costs of the Coos Bay Rail Line. The incremental increase in federal O&M dredging for the PA is $3,101,000 and for the APA is $2,691,000[48]. Annualized total O&M costs calculated at the FY24 federal discount rate (2.75%) are $114,893,000 for the PA and $114,483,000 for the APA.

7.2 Final Alternative Plan Benefits: Containerized Cargo

Containerized cargo benefits are common to the PA and APA. These benefits are based on the PCIP increasing U. S. west coast (USWC) rail intermodal container handling capacity by two million twenty-foot equivalent units (TEUs) annually. This substantial increase in USWC rail intermodal capacity will allow some projected container trade between land-locked inland states and Far East Asia to use Coos Bay as an alternative to sailing through the Panama Canal to U. S. east coast (USEC) ports and trucking containers between the USEC ports and inland state

[48] The incremental increase in federal O&M costs are calculated using FY24 costs of $7.40 per cy in the Entrance and $19.50 per cy in the inner channels.

destinations. The cargo origins and destinations are unchanged by using the container terminal at Coos Bay, but transportation cost savings result from the reduction in ocean voyage costs and from the reduction in landside transportation costs due to the shift from truck to rail transport.

Figure 7-1 graphically depicts the generalized concept of project benefits. Under without-project conditions some cargo traded between Far East Asia (represented by Busan) and U. S. inland states uses the ports of Los Angeles and Long Beach and some cargo uses USEC ports represented by the Port of Savannah. Under with-project conditions some cargo uses Coos Bay as an alternative to the USEC and some cargo continues to use the ports of Los Angeles and Long Beach. For the cargo that would use Coos Bay as an alternative to the USEC, the ocean voyage is reduced by about 11 days and payment of Panama Canal fees are avoided.

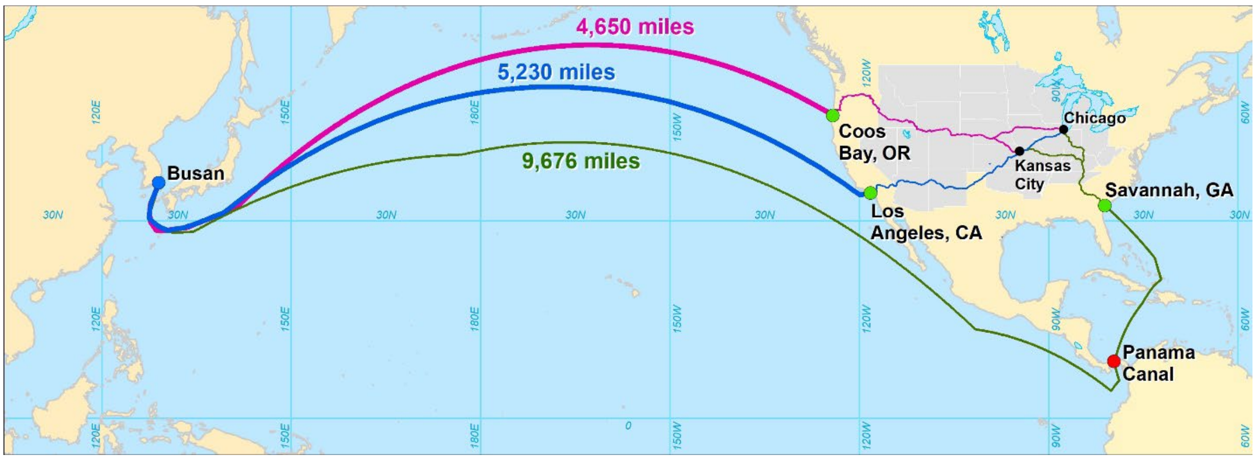

Figure 7-1
Alternative Routes

The USACE Planning Guidance Notebook (ER 1105-2-100) and the interim planning guidance ER 1105-2-103 confirm that the economic benefit of a navigation project is the reduction in the value of resources required to transport commodities. Both guidance documents identify categories of benefits that occur when the commodities have the same origin and destination under without and with-project conditions:

- More efficient use of existing vessels (reduced ocean voyage distance and reduced operating toll costs), and
- Shift in mode benefits (truck transport replaced by rail transport).

In both the without and with-project conditions, the same number of TEUs and the same vessel fleet are projected to transport cargo between the same origins and destinations (Far East Asia and U.S. inland states). The difference between the without and with-project conditions is the availability of Coos Bay as an alternative to USEC ports. Vessel operating cost savings are based on the hours of ocean transport to the USEC by vessel class under without-project conditions and the hours of ocean transport to Coos Bay under with-project conditions. These vessel operating cost savings are calculated as a component of project benefits.

In addition, passage through the Panama Canal is avoided for Far East Asia cargo that uses Coos Bay as an alternative to USEC ports. For this reason, transportation cost savings also includes the reduction in Panama Canal operating costs due to fewer vessels transiting the canal under with-project conditions.

The shift in mode benefits is based on the shift:

- from TEUs being transported by truck between USEC ports and U. S. inland states under without-project conditions, and
- to TEUs being transported by rail between Coos Bay and the U. S. inland states under with-project conditions.

Project benefit calculations rely heavily on information provided in eight USACE navigation channel improvement feasibility studies for harbors located along the USWC and USEC identified in Section 3.4 Without-project Containerized Commodity and Fleet Forecasts.

Under with-project conditions there will be a fully intermodal (ship-rail) container terminal at Coos Bay. The terminal will be designed for a capacity of 2 million TEUs per year. Ship simulation modeling by the Coos Bay Pilots indicates that containerships will only access and depart the container terminal at slack tide. The tides of Coos Bay are mixed semi-diurnal, meaning that Coos Bay experiences two daily highs and two daily lows of unequal duration and amplitude.

Typical navigation operations at Coos Bay would have containerships transiting the channel with favorable tides that occur twice per day. Given that weather constraints, such as high winds, rough seas, and fog periodically occur at Coos Bay, a reasonable, yet conservative estimate would be 330 transit-days per year for containerships. This estimate is conservative because most containerships calling at Coos Bay are projected not to require full channel depth (see Section 7.2.1 Coos Bay Containership Fleet) and therefore channel availability would be greater than it would be if more containerships required full channel depth. The channel is a one-way channel. For this analysis, the number of containership calls (after a ramp up period) is estimated at 330 per year. This estimate is developed only for the purpose of this economic evaluation and is not meant to be an indication of channel capacity at Coos Bay. Actual vessel operations at the container terminal may far exceed the conservative estimate used in this analysis.

Depending on vessel class and operating draft at Coos Bay, some vessels may be restricted to operating with tidal advantage to maintain appropriate under keel clearance (10% of the vessel's static draft). Tides are substantial at Coos Bay with Mean High Water seven feet above Mean Lower Low Water.

This information is exempt from public records per ORS 192.345(2) (trade secrets) and ORS 192.355(17) (economic development). If the Port determines that a record request is exempt from public disclosure, the requestor may seek review of the Port's determination pursuant to ORS 192.411, 192.415, 192.418, 192.422, 192.427, and 192.431.

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7.2.3 Containerized Cargo Transportation Cost Savings

In this analysis, transportation cost savings are calculated only for loaded TEUs. There are three components to transportation costs: vessel waterborne operating costs, Panama Canal fees (operations and maintenance component only), and landside transportation costs.

7.2.3.1 Waterborne Operating Costs

Vessel waterborne operating costs are based on 2013 USACE published vessel operating costs informally updated (reduced) to 2017 using anecdotal information. Vessel operating costs are calculated on a cost per TEU per 1,000 miles basis using the standard import and export TEU cargo weights for Far East Asia cargo (5.7 metric tons for imports and 9.7 metric tons for exports). Under this calculation method, costs per TEU decrease as more TEUs are loaded on the vessel. The cost per TEU on any vessel will be higher if the vessel is loaded to a draft of 35 feet than the cost per TEU when the vessel is loaded to a draft of 45 feet. Also for example, the cost per TEU on a PPX3 will be less than the cost per TEU on a PPX2, when both vessels are loaded to the same draft, because the PPX3 holds more TEUs than the PPX2 at the same draft.

Route distances are based on Busan as a representative Far East Asia port. Norfolk is used as a mid-range USEC port. The ocean voyage distances[50] are:

- Busan to Coos Bay: 4,650 nautical miles, and
- Busan to Norfolk via the Panama Canal: 9,894 nautical miles.

Vessel speed at sea is assumed constant at 19 knots. Vessel operating costs are calculated for the same fleet, vessel draft, and load distributions for the Busan to Norfolk route and for the Busan to Coos Bay route. Under without-project conditions, Far East Asia – inland states cargo identified in Table 7-5 uses USEC ports (represented by Norfolk in waterborne transportation cost calculations). Under with-project conditions, the cargo identified in Table 7-7 uses the Port of Coos Bay at a substantial reduction in waterborne vessel operating costs (Table 7-8).

Table 7-8
Waterborne Vessel Operating Costs

	Loaded TEUs	Norfolk	Coos Bay	Cost Savings
2030	**491,469**	$251,887,000	$118,382,000	$133,505,000
2035	**1,012,818**	$511,972,000	$240,618,000	$271,354,000
2040	**1,134,765**	$569,138,000	$267,485,000	$301,653,000
2045	**1,152,050**	$572,936,000	$269,270,000	$303,666,000
2050	**1,185,804**	$582,946,000	$273,974,000	$308,972,000

Note: Values highlighted in bold referenced in Table 7-7

7.2.4 Panama Canal Operating Costs

Vessels transiting through the Panama Canal pay canal tolls based on a schedule of fees published by the Panama Canal Authority, which took effect in January of 2023. For containerships, fixed fees start at $60,000 per transit, rising to $300,000 for vessels of over 10,000 TEUs in size. A capacity fee ranging from $30-$40 per TEU is added to that, followed by a loaded container and empty container fee. Annual Panama Canal toll costs were calculated based on the proportion of vessels projected for each vessel type (PX, PPX1, PPX2, and PPX3) in the Coos Bay fleet forecast (Table 7-3). The 2022 Panama Canal Annual Report indicates that operating expenses are 33% of toll revenues[51], therefore 33% of vessel fees are equated with the vessel's Panama Canal transit operating cost. Table 7-9 presents operating costs avoided under with-project conditions for each 5-year interval from 2030 – 2050.

[50] Sea-distances.org
[51] Annual Panama Canal operating expenses include salaries, wages, employee benefits, materials and supplies, fuel, and contracted services for a total of $1,009,035. Annual Panama Canal toll revenues are reported as 3,027,943. All values in thousands of balboas (Panama Canal Annual Report 2022).

Table 7-9
Panama Canal Operating Costs Avoided

2030	$25,321,000
2035	$52,659,000
2040	$59,329,000
2045	$60,593,000
2050	$62,885,000

7.2.5 Landside Transportation Costs

Landside transportation costs are largely developed from overland distances the cargo is required to travel and mode-specific transportation cost parameters. The opportunity for rail intermodal between USEC ports and inland state locations is limited by the rail intermodal capacity at USEC ports. In 2022 there were less than 1.5 million rail intermodal TEUs transported between USEC ports and the inland 25 states (Transearch 2023). Planned improvements to USEC intermodal capacity (the largest being a nearly 2 million TEU proposed future increase in intermodal capacity at the Navy Intermodal Terminal at the Port of Charleston) will be insufficient to meet the rail intermodal demand associated with the forecasted USEC port TEU increases presented in Table 3-7: Updated USWC and USEC Ports Total TEU Forecasts. Even with improvements to the USEC rail intermodal capacity over the period of analysis, the vast majority of the TEUs delivered to USEC would continue to be delivered to the inland states via truck.

7.2.5.1 Overland Distances

Landside transportation costs are based on distances from Coos Bay and USEC ports to major cities in the 15 western inland states. Distances from the USEC were calculated as the average distance from the ports of New York and New Jersey (Newark, NJ), Norfolk VA, and Savannah GA. Weighted average distances were calculated based on the distribution of 2022 rail intermodal TEUs to each of the western state inland cities. The weighted averages for Coos Bay and for USEC ports were calculated based on

- the proportion of 2022 rail intermodal TEUs between each city and the USEC ports (Transearch 2023);
- the distances from Coos Bay to each city; and
- the USEC three-port average distance to each city.

All distances, including rail distances, were calculated as road distances based on routing by Google Maps (2023). The weighted average distance for Coos Bay is 1,789 miles and the weighted average distance for USEC ports is 1,401 miles[52].

[52] Weighted average distance calculations are presented in Economics Appendix Table A-17.

Cargo transit between the USEC ports and the major cities of the 15 western inland states is projected to be by truck with an average truckload of two TEUs. This analysis assumes that each truck movement is a loaded movement, so there are no empty truck hauls in the transportation cost calculations. At an average speed of 55 miles per hour, each truck trip takes 26 hours. Cargo transit between Coos Bay and the major cities of the 15 western inland states is projected to be by train with an average trainload of 560 TEUs (140 rail cars). At an average speed of 20.6 miles per hour[53], each train trip takes 87 hours. Table 7-10 presents the number of truckloads and trainloads for 2030 – 2050.

Table 7-10
Truckloads (USEC Ports) and Trainloads (Coos Bay)

	Loaded TEUs	Truckloads	Trainloads
2030	**491,469**	245,734	878
2035	**1,012,818**	506,409	1,809
2040	**1,134,765**	567,382	2,026
2045	**1,152,050**	576,025	2,057
2050	**1,185,804**	592,902	2,118
Note: Values highlighted in bold referenced in Tables 7-5 and 7-6			

Each truckload (two TEUs) travels a weighted average of 1,401 miles taking 26 hours at 55 miles per hour. Each trainload (560 TEUs) travels a weighted average of 1,789 miles taking 87 hours at 20.6 miles per hour. Table 7-11 presents total travel distance for truck and rail.

Table 7-11
Truck and Train Miles and Travel Time

	Truck Miles	Train Miles	Truck Hours	Train Hours
2030	344,273,700	1,570,100	6,259,500	76,200
2035	709,479,000	3,235,600	12,899,600	157,100
2040	794,902,700	3,625,200	14,452,800	176,000
2045	807,011,400	3,680,400	14,672,900	178,700
2050	830,656,000	3,788,200	15,102,800	183,900

53 20.6 hours was calculated from Union Pacific schedule by RailPro (2023)

7.2.5.2 Landside Transportation Cost Parameters

Landside transportation costs are calculated only for loaded containers projected for Coos Bay, as presented in Tables 7-7, 7-8, and 7-10. As presented earlier, these TEUs represent a small proportion of the projected TEUs that would be trucked between USEC ports and the 15 western inland states.

Landside transportation cost parameters have been developed by the U. S. Department of Transportation and are presented in Benefit-Cost Analysis Guidance for Discretionary Grant Programs, December 2023. This guidance provides parameter values for use in the monetization of project impacts to be used in a benefit-cost analysis.

Truck operating costs are calculated using the USDOT recommended truck operating cost per mile and the calculated truck miles presented in Table 7-9. Train operating costs are calculated using the USDOT recommended cost per mile for freight train ($799) and freight railcar ($1.03 per car for 140 railcars per train). Train operating costs per hour are multiplied by the train hours presented in Table 7-9. Under without-project conditions, the TEUs are trucked the weighted average distance of 1,401 miles between USEC ports and the associated inland state destinations. Under with-project conditions, the same number of TEUs are transported by train a weighted average distance of 1,789 miles between the container terminal at Coos Bay and the same inland state destinations used in the trucking calculations. Table 7-12 presents truck and train operating costs and the with-project condition vehicle operating cost savings for each 5-year interval from 2030 - 2050.

Table 7-12
Truck and Train Operating Costs and Savings

	Truck Costs	Train Costs	Savings
2030	$454,441,000	$71,888,000	$382,553,000
2035	$936,512,000	$148,146,000	$788,366,000
2040	$1,049,271,000	$165,983,000	$883,288,000
2045	$1,065,255,000	$168,512,000	$896,743,000
2050	$1,096,466,000	$173,449,000	$923,017,000

Travel time costs are based on the hourly costs of the vehicle operators. Each truck trip takes a weighted average of 26 hours which would require two drivers based on the 14-hour per day limit set by the Federal Motor Carrier Safety Administration (USDOT). This analysis assumes that the drivers work in series and that only one driver is present in the truck while in transit. The American Association of Railroads indicates that a two-person crew in the locomotive cab is standard for most Class 1 mainline operations[54]. This analysis assumes a three-person crew in recognition of the length of the train (140 rail cars). Note that there are no regulatory standards for train crew size. USDOT recommended hourly values for truckdriver ($33.50) and locomotive engineer ($53.50) are multiplied by the number of operators (1 for truck and 3 for train) and by the hours of operation identified in Table 7-11. Table 7-13 presents truck and train travel time costs and the with-project condition travel time cost savings.

Table 7-13
Truck and Train Operator Travel Time Costs and Savings

	Truck Operator Costs	Train Operator Costs	Operator Cost Savings
2030	$209,694,000	$12,233,000	$197,461,000
2035	$432,137,000	$25,209,000	$406,928,000
2040	$484,168,000	$28,245,000	$455,923,000
2045	$491,543,000	$28,675,000	$462,868,000
2050	$505,945,000	$29,515,000	$476,420,000

7.2.6 Total Containerized Cargo Transportation Cost Savings

Total operating costs and travel time costs for truck and train and associated total landside transportation cost savings are presented in Table 7-14. Truck costs are the landside transportation costs that would be incurred under without-project conditions and train costs are the landside transportation costs that would be incurred under with-project conditions. The amount of cargo transported is unchanged and the cargo origins and destinations are unchanged under both without and with-project conditions.

[54] American Association of Railroads: Freight Rail and Crew Size accessed at https://www.aar.org/issue/crew-size/#:~:text=For%20Class%20I%20railroads%2C%20recent,%2Dthe%2Droad%20mainline%20operations on 16May24

Table 7-14
Truck and Train Total Costs and Savings

	Truck Costs	Train Costs	Savings
2030	$664,135,000	$84,120,000	$580,015,000
2035	$1,368,649,000	$173,355,000	$1,195,294,000
2040	$1,533,440,000	$194,228,000	$1,339,212,000
2045	$1,556,798,000	$197,187,000	$1,359,611,000
2050	$1,602,411,000	$202,964,000	$1,399,447,000

Total containerized cargo transportation cost savings are the sum of waterborne operating cost savings (Table 7-8), Panama Canal operations cost savings (Table 7-9), and landside transportation cost savings (Table 7-14). Increases in TEUs and fleet shifts to larger vessels continue from 2030 through 2050 and then are held constant for the remainder of the period of analysis (through 2079). Each year, cost savings are discounted using the FY24 federal discount rate (2.75%). The discounted values are summed, and this discounted sum is the basis for the average annual equivalent value (AAEQ) that is used as the benefit side of the benefit-cost ratio. Table 7-15 presents the AAEQ values for each of the three components of containerized cargo transportation costs savings and their sum.

Table 7-15
AAEQ Containerized Cargo Transportation Cost Savings

Vessel Operating Cost Savings	$290,870,000
Panama Canal Operations Cost Savings	$58,144,000
Landside Transportation Cost Savings	$1,303,560,000
Total Transportation Cost Savings	**$1,652,574,000**

Note: AAEQ values discounted over 50 years at the FY24 federal discount rate of 2.75%

This information is exempt from public records per ORS 192.345(2) (trade secrets) and ORS 192.355(17) (economic development). If the Port determines that a record request is exempt from public disclosure, the requestor may seek review of the Port's determination pursuant to ORS 192.411, 192.415, 192.418, 192.422, 192.427, and 192.431.

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Table 7-20
Final Alternative Plan AAEQ Net Benefits and Benefit/Cost Ratios

Economic Parameter	PA	APA
Vessel Operating Cost Savings	$294,548,000	$290,870,000
Panama Canal Operating Cost Savings	$58,144,000	$58,144,000
Landside Transportation Cost Savings	$1,303,560,000	$1,303,560,000
Total Annualized Project Benefits	**$1,656,252,000**	**$1,652,574,000**
Annualized Project Costs	$162,573,000	$161,257,000
Annual Maintenance Costs	$114,893,000	$114,483,000
Total Annual Costs	**$277,466,000**	**$275,740,000**
Net Benefits	$1,378,786,000	$1,376,834,000
Benefit/Cost Ratio	6.0	6.0

8. EFFECTS OF ALTERNATIVE PLANS

The following sub-sections summarize analyses of alternative plan effects on the physical environment and infrastructure. Additional detail is provided in the referenced sections of the Engineering Appendix and its associated Sub-Appendices. Evaluations of alternative plan effects on natural and social resources are presented in the Environmental Impact Statement.

Analyses performed for this report include evaluations of alternative plan effects on:

- the physical environment;
- federal and non-federal infrastructure;
- performance of the federal navigation project; and
- operation and maintenance of the federal navigation project

8.1 Effects on the Physical Environment

Investigations into the effects of PA and the APA on the physical environment include investigations into effects on:

- tidal prism/water levels;
- tsunami propagation;
- current velocities;
- water quality (salinity, residence time, and dissolved oxygen);
- wave propagation
- shoreline erosion;
- sedimentation;
- groundwater;
- turbidity;
- vibration; and
- noise.

8.1.1 Effects on Tidal Prism

The tidal prism is defined as the volume of water exchanged between the Coos Bay Estuary and the open sea over a complete tidal cycle. Mean tidal prism is measured as the storage volume of the estuary between mean high tide and mean low tide. Mean tidal prism[55] is calculated as the product of the average tidal range (h_b) and the average surface area of the basin between mean high tide and mean low tide (A_b). Because all dredging occurs well below the mean low tide

[55] Prism = $h_b \cdot A_b$

elevation, the area A_b does not change. Therefore, effects on tidal prism can be determined based on changes in tidal range (water levels).

Tidal range in an estuary is governed by the inlet channel dimensions (width, depth, and length) which affect energy loss through the inlet due to friction and inertia of momentum throughout the estuary. Friction restricts the conveyance of water through the channel, dampening the tides upstream. Inertia moves water in the direction opposite to the slope of water surface based on momentum (e.g., water moves from the ocean into the bay even though the bay has a higher water level elevation). Inertia amplifies tidal range upstream in the estuary.

Inertia is more pronounced in estuary systems with a relatively long and hydraulically efficient channel such as Coos Bay. Comparison of historical tidal measurements from the Charleston, OR gauge (Station ID 9432780, used as the offshore boundary) and the North Bend gauge (located at approximately RM 11) show that the tidal range is 7% higher at North Bend than that at Charleston (Engineering Appendix, Section 2.1.3 of Sub Appendix 3: *Estuarine Dynamics*). This tidal amplification indicates that Coos Bay is a hydraulically efficient estuary system, frictional effects are not strong, and that inertia influences the hydrodynamics of Coos Bay.

The PA will increase the average channel cross-sectional area from the Existing Conditions by approximately 14.5%, with 0.1% change in the wetted perimeter[56]. Two studies were conducted to assess how these changes would affect the tidal prism and overall water circulation within the estuary: an analytical method based on the *Coastal Engineering Manual* (EM 1110-2-1100) and a three-dimensional (3D) hydrodynamic model.

The analytical method is detailed in the Engineering Appendix, Attachment D to Sub-Appendix 3 (*Estuarine Dynamics*) to the Engineering Appendix. This approach is based on the one-dimensional equation of motion that incorporates inlet cross-sectional area, bay surface area, ocean tide amplitude and period, length of the connecting inlet channel, and head loss coefficients. Two solutions of the equation are presented in the *Coastal Engineering Manual*, one developed by Keulegan (1967) and one improved by King (1974). Applying these solutions to the WOP Condition and the PA indicates no change to tidal amplitude, and therefore no change to tidal prism, under the PA relative to the WOP Condition. Based on the no change result for the PA, it is expected that the APA would yield the same result since it represents a smaller change.

The second method used to evaluate tidal prism was a high-resolution MIKE-3 3D hydrodynamic model that simulated hydrodynamics and salinity. This is a far more sophisticated method than the analytical method described above. The model domain encompassed the entire Coos Bay estuary from offshore depths of up to 300 ft to freshwater streams. The model was calibrated for existing conditions using an extensive source of measured field data.

The MIKE-3 HD model results show that the mean tidal range generally increases starting at the mouth and moving upstream. The PA results in a slight increase (less than 0.1 ft) of mean tidal range, with the maximum of 0.1 feet, the mean of 0.04 feet, and the mode of 0.05 feet throughout the estuary. In the South Slough, the increase in mean tidal range does not exceed 0.04 ft. In the Isthmus Slough, the Coos River, and the Haynes Inlet, the increase in mean tidal range does not exceed 0.06 ft. The maximum increase occurs in the FNC, where the mean tidal range increases by 0.09 ft (corresponding to a 1.6% increase in mean tidal range). These increases in tidal range

[56] The APA was not modeled because most of the change from the existing condition occurs between the entrance and RM 6, which would occur under both the PA and APA. Note also that the PA is the larger of the two plans.

would have the same small percent increases in tidal prism. Changes to tidal amplitudes at 49 discrete locations throughout the estuary, including the FNC and the tributaries, are detailed in Sub-Appendix 3, *Estuarine Dynamics*.

8.1.2 Effects on Tsunami Propagation

The Oregon Department of Geology and Mineral Industries (DOGAMI) has been responsible for mapping tsunami hazards along the Oregon coast since 1994. Recognizing the tsunami generation potential of the Cascadia Subduction Zone (CSZ), DOGAMI has created a new generation of tsunami inundation maps for the Oregon coast based on the result of modeling of a number of hypothetical, yet plausible, coseismic conditions (Engineering Sub-appendix 4 Offshore Ocean Dynamics).

A tsunami generated by CSZ activity, assuming a Scenario XXL tsunami, was numerically modeled throughout the entire estuary using the MIKE-21 hydrodynamic model. The XXL rupture scenario was selected because it is used to map the tsunami flood hazard zone within Coos Bay. Figure 8-1 shows the extent of run-up under the Existing Conditions and the PA; this is the same metric used to define tsunami inundation under DOGAMI's mapping. Additional run-up maps are presented in Section 7.3 of Sub-Appendix 4, *Offshore and Ocean Entrance Dynamics*.

Figure 8-1: Comparison of Tsunami Inundation under the PA - North Bend and Coos Bay

8.1.3 Effects on Current Velocities

Current velocities are influenced by freshwater inflows and tidal circulation. The project is not expected to result in long-term change to the watershed or land use and, therefore, will not affect freshwater inflows. Therefore, changes to current velocities would result from changes to tidal circulation. The maximum increase in tidal prism is less than 1.6% in the estuary. Therefore, very minor changes to the mean currents are expected. As a conservative approach, changes in current velocities were evaluated for the maximum ebb and flood currents. As a standard practice, the 99th percentile currents (i.e., 99 percent of the current speeds are below this value) were assessed as the maximum currents to avoid numerical issues associated with maximum outliers in numerical model output.

These plots show a reduction in current velocity at RM 5 and RM 8. This reduction is most likely because the PA increases the flow cross-sectional area by deepening and widening the turning basins while the tidal prism increases by less than 1.6%. As roughly the same volume of water passes through a larger cross-section, it is expected to lower the current velocity. In the remainder of the estuary, the PA predicts an increase of current velocity of generally less than 0.25 ft/s in the estuary and tributaries. Changes in maximum currents (Figure 8-2) are tabulated in the

Engineering Appendix, Section 3.6.2 of Sub-Appendix 3 (*Estuarine Dynamics*). Note that the changes below are for maximum currents and are more extreme than the changes to mean currents.

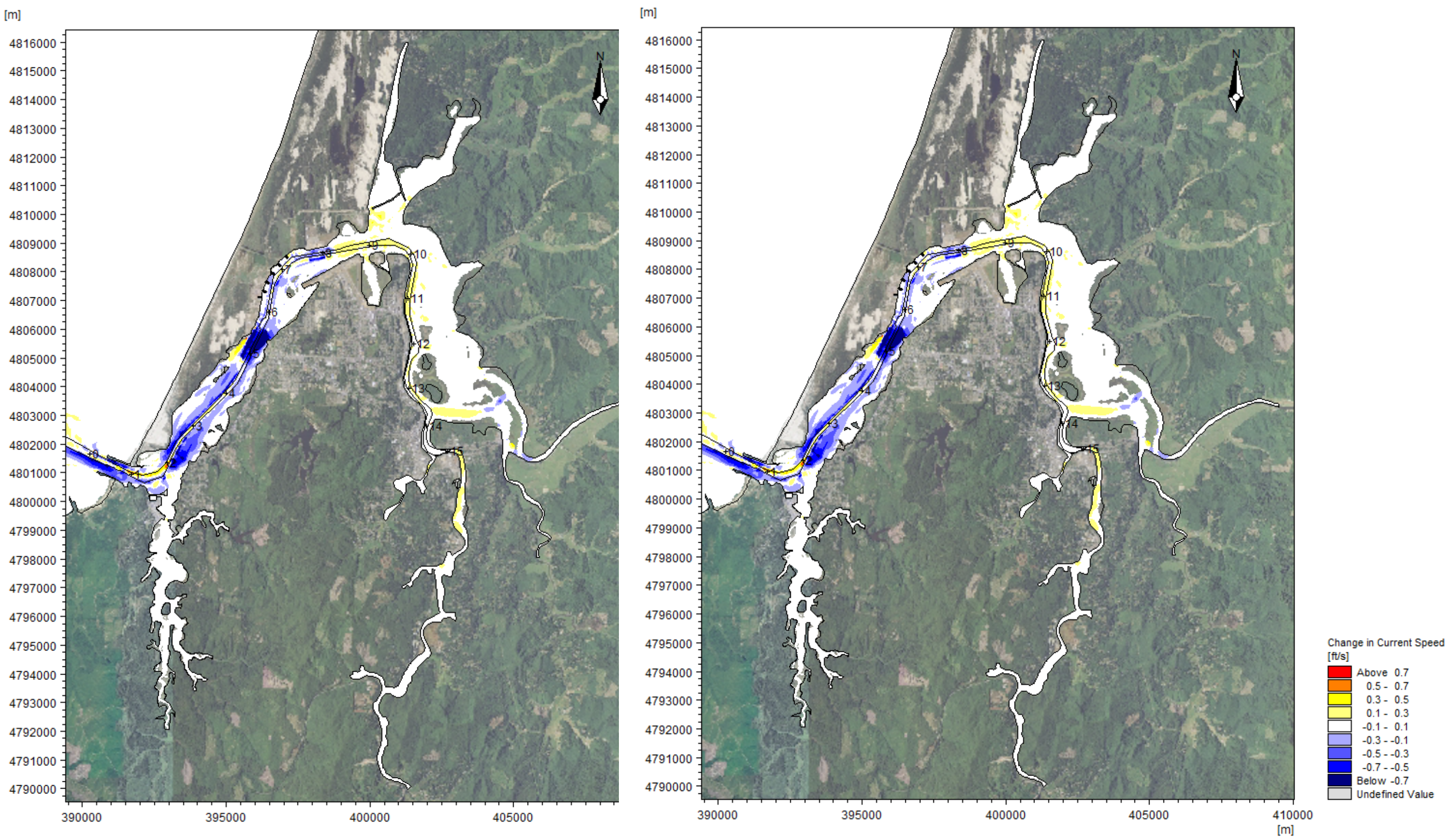


Figure 8-2: Difference in Maximum (99th Percentile) Currents in the Coos Bay Estuary (PA - WOP) for Ebb (left) and (b) Flood (right) Flows

8.1.4 Effects on Water Quality

Effects on water quality were evaluated by modeling with-project changes to salinity and residence time as well as an analytical assessment of potential with-project changes to dissolved oxygen. Details on the methodology and results are in the subsection below. In summary, projected changes to salinity were evaluated at stations throughout the estuary and tributaries. For summer (i.e., low freshwater inflow into the system) simulations, the maximum change in mean salinity was 0.06 psu, which is a change of less than 0.2%. Salinity changes under winter conditions are predicted to exhibit a maximum change in mean salinity at each output location not greater than 0.65 psu (this value corresponds to less than 4% change)[57]. Modeled changes in residence time in the upper bay and tributaries under with-project conditions are less than 1%. Modeled changes in residence time in the Entrance and Lower Bay show a residence time increase of up to 5%. Residence in the Entrance and Lower Bay times are less than 1.5 days for all project conditions. The largest predicted changes in dissolved oxygen (up to a decrease of 0.5 mg/L, or 6%) are predicted to occur during September/October in the Lower Bay, where dissolved oxygen (DO) levels are above 6.5 mg/L 97% of the time. In the tributaries (Isthmus Slough/South Slough/Coos River), decreases in dissolved oxygen are expected to be less than 0.2 mg/L, or 2%.

8.1.4.1 Salinity

Channel widening and deepening in estuaries can result in increased salinity intrusion, resulting from salt wedge propagation further upstream. Changes in salinity were evaluated using the high-resolution MIKE-3 3D hydrodynamic model introduced in the previous section. Simulations were performed for three conditions: a summer (low flow) condition, a winter condition with approximately a 2-year storm corresponding to a spring tidal cycle, and a winter condition with approximately a 2-year storm corresponding to a neap tidal cycle. For each runoff/tidal condition, the Existing Conditions and the PA were simulated. Detailed results are presented in Section 4.5.2 of Sub-Appendix 3, *Estuarine Dynamics*. Model outputs consisted of salinity time series plots and summary statistics (minimum, mean, and maximum salinity) extracted at the observation points shown in Figure 8-3 for the surface, middle, and bottom layer.

[57] An anomaly at RM 0 (offshore of the jetties), surface layer (increase in salinity of 1.6 psu) is assumed to be due to a different location of the ebb current

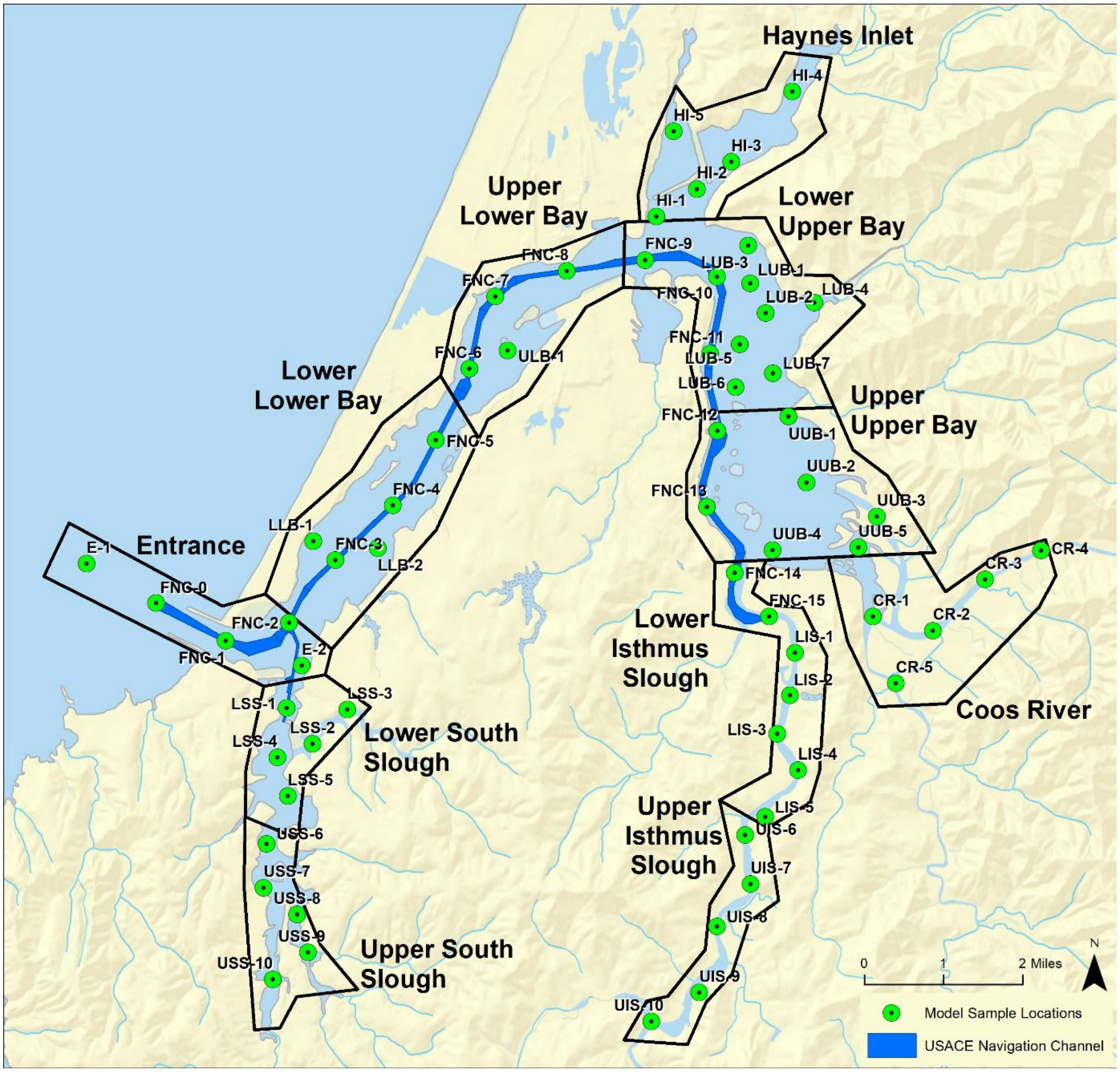


Figure 8-3: Salinity Output Points (74 green circles) and Residence Time Polygons (11 black polygons)

The summer simulations predict a small change in salinity as a result of the PA. The maximum change in mean salinity between the PA and the Existing Conditions was 0.09 psu, with a baseline salinity typically of 25-33 psu within much of the estuary. The percent changes in salinity between the PA and the Existing Conditions ranged from -0.3% to 0.1% (where a positive value represents an increase in salinity). This result is expected; during the summer, the estuary has little freshwater input, and is therefore substantially ocean water with an associated high salinity throughout. The changes in mean bottom salinity under the summer simulation are presented in Table 8-1.

Table 8-1
Summer Conditions, Salinity Modeling Results (PA)

	Max/Min Expected Change	
Location	**Change in Salinity (psu)**	**Change in Salinity (%)**
Entrance	<0.01	<0.1%
Lower Lower Bay	+0.01/<0.01	<0.1%
Upper Lower Bay	-0.02/<0.01	-0.1%/<0.1%
Haynes Inlet	-0.06/<0.01	-0.2%/<0.1%
Lower Upper Bay	<0.01	<0.1%
Upper Upper Bay	-0.09/<0.01	-0.3%/<0.1%
Coos River	<0.01	<0.1%
Lower Isthmus Slough	-0.04/<0.01	-0.1%/<0.1%
Upper Isthmus Slough	<0.01/-0.08	<0.1%/-1.4%
Lower South Slough	<0.01	<0.1%
Upper South Slough	<0.01	<0.1%

The winter/spring tide simulations predict that increases to mean salinity are less than 0.46 psu at the surface, 0.62 psu at the mid-layer, and 0.56 psu at the bottom layer. The exception to this being up the estuary on the Coos River, where the mean surface salinity is less than 3.3 psu, the increase in salinity is less than 3.5%. These results indicate that under the with-project conditions, a salt wedge is able to propagate further upstream. The largest absolute increases in salinity occur upstream of RM 9.0 of the FNC, where the salt wedge propagation concentrates in the FNC as opposed to the adjacent tidal flats. In these areas, the FNC represents a small portion of the channel area. The saline water tends to concentrate in the deeper, dredged area and, therefore, the enhanced salt wedge is most noticeable here. In the Lower Bay (RM < 9.0), by contrast, a larger portion of the cross-section is channelized, and the saline water is distributed throughout the channel bottom. The observation points in the Lower Bay (i.e., LLB-1, LLB-2, and ULB-1) generally show a decrease in salinity due to their geographic position in shallow water. These points are located on the shallow banks of the channel; as more saltwater propagates within the deeper main channel, the proportion of freshwater on these shallow banks increases.

The winter/neap tide simulations show higher salinities overall than the winter/spring tide simulations. The spring tidal cycle corresponds to much lower low tides than the neap cycle, resulting in fresher water under the former. The winter/neap tide simulations predict similar changes as the winter/spring tide simulations, although with a slightly higher magnitude. Increases to mean salinity are less than 0.54 psu at the surface, 0.82 psu at the mid-layer, and 0.8 psu at the bottom layer. Besides Coos River, where the mean surface salinity is less than 3.9 psu, the increase in salinity is less than 4.4%. Generally, the largest changes in salinity were observed for the winter/neap tide simulation. The maximum changes in mean bottom salinity under the winter/neap tide simulation are presented in Table 8-2.

Table 8-2
Salinity Modeling Results Winter/NEAP Tide (PA)

	Max/Min Expected Change	
Location	**Change in Salinity (psu)**	**Change in Salinity (%)**
Entrance	-0.13/<0.01	-0.4%/<0.1%
Lower Lower Bay	<0.01	<0.1%
Upper Lower Bay	+0.01/<0.01	<0.1%
Haynes Inlet	+0.11/<0.01	+0.4%/<0.1%
Lower Upper Bay	-0.02/<0.01	-0.1%/<0.1%
Upper Upper Bay	-0.12/<0.01	-0.4%/<0.1%
Coos River	+0.34/<0.01	+1.4%/<0.1%
Lower Isthmus Slough	+0.04/<0.01	+0.1%/<0.1%
Upper Isthmus Slough	+0.49/<0.01	+2.0%/<0.1%
Lower South Slough	<0.01	<0.1%
Upper South Slough	-0.06/<0.01	-0.2%/<0.1%

8.1.4.2 Residence Time and Water Age

Within estuarine systems, such as Coos Bay, hydrodynamic processes exchange water and its constituents between the estuary and the Ocean. A first-order description of this exchange is expressed as *residence time*, which is a measure of the amount of time it takes for water in one area of the estuary to be replaced by water from another area of the estuary. It is commonly referred to as "flushing time" as it represents the rate at which waters in a hydraulic system are moved through the system.

Residence time is often used as a first-order indicator of changes to water quality resulting from physical modifications to an estuary system. Application of a residence time analysis for Coos Bay is supported by recent work by Sutherland and O'Neill (2016) who found that, "*the low DO*

[Dissolved Oxygen] *observed in Coos Bay in late summer must occur due to local processes when waters spend more time in the estuary [i.e., longer residence time], and they are subjected to increased biologic respiration that draws down DO levels.*"

In addition to residence time, another useful parameter to quantify water exchange is *water age*, which is a measure of the length of time that water has resided within a specified area of the estuary, such as a computational cell within the model domain. It is frequently referred to as "water renewal time," as used in Shen et al. (2017), because it measures the amount of time it takes to renew the water in a specified area. As water moves through the system, its age continues to increase until it leaves the system. Water age is used as an input to an assessment of changes to DO concentrations (Section 8.1.4.3).

A fundamental difference between the calculations of residence time and water age calculations is how the polygons are considered. For residence time calculations, waters from different cells are considered to be waters from other areas (i.e., if water from the Coos River polygon replaced the water from the Lower Isthmus Slough polygon, it would be considered to be flushed); for water age calculations, the water continued to age unless it was replaced by offshore water (i.e., if water moves within the estuary but never moves offshore, it contributes to the age of the polygon in which it temporarily resides).

The MIKE 3D hydrodynamic model was used to estimate residence time and water age within the 11 modeled polygons that comprise Coos Bay (Figure 8-3), including summer and winter conditions. The full description of model setup and the equations used to calculate each condition is presented in Section 5 of Sub-Appendix 3 (*Estuarine Dynamics*) to the Engineering Appendix. This section focuses on changes to residence time and water age for the summer conditions, since low DO concentrations are historically uncommon during winter conditions.

Effects on Residence Time

Table 8-3 shows modeled residence times in the 11 estuary sub-areas (polygons). Residence times appear to increase within the Lower Bay and increase into the Haynes Inlet. The increase in the Lower Bay may be a result of the increased volume capacity of this area compared to the small increase in tidal prism, which also results in a reduction in current speeds. Slightly reduced residence times (i.e., 0.2 hours) in the Upper Bay and the surrounding tributaries are likely a result of the slight increase in tidal range. High residence times in the Upper Isthmus Slough are likely due to only having one discharge location and being adjacent to the Lower Isthmus Slough. Tracers from the Upper Isthmus Slough move back and forth between Upper and Lower Isthmus slough polygons without mixing throughout the estuary. Overall, all changes to residence times are small, within 1.2 hours (except for in the Upper Lower Bay). In the Upper Lower Bay, the increased residence time is due to the shape of the trend line and a slightly different threshold concentration, while the actual tracer concentrations are similar.

Table 8-3
Modeled residence times in Coos Bay, summer condition

Polygon	Residence Time, Existing Conditions (days)	Residence Time, PA (days)	Residence Time Change (hours), PA – Existing	Percent Change, PA vs Existing
Entrance	0.44	0.44	0	0%
Lower Lower Bay	0.55	0.59	+1.0	7%
Upper Lower Bay*	1.03	1.49	+11.0	45%
Haynes Inlet	1.51	1.53	+0.5	1%
Lower Upper Bay	1.60	1.60	0	0%
Upper Upper Bay	2.63	2.62	-0.2	0%
Coos River	3.05	3.04	-0.2	0%
Lower Isthmus Slough	1.53	1.52	-0.2	-1%
Upper Isthmus Slough	29.02	29.07	+1.2	0%
Lower South Slough	0.67	0.67	0	0%
Upper South Slough	2.26	2.27	+0.2	0%

* Particle concentrations are very similar, but a slight difference in the trendline causes the anomalous value. See Engineering Sub-Appendix 3 (*Estuarine Dynamics)*

Effects on Water Age

Figures 8-4 shows changes in summer water age under the PA relative to the WOP Condition. As this plot shows, water ages are expected to increase throughout the estuary under the PA. It is important to note that while the PA does not appreciably impact tidal prism volume (water volume between mean high tide and mean low tide), channel dredging does increase the water volume in the estuary below the tidal prism. Ultimately, these results show that the increase in volume of the estuary is more substantial than the increase in tidal flushing, and that water particles are expected to reside in Coos Bay for more time, on average. These results appear to differ from the residence time calculation because of the way polygon boundaries are applied within the model. The residence time calculation shows that water particles spend less time, on average, in the upstream individual polygons under the PA. The water age calculation shows that water particles reside for more time within the entire Coos Bay system under the PA (similarly, summing the individual residence times would yield a net increase in residence time). The largest increases in water age occur within the Upper Lower Bay, which results from the increase in water volume in this area. The mean water age increase is less than 1.85 days.

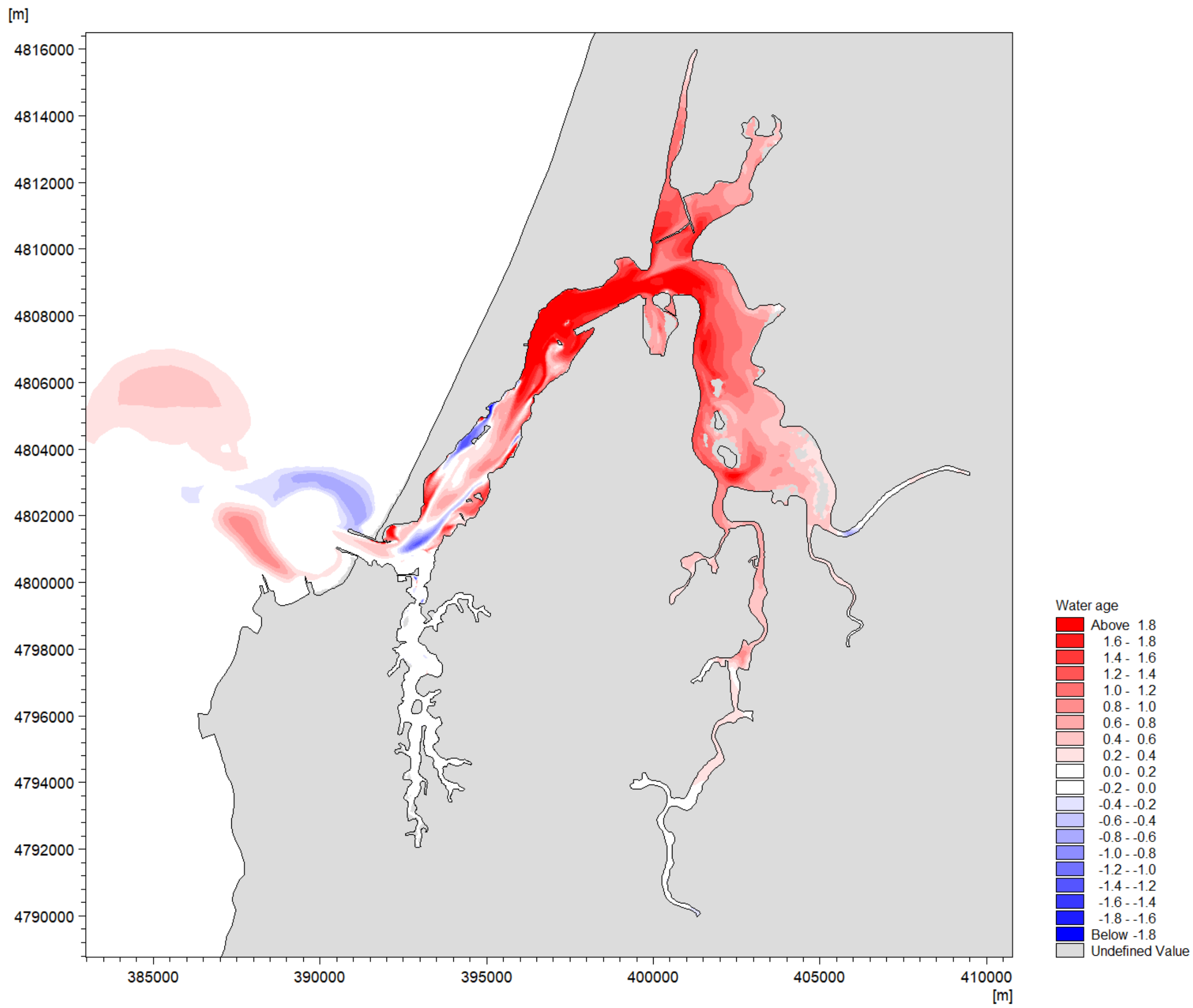


Figure 8-4: Color Contour Plot of Depth-averaged Changes (PA minus WOP Condition) in Water Age [Days], Summer Simulations

8.1.4.3 Effects on Dissolved Oxygen

The predicted changes to dissolved oxygen under with-project conditions are modeled by a mass balance equation[58] in which decreases in DO are offset by reaeration. There are numerous examples of applying similar limited-scope models, such as the Streeter-Phelps Equations, to assess DO. Specific examples include: modifications to the Gulf Intracoastal Waterway (GIWW), the Mississippi River Gulf Outlet (MRGO), and the Inner Harbor Navigation Channel (IHNC)

[58] $\frac{d\,DO}{dt} = -2.67\,K_d\,DOC - 4.57\,K_n\,NH_4 - \frac{SOD}{H} + \frac{K_r}{H}\left(DO_s - DO\right)$ where K_d is the decay or mineralization rate (day^{-1}) for DOC (g/m^3), K_n is the nitrification rate (day^{-1}) of NH_4 (g/m^3), H is local water depth (m), K_r is oxygen mass transfer coefficient (m/day), DO_s (mg/L) is the saturation value of DO, and dt is the change in time (day). The local water depth is used for SOD (g O_2/m^2/day) exertion and reaeration since the Coos Bay estuary is vertically well mixed in the summer.

associated with hurricane surge barriers to protect New Orleans (Dortch and Martin 2008); proposed Perquimans Marina (M&N 2012); and proposed San Rafael Rock Quarry (M&N 2014).

This DO analysis is based on the conservation of DO mass over the water column at a planar geospatial point location, as affected by three DO uptake mechanisms:

- mineralization of dissolved organic carbon (DOC);
- nitrification of ammonium nitrogen (NH_4-N); and
- benthic sediment oxygen demand (SOD).

The single source of oxygen in the mass balance is surface reaeration. The mass balance equation is solved for a rate of change of DO. Increasing water age (Section 8.1.4.2) allows the uptake processes to occur for a longer time within a particular area, thereby increasing the amount of DO uptake and reducing DO concentrations.

The input values used for this methodology are presented in Section 5.3 of the Engineering Appendix, Sub-Appendix 3 (*Estuarine Dynamics*). DO uptake rates were based on values presented in literature, while DO, salinity, and temperature input values were based on measured or modeled (in the case of salinity) data throughout the Coos Bay estuary. For this calculation, the change in water age was expressed as a cumulative distribution within each of the 11 residence time polygons, as calculated by the MIKE 21 hydrodynamic model (Figure 8-3).

Table 8-6 shows the non-exceedance cumulative distributions for predicted changes in DO under the PA. Average expected changes (mean values in Table 8-6) to the DO in the tributaries, based on projected changes in temperature and salinity, are expected to be less than 0.26 mg/L and in the Upper Upper Bay less than 0.4 mg/L. The greatest reduction in average summer DO (i.e., 0.85 mg/L) occurs at the Upper Lower Bay as a result of the greatest increase in water age. However, the existing DO at this location is relatively high, with the median summer DO above 7 mg/L (see Engineering Appendix). In the Lower Isthmus Slough, where the existing DO is low, the expected reduction in DO is 0.26 mg/L under the PA (approximately a 5% change), with the maximum predicted change being 0.37 mg/L at the 99th percentile. All changes to median DO under the PA are within 11% of the existing median DO concentrations.

The ODFW has identified a DO concentration of 6.5 mg/ as a lower bound for healthy DO concentrations in a water body (Partnership for Coastal Watersheds, 2019). Generally, a DO threshold of 4 mg/l is considered the minimum DO for a healthy water body and DO levels below 3mg/l are a concern (USEPA, 2019). Under the PA (Table 8-4) the largest changes in DO (up to a decrease of 0.5 mg/L, or 6%) are predicted to occur in the main channel, where DO levels are above 6.5 mg/L 97% of the time. In the tributaries (Isthmus Slough, South Slough, and Coos River) under the PA, decreases in DO are expected to be less than 0.2 mg/L, or 2% of baseline.

Table 8-4
Non-exceedance CFD (pct less than value) for Summer Change in DO (mg/L), PA

Area	1%	5%	10%	25%	50%	75%	90%	95%	99%	% Change in Median
Entrance	0.50	0.24	0.07	0.00	-0.02	-0.12	-0.22	-0.27	-0.77	-0.05
Lower Lower Bay	0.57	0.34	0.17	-0.06	-0.22	-0.36	-0.57	-0.69	-0.84	-0.21
Upper Lower Bay	-0.16	-0.30	-0.47	-0.72	-0.86	-1.04	-1.16	-1.22	-1.32	-0.85
Haynes Inlet	-0.14	-0.17	-0.18	-0.22	-0.29	-0.37	-0.44	-0.46	-0.49	-0.30
Lower Upper Bay	-0.23	-0.37	-0.40	-0.47	-0.61	-0.80	-0.91	-0.95	-1.01	-0.63
Upper Upper Bay	-0.16	-0.18	-0.21	-0.27	-0.34	-0.48	-0.53	-0.57	-0.71	-0.37
Lower Isthmus Slough	0.28	0.13	0.01	-0.06	-0.14	-0.17	-0.20	-0.21	-0.24	-0.10
Upper Isthmus Slough	-0.11	-0.17	-0.20	-0.21	-0.24	-0.32	-0.36	-0.37	-0.37	-0.26
Coos River	0.05	0.00	-0.01	-0.02	-0.03	-0.06	-0.09	-0.13	-0.17	-0.04
Lower South Slough	0.16	0.06	0.05	0.04	0.02	0.00	-0.02	-0.03	-0.11	0.02
Upper South Slough	0.02	0.02	0.02	0.02	0.01	0.00	0.00	0.00	-0.01	0.01

The analytical method predicts changes to DO. The distribution of DO can be estimated by adding the changes to the measured median DO. Figures Figure 8-8-5 through 8-12 take the worst-case month of the year from the measured median data and apply DO changes under the PA. These figures also include two standards posted by Oregon Department of Fish and Wildlife (ODFW); the 6.5 mg/L standard is the 30-day mean minimum and the 4.0 mg/L is the instantaneous minimum.

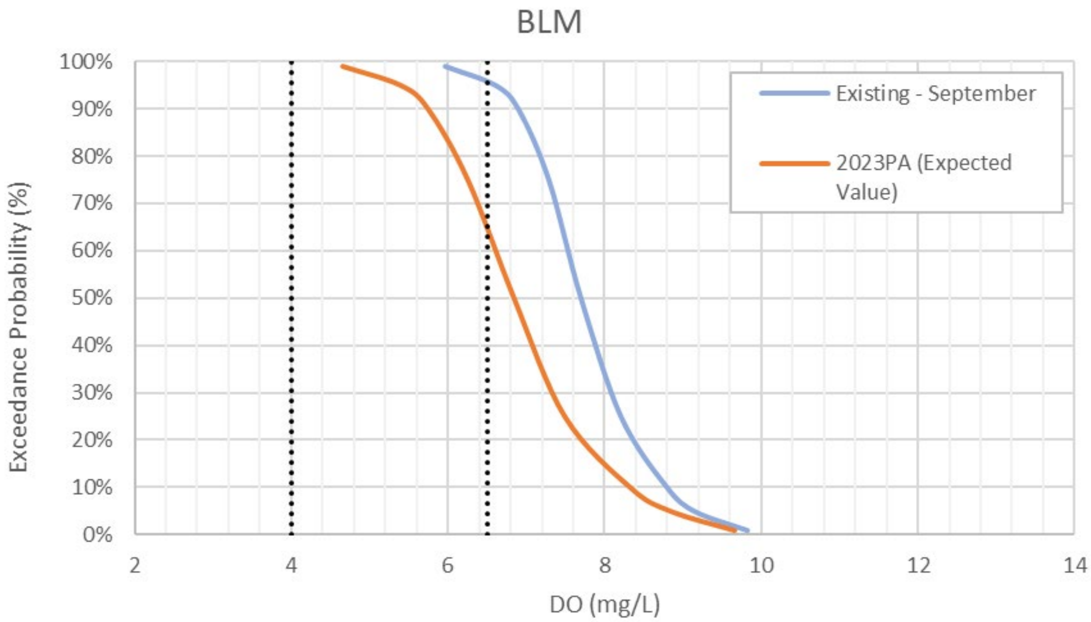


Figure 8-5: DO under the PA, BLM sensor

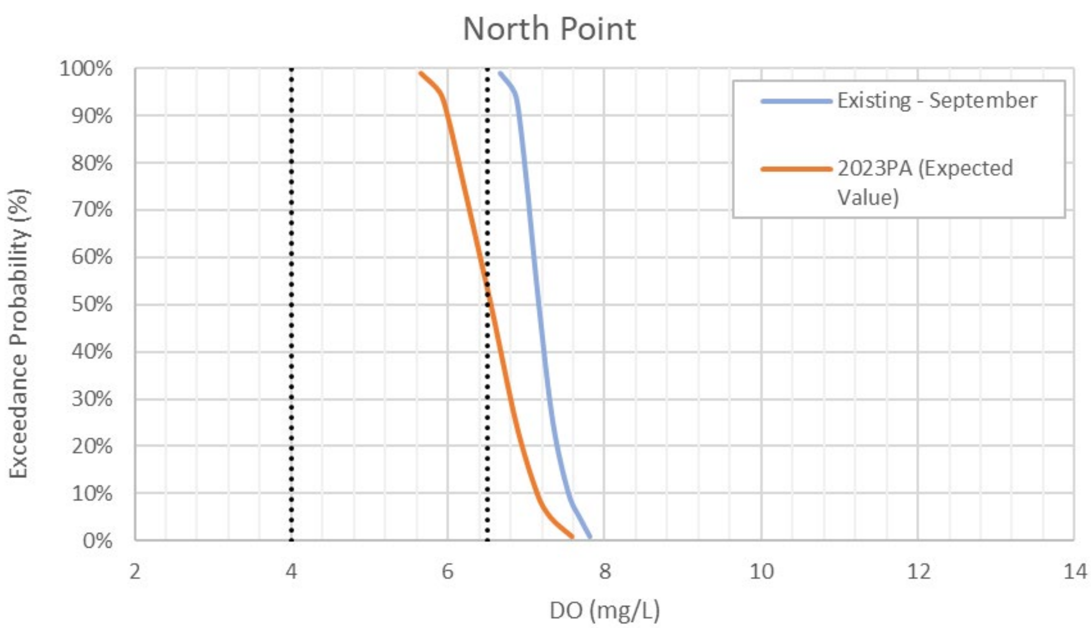


Figure 8-6: DO under the PA, North Point sensor

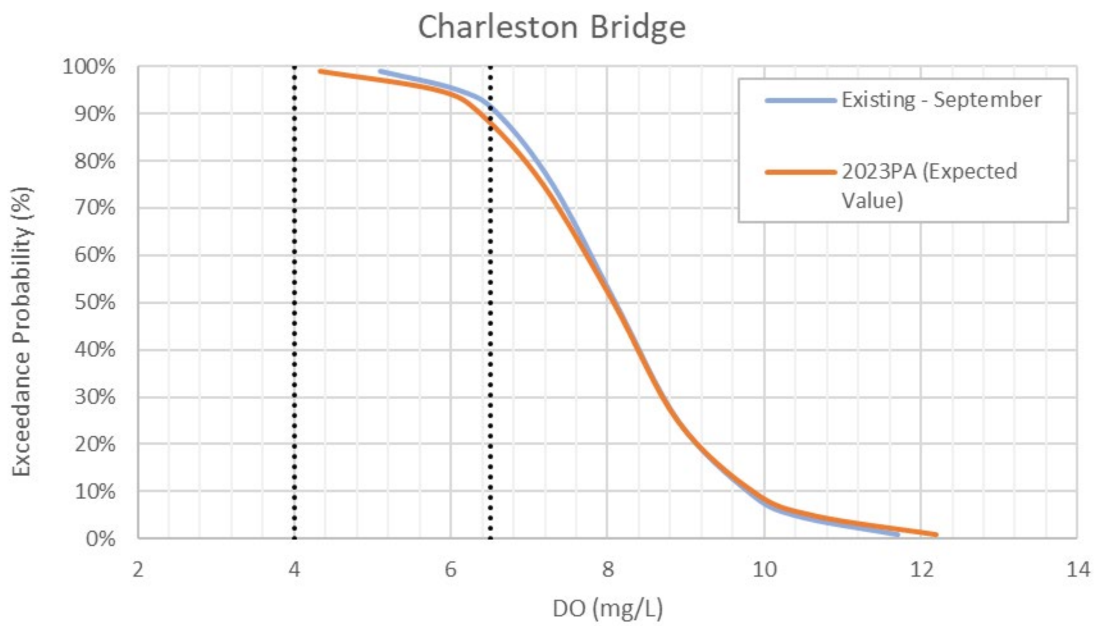


Figure 8-7: DO under the PA, Charleston Bridge sensor

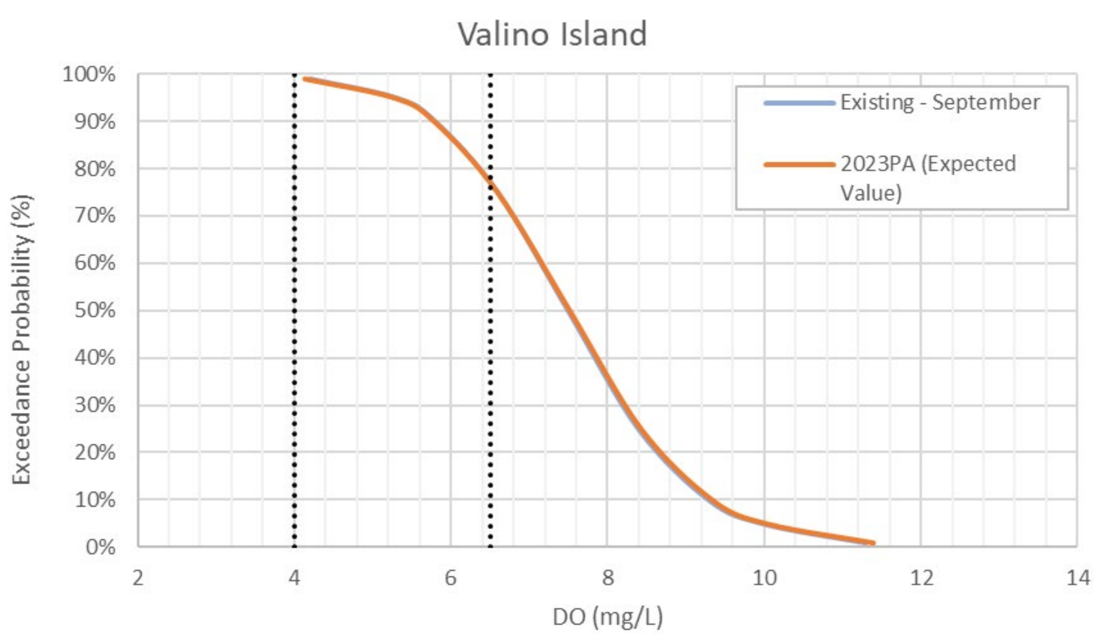


Figure 8-8: DO under the PA, Valino Island sensor

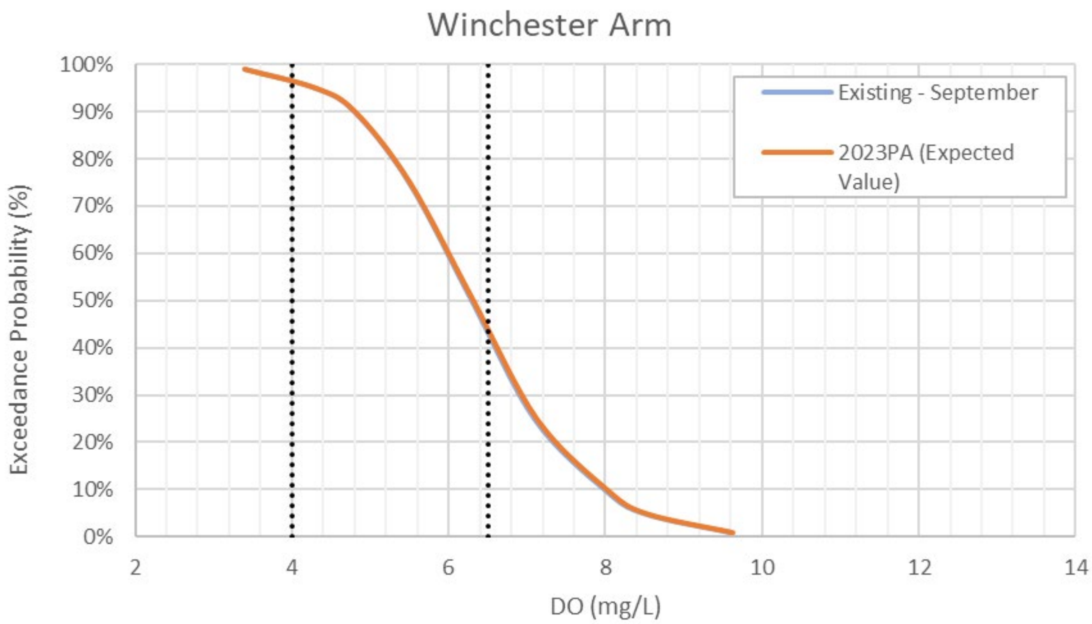


Figure 8-9: DO under the PA, Winchester Arm sensor

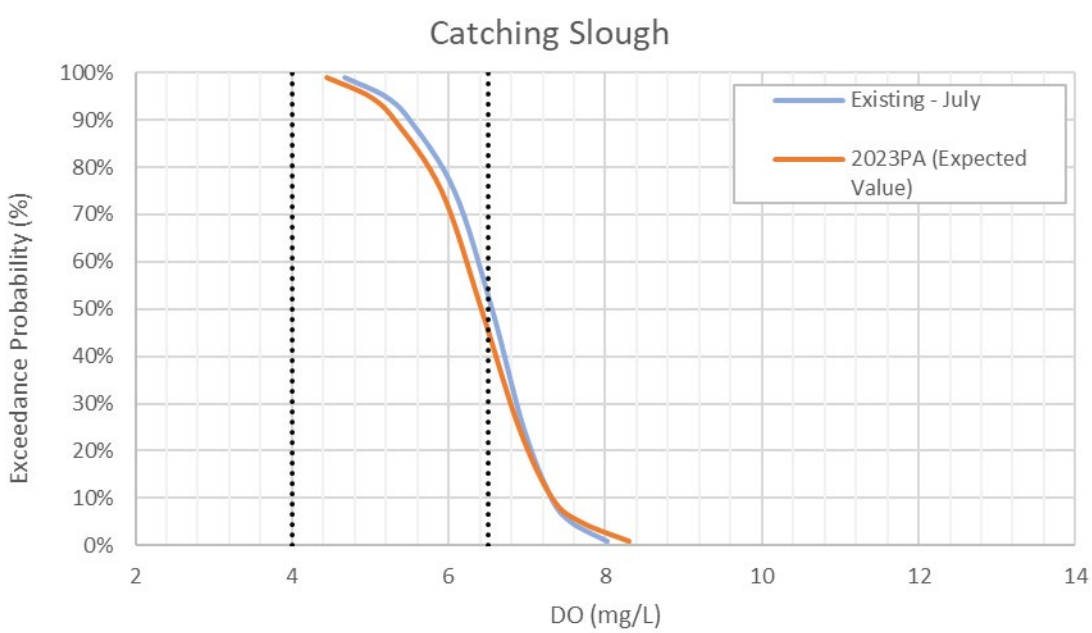


Figure 8-10: DO under the PA, Catching Slough sensor

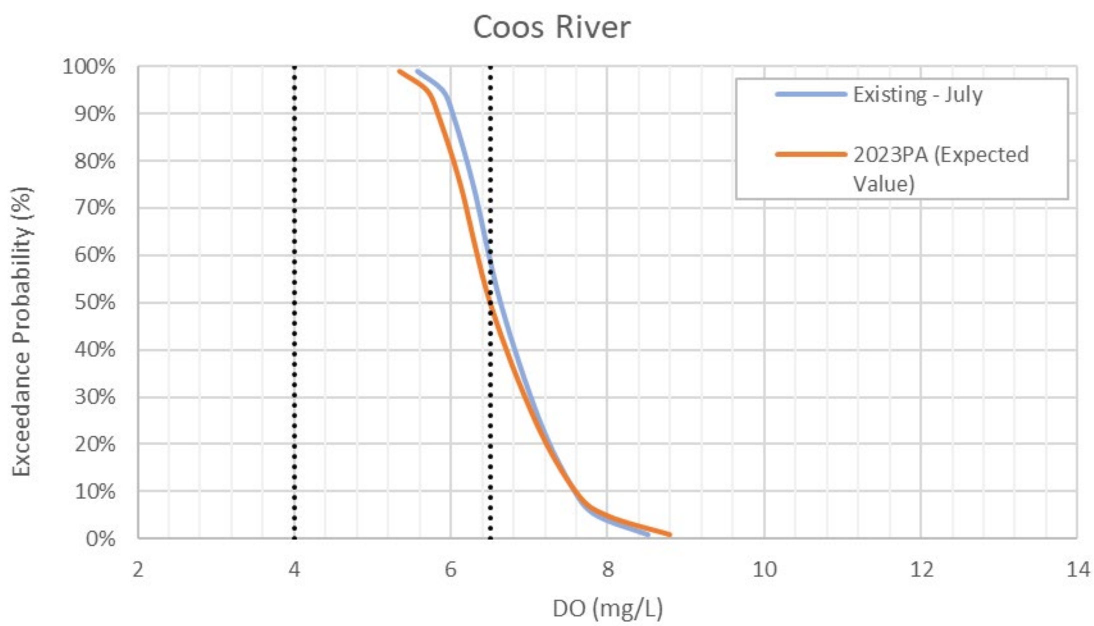


Figure 8-11: DO under the PA, Coos River sensor

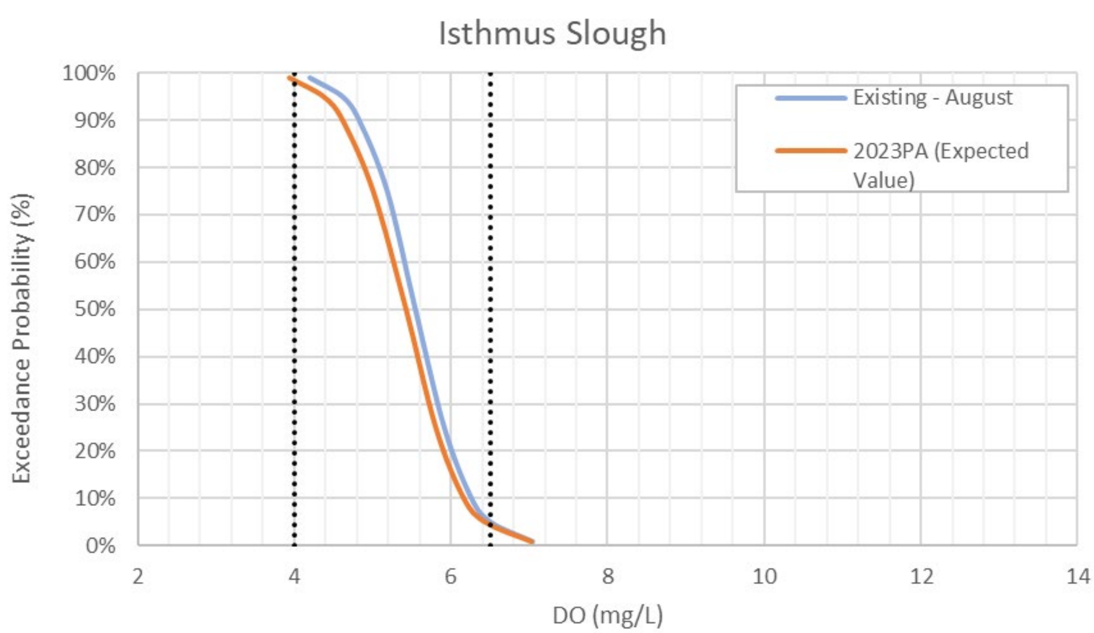


Figure 8-12: DO under the PA, Isthmus Slough sensor

8.1.5 Effects on Wave Propagation

Effects on wave propagation were modeled based on wave conditions selected from the available deep-water wave measurements. A Spectral Wave Model (MIKE21 SW) was developed to transform offshore storm conditions (wave spectra) for selected events to a depth of approximately 150 ft MLLW. A high resolution Boussinesq Wave (BW) Model (BOUSS-2D) was used to propagate waves from the computed spectra into the Coos Bay Entrance Channel. The BW Model incorporated the effects of water level and wave-current interactions, which can occur during storm events. OIPCB received USACE approval for one-time use of these models (OIPCB, 2016).

Wave simulations were performed for the 79 largest storms that occurred near Coos Bay from 2005 through 2016; the storms are described in Section 2.1.6 of Sub-appendix 4, *Offshore and Ocean Entrance Dynamics*. Each of the storms was first simulated under four tidal conditions without consideration of Sea Level Change (SLC), which have an equal probability (MLLW, MHHW, MSL plus flood currents, and MSL plus ebb currents). Then the selected representative SLC value of +3.2 ft was added to each tidal condition. Complete modeling details are presented in Sub-Appendix 4, *Offshore and Ocean Entrance Dynamics Report*.

Significant wave heights were extracted from the BOUSS-2D model at 54 points. **Error! Reference source not found.**8-13 illustrates the wave data extraction points (yellow dots) in the vicinity of the jetties. The locations are approximately 400 ft away from the jetties (about 1-2 wavelengths) to avoid impacts from the structure within the model absorption layer in BOUSS-2D. Significant wave heights were also extracted offshore of the authorized jetty lengths and along the Pacific Coast shoreline. Figure 8-13 shows a large area view with all locations, including offshore points and those along the northern adjacent shoreline (i.e., nearshore).

Figure 8-13
Zoom-out View of All 54 Wave Model Extraction Locations

It should be noted that the analysis does not include an extreme value analysis that would typically be used for design. Instead, the wave simulations provide an assessment of how the PA or APA would affect the propagation of actual, measured waves into the Coos Bay Eastuary (Table 8-5).

Table 8-5
50-year Extreme Wave Heights (Hs in ft) at the Extraction Locations (w/o SLC and w SLC)

Location	w/o SLC			w +3.2' SLC		
	WOP Condition	PA	Difference[1]	WOP Condition	PA	Difference
North Jetty (N2)	30.9	29.1	-1.8	32.0	30.7	-1.3
South Jetty (S3)	26.7	27.7	1.1	27.8	29.3	1.5
Los Spiral Bay (L2)	4.2	1.8	-2.4	6.3	3.0	-3.3
Charleston Marina (CM1)	2.0	1.5	-0.5	2.2	1.8	-0.4
Channel Center (C1)	3.8	2.4	-1.4	4.1	2.8	-1.3
Nearshore Beach (Nearshore3)	29.1	29.1	0.0	29.7	29.8	0.1
Offshore (Offshore1)	31.1	33.1	2.0	31.1	33.4	2.2

[1] Significant wave height difference of PA from WOP Condition.

8.1.6 Effects on Shoreline Erosion

The potential for shoreline erosion resulting from with project conditions included analysis of three areas that encompass the full range of shorelines within the study area:

- Pacific Coast shorelines
- Log-spiral Bay (LSB); and
- shorelines within the estuary.

Sedimentation in the Entrance Channel was estimated using the Coastal Modeling System (CMS) model. CMS is a USACE-approved model capable of simulating relevant hydrodynamic and sediment transport processes in tidal inlets and coastal areas. In this application, the model simulates a typical one-year period, which includes both extreme storm conditions and frequently-occurring swell conditions. Input to the model consists of sediment grain sizes, waves, and currents and bathymetry for the various project scenarios. The model was calibrated to reflect measured shoaling between the USACE surveys.

The Existing Conditions scenario was simulated to provide a baseline estimate of future sedimentation in the absence of channel deepening project. The PA and the APA include the modified North Jetty, the dredged channel including advance maintenance dredging (AMD), and side slope, both with *constructed condition* and *future equilibrium* side slopes.

A difference plot to compare shoaling under the PA or APA minus the Existing Conditions is presented in Figure 8-14; in this figure, green and red colors represent more shoaling under the PA relative to the Existing Conditions, and blue colors represent more erosion under the PA or APA. It should be noted that in areas where the bottom substrate is rock and would not be subject to erosion, the difference plot could still show blue colors if the area experiences less deposition under the PA or APA (e.g., near Guano Rock). Therefore, Figure 8-15 identifies areas which remain or become erosional under the PA and APA. Based on the result, areas that may remain or become erosional are along the North Jetty trunk (Area A), jetty structures along the LSB (Area B, north and south), and Charleston Harbor breakwater (Area C).

The modeling study is detailed in Section 5 of Sub-Appendix 4, *Offshore and Ocean Entrance Dynamics*.

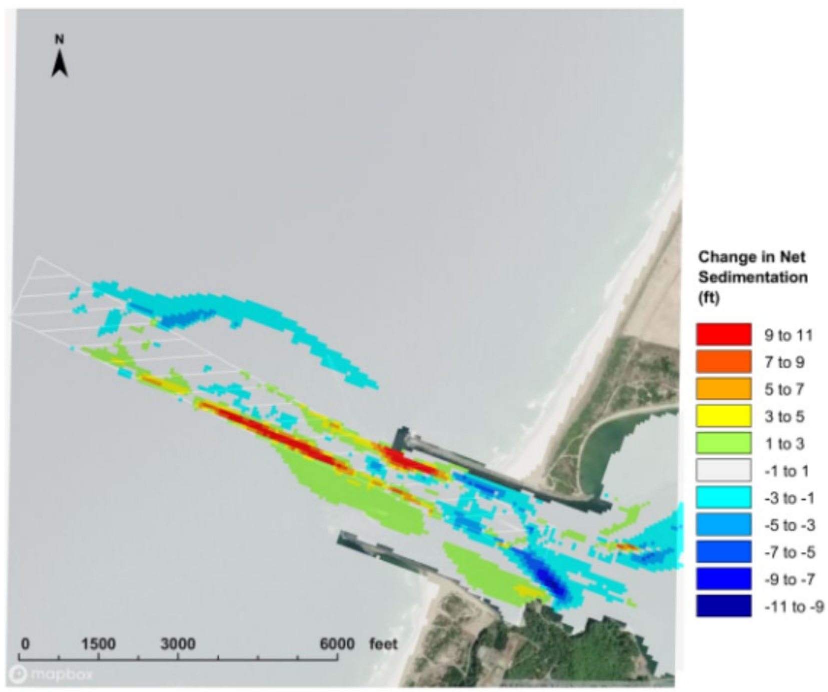


Figure 8-14
Comparison of Sedimentation between the PA with Future Equilibrium Side Slopes and the Existing Conditions

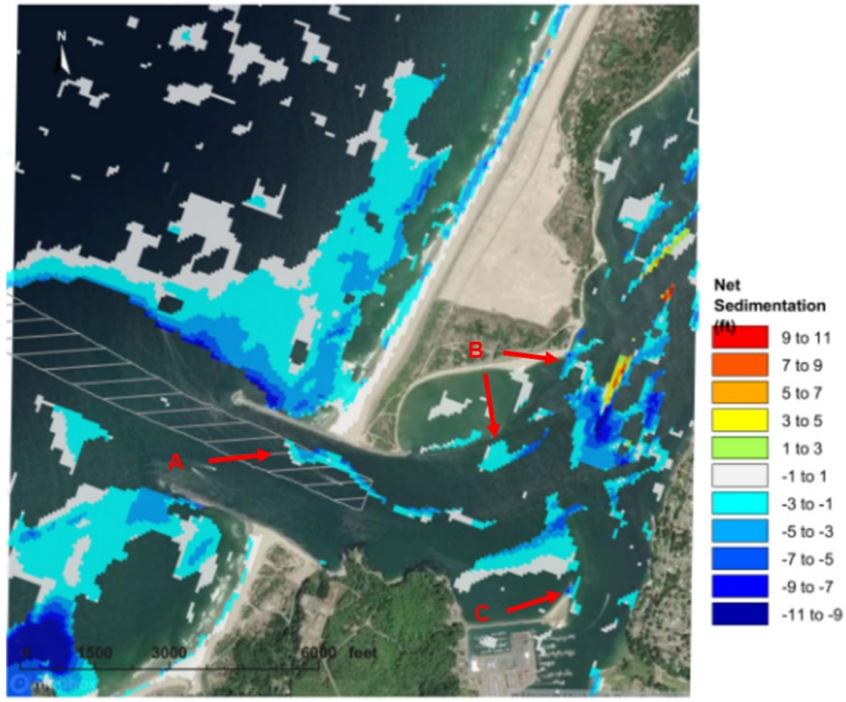


Figure 8-15
Erosional Potential under the PA with Future Equilibrium Side Slopes as Compared to the Existing Conditions

Estuarine sediment transport and deposition was modeled using the 2D MIKE-21 FM model suite, with coupled hydrodynamic and sand transport modules. Erosion, transport, and deposition of sand under the action of currents was taken into account in the sand transport module. The choice to use MIKE-21 reflects the desire to use a suite of models that has been used successfully in this environment, thus mitigating the uncertainty of setting up other models that may not be appropriate for this environment. USACE provided one-time approval for use of this model (OIPCB 2016).

The sediment transport model was calibrated to the annual average quantity of maintenance dredging. This volume was selected for calibration, as opposed to measured shoaling, because USACE rarely dredges the entire FNC with the estuary in a given year, and, therefore, measurements of annual shoaling throughout the project are not available. Modeling was conducted for the full year of 2011. The model is detailed in Section 6 of Sub-Appendix 3, *Estuarine Dynamics*.

Difference in bed level change over 1-year (i.e., full year of 2011) as a result of the PA can be seen in Figure 8-16 and Figure 8-17. The model results indicate that erosion or deposition as a result of the PA occurs mainly between RM 5 and RM 8. Outside of RM 5 to RM 8, the majority of the navigation channel and shallow-water habitat areas show either no changes or minor changes because these areas are further away from the proposed navigation channel improvements and hence the improvements have very little effect on the hydrodynamics at these locations.

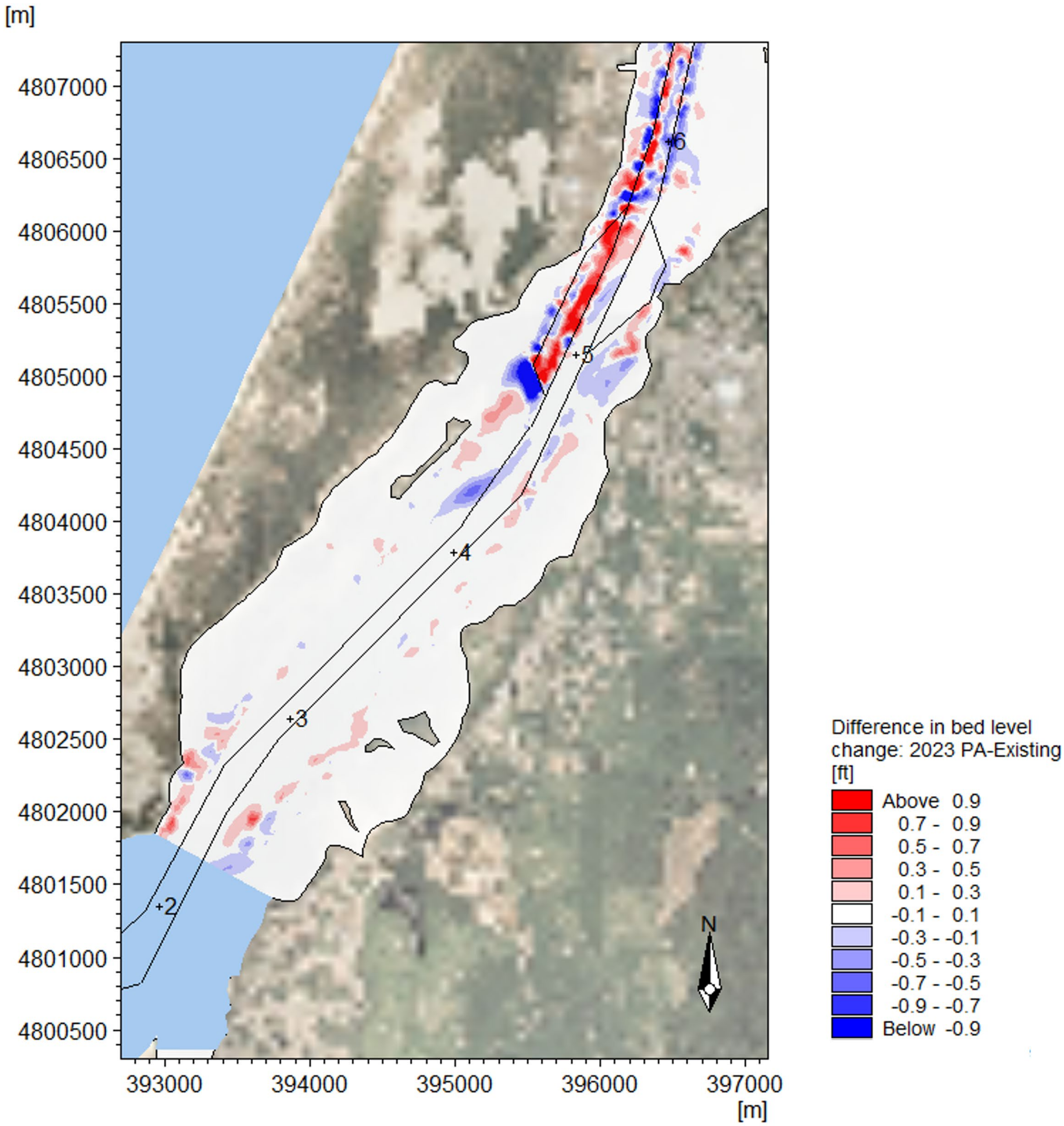


Figure 8-16
Difference in Bed Level Change as a Result of PA (PA – Existing Conditions), a Zoomed-In View of RM 2.5 – RM 6

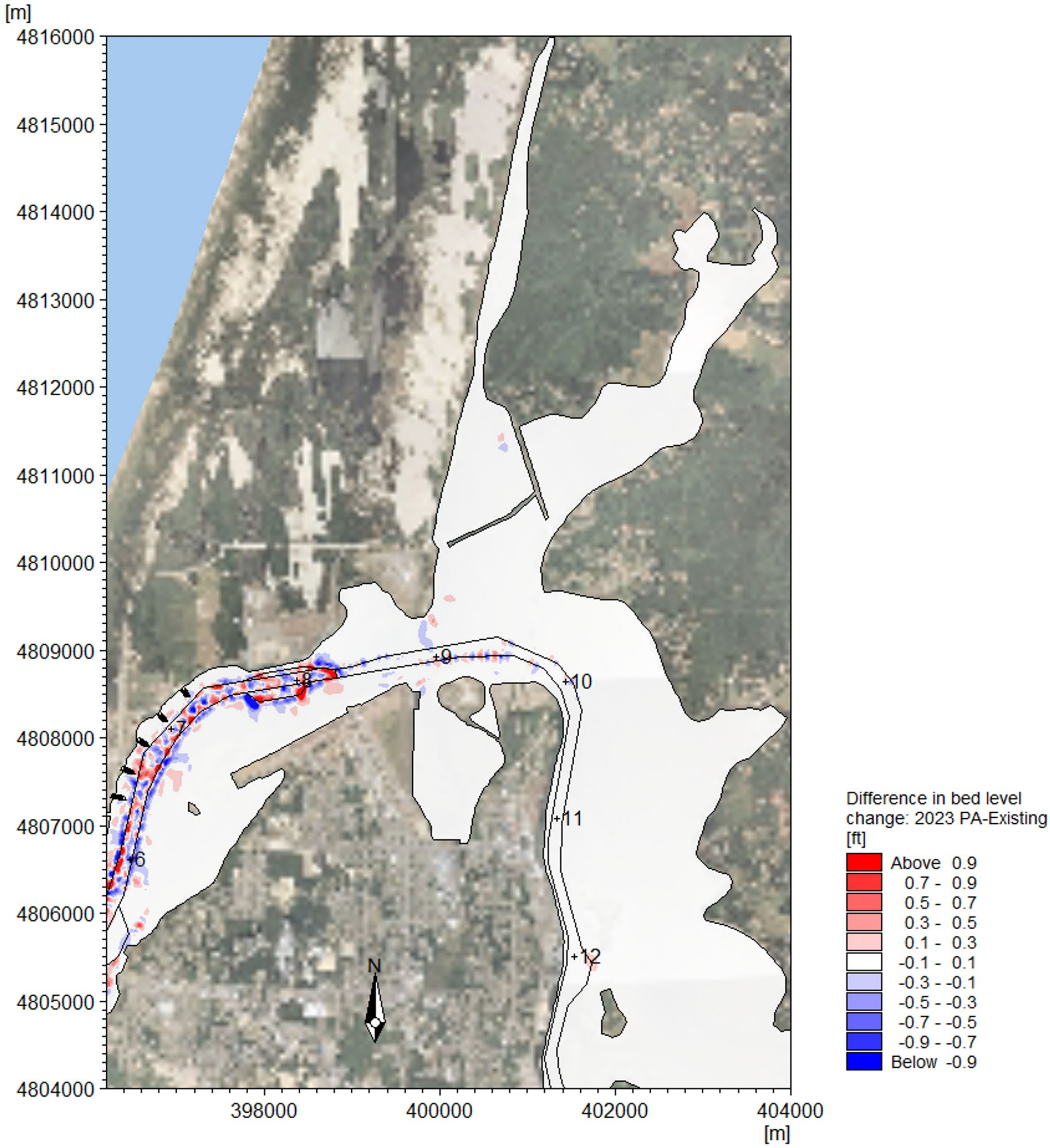


Figure 8-17
Difference in Bed Level Change as a Result of PA (PA – Existing Conditions), a Zoomed-In View of RM 6 – RM 12

8.1.6.1 Vessel-generated Waves

Section 7 of the Engineering Appendix, Sub-Appendix 3 (*Estuarine Dynamics*) describes analytical methods for calculating primary waves (drawdown) and secondary waves (vessel wakes) from passing vessels. The analysis consisted of estimating wave heights at the point of wave generation, as well as propagation of the vessel-induced waves to the shoreline. Modeled scenarios included the Existing, WOP Condition, and PA. All cases considered both design vessels for bulk carriers and containerships, transiting at the velocities used during ship simulations. Vessel position within the channel was similarly based on swept path analysis from ship simulation modeling. Tugs were also investigated under all project conditions. The analysis yielded the following conclusions:

1) For tugs transiting the channel, drawdown is expected to be small and negligible, while wake can be up to 3.5 ft at the right bank for tugs traveling at high speed (12-15 knots). However, this is a relatively high speed for tugs, and is unlikely. The difference in wake generation between conventional tugs and azimuth stern drive (ASD) tugs is very little. Deepening and widening the channel under the PA will result in a slight reduction in wake height due to increased channel cross-section. Therefore, the effect of the project would be to lessen the wake energy at the shoreline.
2) For larger vessels, such as the bulk carrier and container ship in the channel, wake is expected to be small due to required low vessel speeds, but drawdown can produce wave heights up to 0.6 ft. Deepening and widening the channel will result in a 0.1-0.3 ft reduction in drawdown in most parts of the channel. One exception to this is in the Entrance Range and Entrance Turn where the simulated container ships under the PA transited at a relatively high speed (9-10 kt), corresponding to wake of 1-3 ft.

In summary, the model results show an overall small reduction in wake height generated by tugs and only small changes in drawdown height associated with larger vessels transiting between the Existing Conditions and the PA. Compared to the Existing Conditions, impacts from container ships are newly introduced under the PA. For bulk carriers, the ship sizes are larger, and the frequency of larger bulk vessels will likely decrease under the PA compared to the Existing Conditions. Under the APA, the size and number of bulk carriers would be the same as the WOP and there would be no expected change to vessel wake height or draw down between RM 6 and 8.2.

8.1.7 Effects on Sedimentation

Sediment transport was analyzed using several tools: assessment of historic shorelines, development of a sediment budget, and numerical sediment transport modeling. These studies are detailed in the Engineering Appendix, Sub-Appendix 4, *Offshore and Ocean Entrance Dynamics Report*. Changes to long-term sedimentation patterns were analyzed using numerical modeling. Two sediment transport models were developed: Coastal Modeling System (CMS) was used to simulate sedimentation in the Entrance Channel and a MIKE-21 model was used to simulate sedimentation within the estuary. The model results were used to estimate the change in sedimentation between the various project conditions.

8.1.7.1 Effects on Sedimentation in the Entrance Channel

The Entrance Channel CMS model is described in Section **Error! Reference source not found.** and detailed in Sub-appendix 4, *Offshore and Ocean Entrance Dynamics*. CMS is a USACE-approved model capable of simulating relevant hydrodynamic and sediment transport processes in tidal inlets and coastal areas. In this application, the model simulates a typical one-year period, which includes both extreme storm conditions and frequently-occurring swell conditions.

The calibration, validation, and Existing Condition simulations use measured bathymetry as input. The model was calibrated to reflect measured shoaling between USACE surveys. The PA input includes the proposed channels including AMD and rock buffer, and expected side slope equilibration to the existing side slope angles (Table 8-6).

Table 8-6
Shoaling in the Entrance Channel under Different Conditions

Metric	Existing Condition	PA Channel	APA Channel
Net Sedimentation (cy/yr)	641,000	923,000	923,000
Change Relative to Existing Condition (cy/yr)	N/A	+282,000	+282,000

8.1.7.2 Effects on Sedimentation in the Estuary

The MIKE-21 model used to simulate sediment transport in the estuary is described in Section **Error! Reference source not found.** and detailed in Sub-appendix 3, *Estuarine Dynamics*. The modeling uses the sand transport module of the MIKE-21 FM model, which considers erosion, transport, and deposition of sand under the action of currents. USACE provided one-time approval for the use of this model (OIPCB 2016). The model was simulated based on the hydrologic conditions of 2011, which is a typical hydrological year based on freshwater inflow to the Coos Bay estuary.

The Existing Conditions simulation uses measured bathymetry as input. For the Existing Conditions, model input included a channel depth dredged to the existing AMD downstream of RM 12, and to -37 ft MLLW in the upper bay (upstream of RM 12). The PA input includes the dredged channel including AMD, dredging the upper bay to -37 ft MLLW, and side slope equilibration to the existing side slope angles. Model inputs are detailed in Sub-appendix 3, *Estuarine Dynamics*).

Error! Reference source not found.8-7 shows the modeled increases in shoaling with the existing O&M. The expected annual shoaling is projected to increase by 52,000 cy/yr under the PA and by 25,000 cy/yr under the APA. Note that there is no net input of sediment; instead, hydraulic forces redistribute available sediment, causing recurrent shoals in the navigation channel. Widening the channel therefore brings the channel boundaries next to shoals from which sediment can erode. However, deepening the channel does not result in trapping a larger quantity of sediment.

The Charleston Channel was also included in the analysis and there is no change to the Charleston Channel sedimentation patterns because of the PA or APA.

Table 8-7
Sedimentation in the Inner Channel under Different Project Conditions

Reach	Existing Condition	Simulated Sedimentation (cy/yr)	
		PA	APA
RM 2 - 6	55,000	80,000	71,000
RM 6-9	74,000	100,000	74,000
RM 9-12	62,000	63,000	62,000
Total in Channel, RM 2.5-12	**191,000**	**243,000**	**216,000**
Change compared to Existing Condition	**-**	**+52,000**	**+25,000**

8.1.8 Effects on Groundwater

Limited data on groundwater near Coos Bay is limited, however wells developed and monitored by Brown and Newcomb (1963) just north of Coos Bay did not penetrate saline water, even though they were located a short distance from the coast and were deeper than 85 ft. Water levels were generally within 5 ft of the ground surface and were consistently above MSL. The report does not note any confined aquifers. The authors concluded that the recharge via precipitation maintains the water table several feet above sea level and therefore, all dredging will be below the groundwater table. Previous studies have found that, absent confining aquifers, the potential for saltwater to move from the river channel to the surficial aquifer system is limited (Bellino & Spechler 2013). Because no confined aquifers have been identified in Coos Bay, no effects to groundwater are anticipated.

Previous environmental documentation by USACE (2014, 2016) for channel deepening projects have noted that effects to groundwater are driven by changes to groundwater extraction or recharge. At Grays Harbor, since no confined aquifers were identified, USACE (2014) found that the project would not alter groundwater pumping rates nor deepen the project beyond the salt wedge. Therefore, the potential to create saltwater intrusion problems was found to be negligible. Similarly, the Seattle Harbor deepening study (USACE 2016) stated that the proposed action would be limited to the subtidal environment and, therefore, no groundwater would be affected.

The same conclusions can be made about the PA and the APA. Therefore, no effects to groundwater conditions are expected because of the PA or APA.

8.1.9 Effects on Turbidity

Short-term turbidity may be generated during construction by dredging operations. Dredging will be subject to turbidity limits imposed through the permitting process. ODEQ requirements for turbidity monitoring are provided below, and compliance standards are provided in Table 8-8.

- Material containing more than 20% fines: Monitoring must be performed with turbidimeters, where the background concentration is assessed 200 ft upcurrent of the activity, and the compliance point is assessed 200 ft down current of the activity.
- Material containing less than 20% fines: Visual monitoring is acceptable.

Table 8-8
Turbidity Compliance Standards

Allowable Exceedance Turbidity Level	Action Required at 1st Monitoring Interval	Action Required at 2nd Monitoring Interval
Monitoring with Turbidimeter		
0 to 5 NTU above background	Continue to monitor every 2 hours	Continue to monitor every 2 hours
5 to 29 NTU above background	Modify BMPs & continue to monitor every 2 hours	Stop work after 4 hours at 5-29 NTU above background
30 to 40 NTU above background	Modify BMPs & continue to monitor every 2 hours	Stop work after 2 confirmed hours at 30-49 NTU above background
50 NTU or more above background	Stop work	Stop work
Visual Monitoring		
No plume observed	Continue to monitor every 2 hours	Continue to monitor every 2 hours
Plume observed within compliance distance	Modify controls and continue to monitor every 2 hours	Stop work after 4 hours with an observed plume within compliance distance
Plume observed beyond compliance distance	Stop work	Stop work

The projected dredging methods are capable of compliance with the ODEQ turbidity standards. Cutter suction dredging will be able to achieve compliance with turbidity standards in sandstone and mechanical dredging will be able to achieve compliance with turbidity standards in siltstone.

8.2 Effects on Federal and Non-Federal Infrastructure

Investigations into the effects of plan alternatives on federal and non-federal infrastructure include investigations into effects on:

- channel slope stability;
- jetty stability;
- pile dike stability;
- ODMDS E;
- ODMDS F;
- disposal Site G;
- Charleston breakwater;
- Southwest Oregon Regional Airport; and
- T-dock.

8.2.1 Channel Slope Stability

Detailed technical analyses were performed to assess the channel side slopes that may result from the channel modification project (summarized in the Engineering Appendix Section 6.8). After completion of capital dredging, side slopes are expected to continue to flatten until they reach a more stable slope angle, after which sedimentation patterns will reach an equilibrium state. Estimating the future equilibrium side slopes is critical for the purpose of predicting total dredge volumes that may result from the channel equilibration process (Section 6.9 of the Engineering Appendix) and for the purpose of estimating potential effects to federal infrastructure, including the Entrance Channel jetties and other resources. For detailed discussion of the side slope equilibration processes and impacts, refer to the Engineering Appendix, Sub-Appendix 6 (C*hannel Side Slope Analysis*).

Future equilibrium side slopes are defined herein as the slope angles that are likely to occur in the channel after the dredged channel has reached morphologic equilibrium. The process of side slope equilibration occurs simultaneously with several other processes that move sediment within the channel.

In acknowledgement of the fact that several processes are continuously occurring, the methodology used to estimate the long-term *future equilibrium* side slopes seeks to identify the various processes within the channel, and to isolate those processes that do and do not drive side slope equilibration. The methodology to estimate equilibrium side slopes consists of a sequence of three key assessments:

- Bound the range of side slope angles based on the median measured slope angles within each reach;
- Identify particular portions of the channel that could be subject to equilibration; and
- Estimate the long-term future channel behavior based on quantitative and qualitative assessment of morphological processes.

Complete details of this methodology are presented in Sub-appendix 6, *Channel Side Slope Analysis*.

The zone of equilibration is defined as the region within the side slope daylight; essentially, it represents the entire area that may be influenced by dredging. The zone of equilibration was estimated by imposing future equilibrium side slopes on the channel boundaries and daylighting to existing bathymetry. Details of mapping the daylight points are included in Section 7 of Engineering Appendix Sub-Appendix 6, *Channel Side Slope Analysis*.

The zone of equilibration for the PA is shown in Figures 8-18; this is based on conservative side slope values presented in Table 6-16 of the Engineering Appendix. The surfaces presented in these figures also include the elevation of the channel/equilibrium side slope surface at each location within the zone of equilibration. The zone of equilibration surface was imported into ArcGIS and submitted to the project design team as a 3-dimensional triangular irregular networks (TIN) surface. This zone addresses the full length of the channel and beyond until the future equilibrium side slopes daylight to bathymetry elevation model. The acreage covered by the equilibrating side slopes of the future equilibrium side slopes beyond the constructed federal navigation channel geometry is approximately 346 acres for the PA.

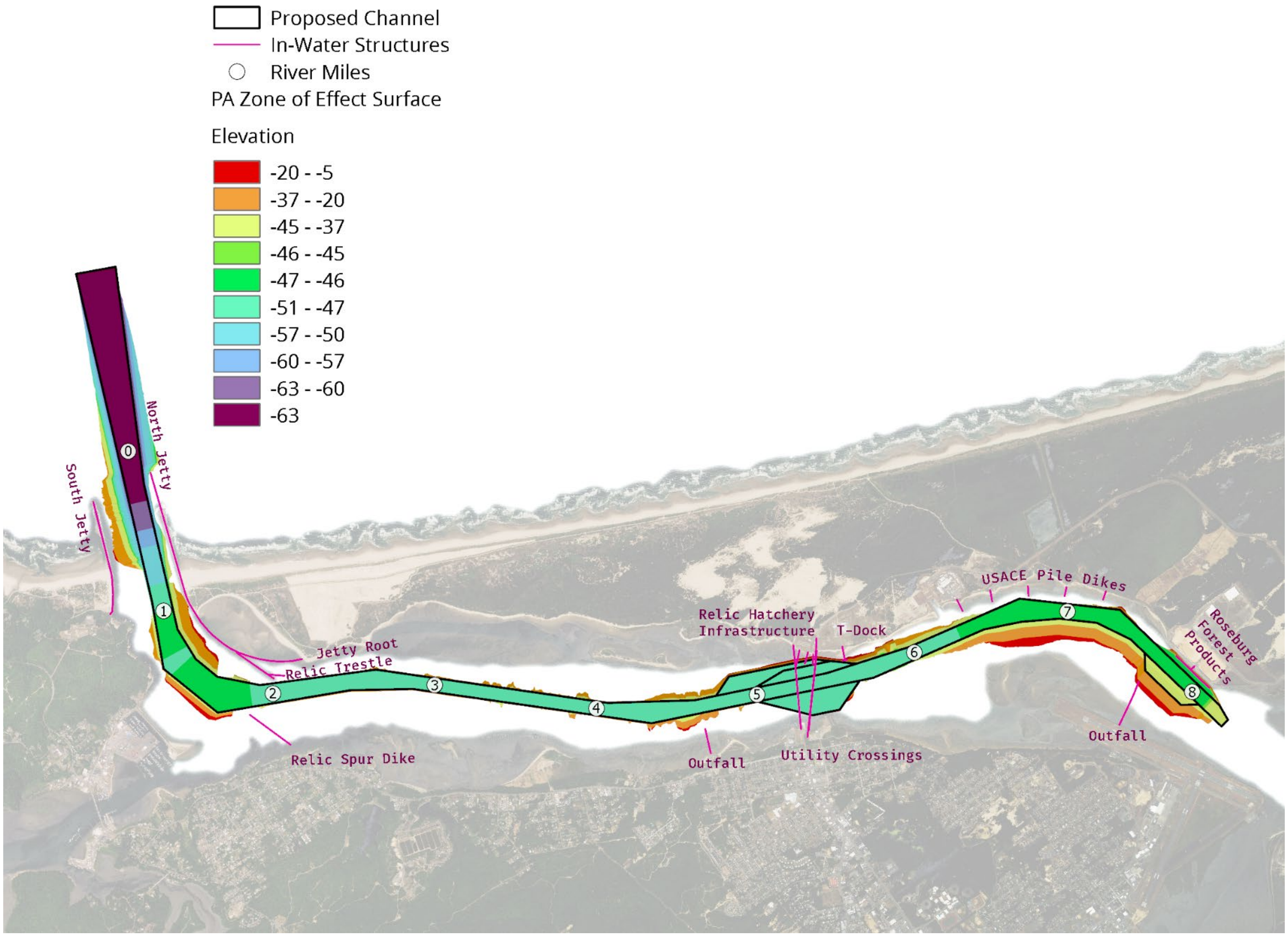


Figure 8-18: Maximum Zone of Equilibration Surface (PA)

8.2.2 Effects on Jetty Stability

Effects on the stability of the North and South Jetties are based on analyses of with-project changes to:

- Equilibrium side slopes;
- Wave height; and
- Erosion.

8.2.2.1 Slide Slope Equilibration Effects on Jetty Stability

The largest magnitude of side slope equilibration is expected to occur in the Entrance Channel, where waves and strong currents can rapidly mobilize and redistribute sediment. At the North Jetty, capital dredging is expected to occur with channel side slopes at 4:1 (horizontal:vertical) in the Entrance Channel; side slope equilibration could result in slopes as mild as 15:1 adjacent to the jetty trunk and 18:1 adjacent to the jetty root. Cross-sections cut at 100-ft intervals showing side slope equilibration relative to the North Jetty can be seen in the Engineering Appendix, Sub-Appendix 13 (*Cross Sections*) at Stations 21+00 (Sheet 29) through 2+00+00 (Sheet 117). The results indicate that toe protection is required for the North Jetty and is assumed for both the PA and APA.

At the South Jetty, capital dredging is expected to occur at 4:1 in the Entrance Channel; side slope equilibration could result in slopes as mild as 22:1 adjacent to the South Jetty. Assuming these slope angles, side slope equilibration is expected to daylight more than 50 ft from the South Jetty toe (Figure 8-19). Therefore, no effects from side slope equilibration are expected at the South Jetty and no toe protection options were necessary or appropriate. Cross-sections cut at 100-ft intervals showing side slope equilibration relative to the South Jetty can be seen in the Engineering Appendix, Sub-Appendix 13 (*Cross Sections*), at Stations 14+00 (Sheet 22) through 40+00 (Sheet 49).

For the North Jetty, four toe protection options were considered: installing piles adjacent to the North Jetty toe, relocating the jetty northward; pre-dredging the slope to the equilibrium estimate and armoring the slope; constructing a rock apron; and installing a concrete or gabion mattress (Engineering Appendix Section 6.10.2 Evaluation and Selection of Toe Protections Option).

Literature describing the behavior of a rock apron (Van der Hoeven 2002 and Froehlich 2009) indicate that such a structure is capable of providing flexible protection that can adapt to flow conditions. In addition, a rock apron will settle evenly, and it will cover the entire slope as it equilibrates. Moreover, a rock apron can be designed to be flexible along the toe of the structure during construction, providing ease of construction. Adding additional armor stone to these areas would have the effect of improving the stability of the sediment and of the jetty toe foundation.

Rock apron design is based on armor properties required for stability and the geometry of the structure. The material must be sufficient to withstand loading from waves and from currents. The geometry of the apron must be designed such that the structure provides sufficient protection for the potential future equilibrium side slopes, as described above. Design guidance is based on guidance from the Coastal Engineering Manual (CEM) (USACE 2012b), research papers (Van der Hoeven 2002, Verhagen et al. 2003, and Froehlich, 2009), the Rock Manual (CIRIA 2007), and other USACE (1994b) work. The rock apron has been designed to protect against potential effects of side slope equilibration (Engineering Appendix Section 6.10). The structure has been designed to provide a level of protection that exceeds the potential undercut depth from side slope equilibration.

Settling is caused by side slope equilibration or scour at the jetty toe, removing sediment beneath the toe of the apron. Research at model scale and on inspection of constructed structures has helped to understand the settling process and the long-term behavior of rock aprons. The research is contained in Van der Hoeven (2002). The apron will fill into the void left from side slope equilibration or scour at the jetty toe, stabilizing the sediment slope behind the settled rock. As the rock moves downwards, it continues to readjust, all the while stabilizing the overlying slope. By this phase, the rock has a similar slope to the North Jetty. In the final settled condition, the entire gradation remains well-mixed, minimizing void space and preventing sediment from eroding from underneath the structure. The apron forms a continuation of the existing jetty apron, which is located on existing relict stone, as shown in Not To Scale Figure 8-19.

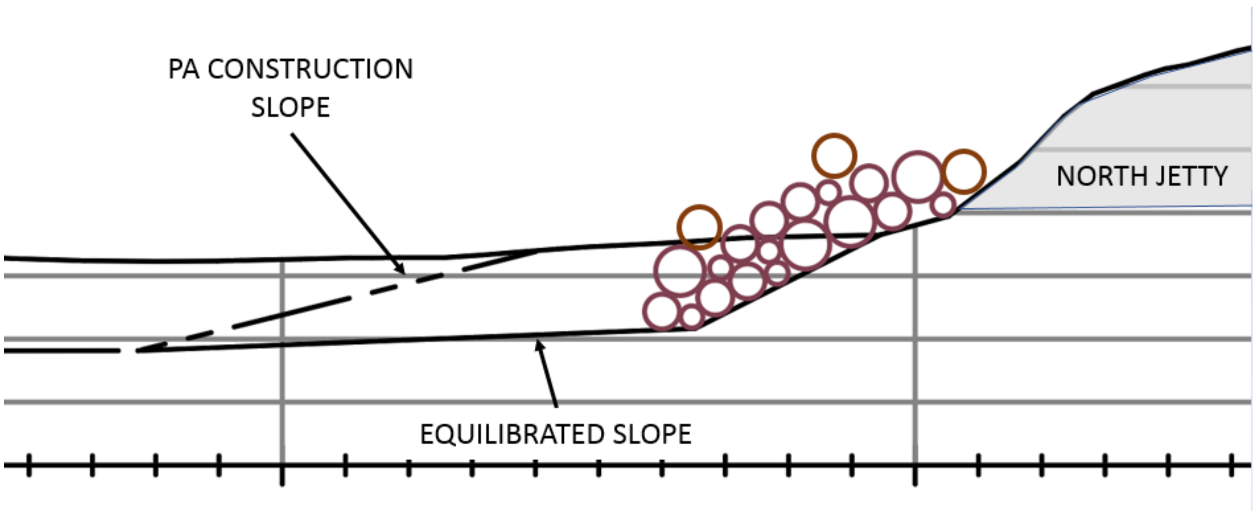


Figure 8-19: Settled Rock Apron

The long-term stability of the Rock Apron design was evaluated for the potential for sediment mobilization due to waves, currents, and differential pressure head across the jetty.

An estimate of wave scour was performed in order to determine whether wave scour may require additional protection beyond the required slope protection (i.e., is the scour depth greater than the potential side slope depth after equilibration). The method presented in the CEM (USACE 2012b) and developed by Hughes, S. A. was used to estimate the maximum wave scour depth. Prediction of scour was based on empirically derived equations from laboratory test and field observation. It should be noted that these equations assume that the sediment does not have any overlying rock. This assessment considers sand under a rock apron, and therefore this method would be very conservative for the case under consideration. The guidance describes several mechanisms that lead to scour, including "wave pressure differentials and groundwater flow that produce a 'quick' condition." These mechanisms are considered in this calculation (Engineering Appendix Section 6.10.5).

A general rule of thumb is that the scour depth is approximately equal to the maximum wave height at the structure (which would be just under 40 ft at the jetty head and 11 ft at the jetty root). The result of the scour calculations yields a maximum scour depth of 39 ft MLLW at the jetty head and 8 ft MLLW at the jetty root, below which sand should not be mobilized by waves. Based on the hillshade images in the Engineering Appendix, Sub-Appendix 2, *Geophysical Report*, this result is conservative – sediment can be seen at depths of 35 ft MLLW without scouring. As noted above, the rock apron would generally be placed below these depths (below 40 ft MLLW at the jetty head and at 20 ft MLLW at the jetty root). In addition, the rock apron will be placed on the existing sediment, which is already stable. Placing a rock apron would increase the stability of the underlying sediment, further reducing the risk sediment mobilization. Ultimately, wave action will not be able to erode the foundation of the rock apron. This is consistent with the fact that waves are not eroding sediment from under the existing rock apron.

Hydraulic gradients developing within the rock apron were also evaluated to assess the potential effect of a differential pressure head across the jetty. This evaluation used the methodology from the Dutch group CUR (1993) to calculate the exit gradient, as recommended by Van der Hoeven (2002). The determination of the exit gradient depends only on the hydraulics of the flow and not on slope angle, which is not a parameter in the exit gradient equation. The computed critical gradient was 0.181, which is the gradient required to move sediments through the rock apron. The computed critical gradient is nearly five times greater than the maximum actual gradient possible (0.037). Therefore, the hydraulic gradient through the apron is not expected to produce sufficient force to mobilize sediment.

To evaluate hydraulic gradients due to differential head across the North Jetty, a two-dimensional model was analyzed using the computer program SLIDE, developed by Rocscience. Both finite element groundwater seepage analysis and limit equilibrium slope stability analysis were completed for the cross section at RM 0.53, previously analyzed in the channel slope stability report. For reference, transient groundwater seepage best approximates the conditions at the North Jetty; however, as a very conservative assumption, a steady state head differential of 10 ft was assumed in the analysis. This situation is highly unlikely given the significant jetty porosity. The SLIDE modeling showed the hydraulic gradients in the vicinity of the proposed rock aprons were on the order of 0.01. The very low hydraulic gradient at this depth reflects that the differential head is dissipated through the much more permeable, overlying jetty stone. The resulting change in the factor of safety considering these conservative seepage forces is less than 2%, indicating the potential for strength loss due to this mechanism is not a significant consideration.

8.2.2.2 Wave Height Effects on Jetty Stability

Effects on wave propagation were presented in Section 8.1.5 Effects on Wave Propagation. Analysis of armor stone stability was based on the wave threshold for armor stone stability at all BOUSS-2D model extraction points along the North Jetty. Based on jetty parameters and stability coefficient K_D, the Hudson armor stability equation was used to calculate the maximum wave height for which the armor would be stable. This wave height was compared to the 95th percentile wave height from all the storms simulated (Section 6 of Sub-Appendix 4, *Offshore and Ocean Entrance Dynamics*).

Design guidance (CIRIA 2007) indicates that, under the Hudson equation, an increase in damage due to armor stone instability can be expected for an 8% increase in wave height; this corresponds to roughly a 26% increase in armor stone size. The changes in wave heights and equivalent armor stone sizes are presented in Table 6-3 of Sub-Appendix 4, *Offshore and Ocean Entrance Dynamics*. Along the North Jetty, none of the 95th percentile wave heights exceeded the stability thresholds. Moreover, all wave extraction points except N1 showed a decrease in 95th percentile wave heights resulting from the PA or APA. However, the 95th percentile wave heights at N1 under the Existing Conditions and PA or APA are expected to be 23.46 ft and 23.69 ft, respectively. These wave heights are much less than the wave threshold of 31 ft. Therefore, neither the PA nor APA is expected to result in any increased damage to the North Jetty.

Armor stone on the South Jetty head is sheltered by a concrete monolith that extends 300 ft offshore of the structure at MLLW, which appears to dissipate a portion of the incoming wave energy. The armor stone at the South Jetty head is presently in fair condition (USACE 2012).

Similar to the North Jetty, analysis of armor stone stability was based on the wave thresholds for armor stone stability at all BOUSS-2D model extraction points along the South Jetty. The 95th percentile wave heights under the Existing Conditions and the PA or the APA exceed the corresponding armor stone stability thresholds at the South Jetty head (S1 through S4) and part of the South Jetty root (S7). However, results generally show a decrease in wave height resulting from the PA or the APA. The maximum increase in wave height occurs at S2, where 95th percentile wave heights increase from 23.29 ft to 23.85 ft. This represents a 2.4% change (i.e., significantly lower than 8%) and, based on the CIRIA (2007) criteria, is not expected to increase damage to the South Jetty.

8.2.2.3 Effects of Erosion on Jetty Stability

The CMS model was used to evaluate currents and sediment transport in the Entrance Channel. Model results indicate that as ebb currents flow out of Coos Bay, they tend to meander through the inlet. This phenomenon already exists under the Existing Conditions. Widening the channel closer to the North Jetty under the PA or APA increases the hydraulic efficiency near the North Jetty, causing the meander to come closer to the North Jetty; thus, more erosion is predicted by the model. Figure 8-20 illustrates this potentially increased meander under the PA or APA. The model result shows a higher erosion potential under the PA and APA along the North Jetty in RM 0.7–1.0. As noted in Section 6.2 of Sub-Appendix 4, *Offshore and Ocean Entrance Dynamics*, this portion of the North Jetty toe already experiences some scour. Other areas adjacent to the North Jetty are expected to be accretional.

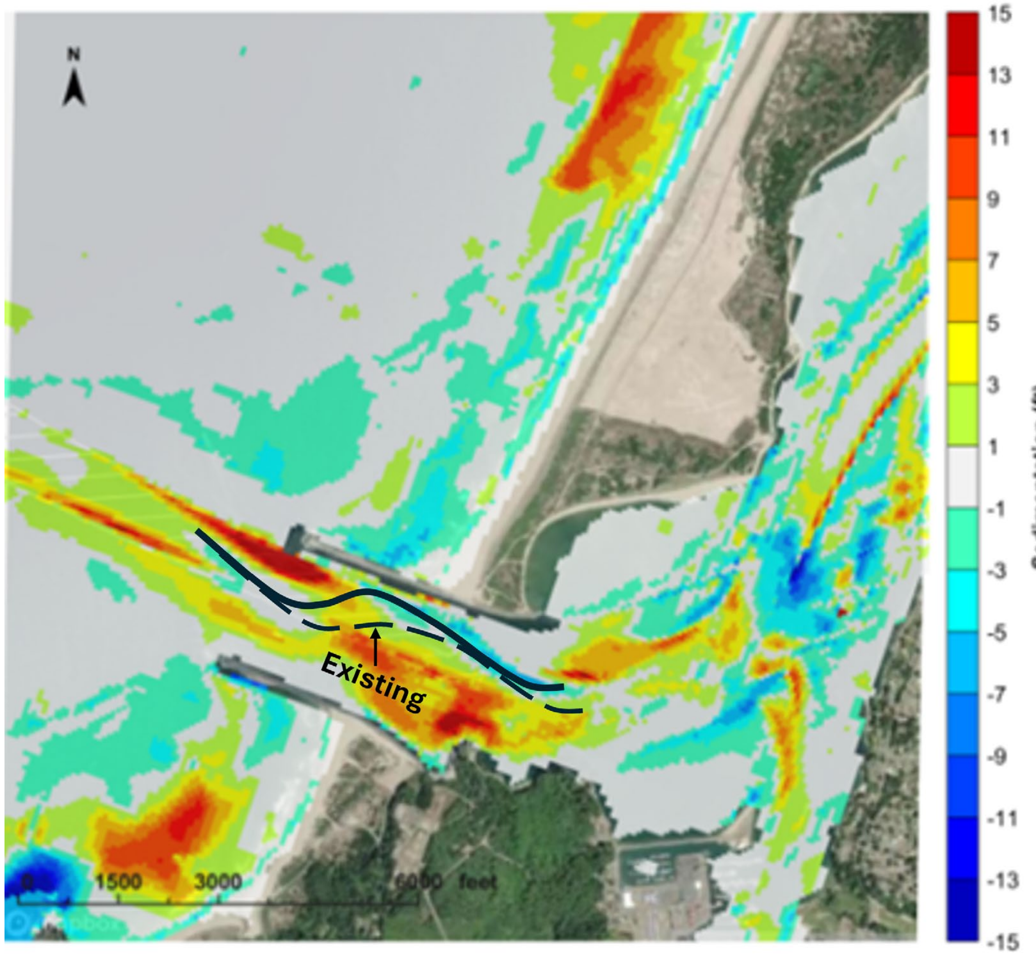


Figure 8-20: PA Condition Sedimentation Plot Overlain by Current Meander (Black Line)

The rock apron along the North Jetty has been designed to protect against this potential scour. As shown in Figure 8-20, potential erosion is between 1 and 3 ft. To be conservative, the rock apron has been designed to protect against up to 10 ft of erosion. Construction of the rock apron is a component of the PA and APA, therefore no effects to the North Jetty toe stability are expected.

Effects of erosion along the toe of the South Jetty were evaluated based on the same sediment transport model used for the North Jetty. Neither the PA nor the APA is expected to increase erosion in the vicinity of the South Jetty (Figure 8-20 shown previously). No effects from sediment transport are expected.

8.2.3 Pile Dike Stability

The existing pile dikes (Figure 8-21) maintain the existing channel alignment (i.e., they have stabilized the channel from further erosion into the North Spit) and reduce maintenance dredging requirements. In addition, the pile dikes are protected by a rock revetment along the length of each structure and by a rock apron around the channel-most pile of each structure. The rock apron at the dike heads has a radius of 50 ft and a thickness of 3 ft. At the end of the structure, the stone revetment has a thickness of 6 ft, and extends 15 ft beyond the tip of the outer-most pile. The pile dikes are in a deteriorated condition (see Section 2.2.1.3 of the Engineering Appendix), however sufficient rock remains in place from the original placement to provide protection for the pile dikes.

Capital dredging is expected to apply an initial dredge slope of 3:1 at each of the pile dikes. Note that the pile dikes are up river of the APA and dredging in the channel near the pile dikes is included only in the PA.

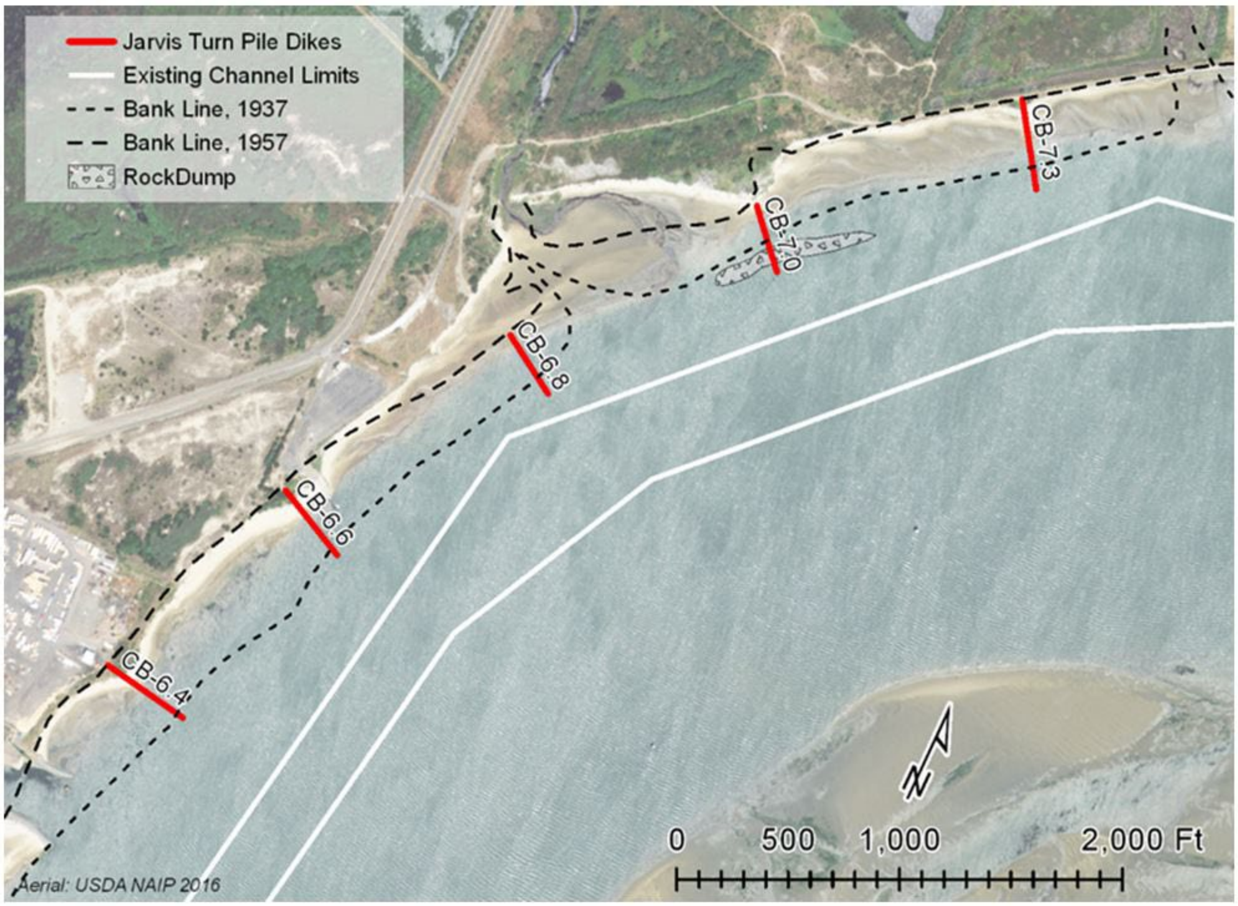
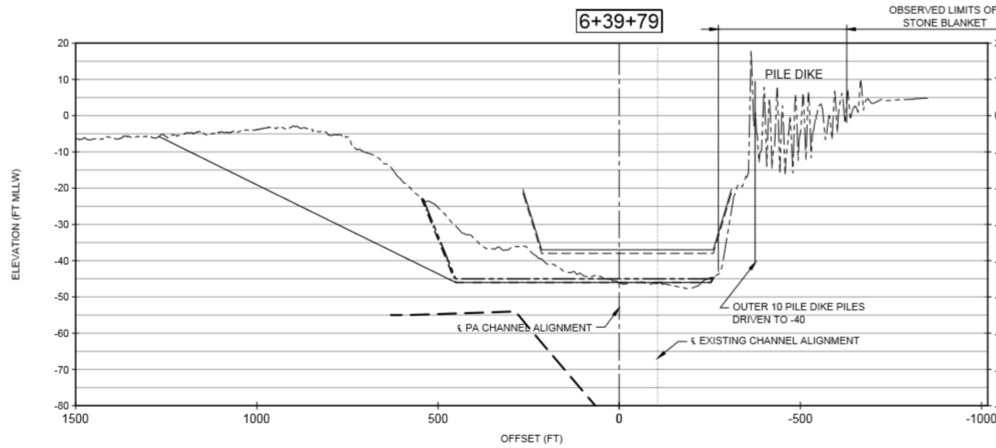


Figure 8-21: Coos Bay Pile Dikes

The navigation channel is naturally deep in the vicinity of the pile dikes, and only limited dredging is required. Because the dredge cut is expected to be shallow, equilibration is expected to be limited. Detailed cross sections at the pile dikes can be seen in Sub-Appendix 13.

The limited side slope equilibration that may occur has been shown to terminate more than 50 ft from the rock apron surrounding the pile dikes. Cross-section 6+39+79, as shown in Figure 8-22, depicts the pile dike in closest proximity to where the equilibrated channel daylights. Therefore, no effects are expected.



EXISTING CHANNEL DEPTH	-37.00
EXISTING CHANNEL DEPTH + AMD	-38.00
PA CHANNEL DEPTH	-45.00
PA CHANNEL + AMD	-46.00

Figure 8-22: Cross-section 6+39+79 depicts the pile dike in closest proximity to where the equilibrated channel daylights

In addition, sufficient rock from the original revetment is still present at the pile dikes to protect them from any potential effects.

Given the critical function of the pile dikes in maintaining the navigation channel alignment and stability, hydrodynamic modeling was used to evaluate the potential of current-driven erosion in the vicinity of pile dikes that could threaten their performance. The difference in maximum (99^{th} percentile) depth-averaged currents was calculated in the vicinity of pile dikes between the Existing Conditions and the PA (see Figure 8-23). The results indicate that generally current velocities are reduced under the PA. The only exception is at CB-7.3, where an increase of less than 0.3 ft/s during ebb flow can be seen.

Overall, the PA is not expected to increase erosion in the vicinity of pile dikes.

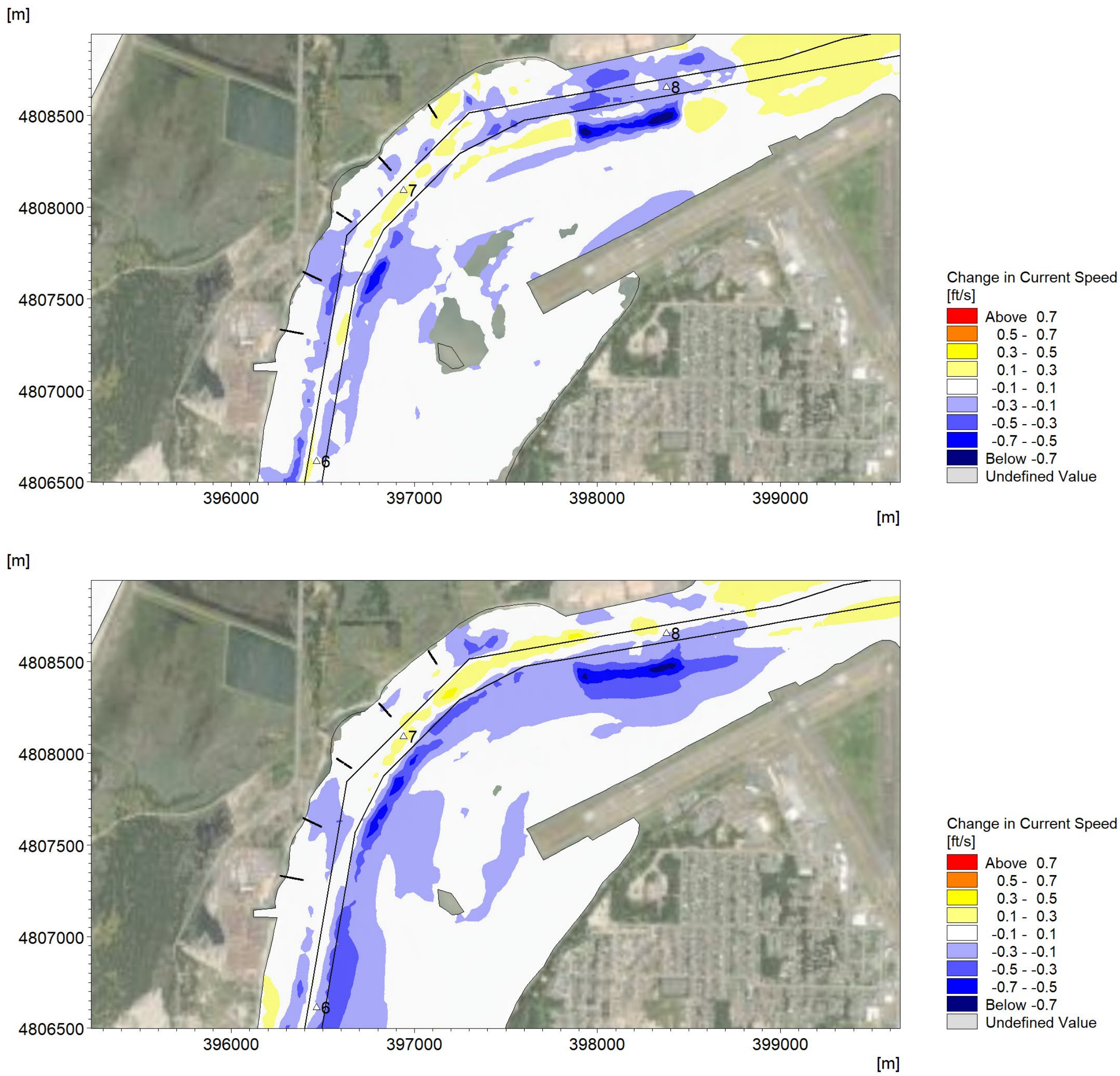


Figure 8-23
Difference in Maximum (99th Percentile) Currents near Pile Dikes (PA – Existing Conditions) for Ebb (Top) and Flood (Bottom) Flow

8.2.4 ODMDS E

ODMDS E (Figure 8-24) is authorized for the disposal of sand dredged from below RM 12, but it was not used between 1990 and 2005 due to mounding. Most recently in 2006, 79,900 cy of material was disposed at the site. The site has not been used since 2006 because a significant percentage of the material disposed in Site E migrates back into the navigation channel and therefore is an inefficient placement site. For this reason, future use is unlikely other than temporarily during extreme adverse weather conditions and if no other site is available.

The PA and APA channels will extend further offshore than the existing channel, resulting in overlap with ODMDS E (Figure 8-24). Under with-project conditions the ODMDS E footprint would be reduced to avoid channel overlap. The area of ODMDS E is reduced from 116 acres under the existing condition to 93 acres under the PA and the APA.

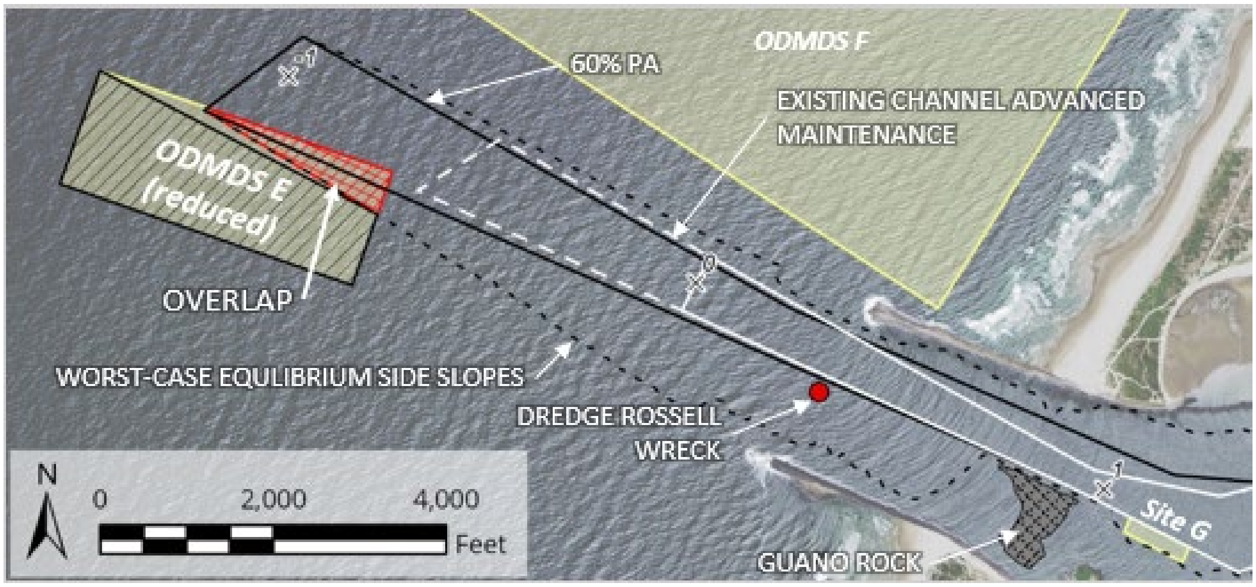


Figure 8-24: Overlap of PA and APA Navigation Channel and ODMDS E

Impacts to ODMDS E capacity were analyzed by estimating the reduction in static and annual capacities. The static capacity was estimated by determining the volume of sediment that could be disposed at the site without increasing wave heights more than 10%. The annual capacity is estimated as the volume that could be disposed each year, over a service life of 50 years, such that the static capacity is not exceeded. This calculation included modeled dispersion from the site. These analyses are detailed in the Engineering Appendix, Sub-Appendix 10 (*Dredged Material Disposal Sites*).

Table 8-9 shows static and annual capacity under the WOP Condition, the PA, and APA. The annual capacity under all project conditions exceeds projected annual use of the site, which has been used only once since 1990 (79,000 cy). The PA and the APA would reduce the static capacity of ODMDS E by 30%.

Table 8-9
Capacity of ODMDS E

Condition	Static Capacity (cy)	Annual Capacity (cy/yr – assumes 50-year life)
Existing Condition	457,000	72,000*
PA & APA	322,000	51,000
*Note: Site E has been used only once since 1990		

8.2.5 ODMDS F

Under existing USACE maintenance dredging practices, the majority of maintenance material is disposed in ODMDS F Nearshore (Figure 3-1) to support nourishment of the littoral environment. ODMDS F Offshore is used when weather and wave conditions do not allow dredging equipment to move into the shallower portions of ODMDS F Nearshore. Since the previous channel modification in 1998, the average volume disposed in ODMDS F has averaged 770,000 cy/yr (USACE 2015). ODMDS F Nearshore has been used by the Portland District for the placement of dredged material into the littoral system with an average placement of 495,000 cy per year from 2006 – 2015 (McMillan, 2018). Approximately 14,000 cy of OIPCB Unified Dredging Permit material are disposed in Site F each three-year dredging cycle.

Based on the size of Site F, its dispersive characteristic, and preferential use of the nearshore portion of Site F for littoral nourishment the site has virtually unlimited capacity for the placement of maintenance dredging material under existing conditions (USEPA 2006). The increase in maintenance material placement in ODMDS F as a result of the PA and APA will reduce the service life of the site to approximately 40 years and 45 years, respectively (Table 8-10).

Table 8-10
ODMDS F Disposal Volumes and Service Life Estimate

Description	Existing Condition	APA	PA
Placement (cy/yr)	770,000	1,139,000	1,166,000
Accumulation (cy/yr)	-	239,000	266,000
Service Life (yr)	Indefinite	~45	~40

8.2.6 Disposal Site G

Site G (Figure 3-1) is a fully dispersive site that was selected by the Portland District (USACE 2015) for use only if ocean conditions are too hazardous for a dredge to access the ODMDS or if hydraulic cutterhead (pipeline) dredging is conducted in the Charleston Access Channel (USACE 2015). Maintenance material has been disposed in Site G in 17 of the last 27 years (see Section 2.4.3 for detailed description of Site G usage). Review of bathymetric surveys in years following placements at Site G indicate no accumulation, supporting the assertion that the site performs according to its dispersive designation. Further, USACE reports that material is disposed via pipeline dredge only during ebb tides to allow dispersal of the material to the ocean with the energy of the outgoing tide (USACE 2015).

Surveyed cross-sections in the vicinity of Site G indicate that the site has been effective in dispersing material that has been placed there, and that the site is relatively stable. Surveys are conducted at intervals of approximately one year, and dispersal has been shown to occur within one year of placement. From 2011 to 2012, following the placement of 60,000 cy, all the material disposed at the site was dispersed within the year. Wave and current modeling at the site indicate the hydrodynamics at the site are expected to remain much the same under the PA and APA as under the WOP Condition.

Because of Site G's proximity to the channel (Figure 8-25), side slope equilibration will likely deepen the riverbed at Site G by up to 8 feet. Therefore, a detailed review of historical and existing conditions was performed for Site G (see Section 8.2.6 Disposal Site G) for the purpose of comparison to with-project conditions. Section 10.3.4 of the Engineering Appendix presents the analysis of potential impacts to Site G, which concludes that implementation of the PA or APA are not anticipated to impact USACE's existing or future use of Site G.

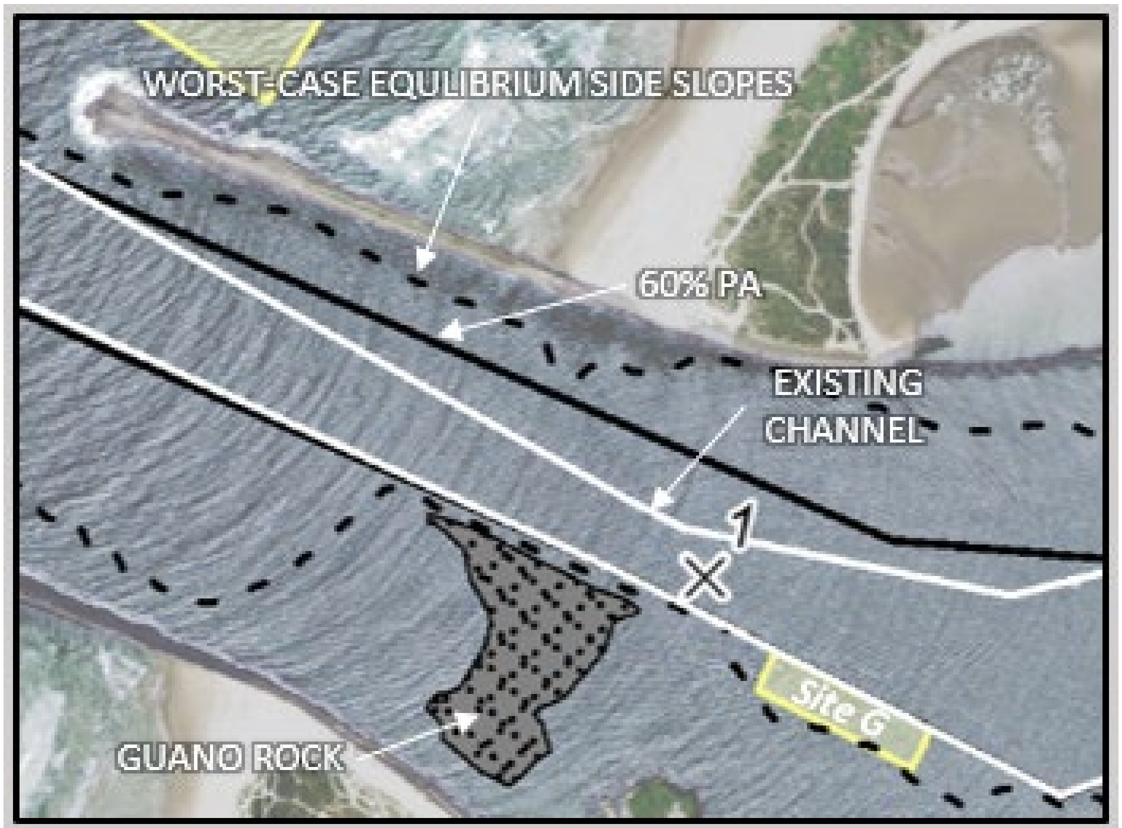


Figure 8-25: Extent of Side Slope Equilibration near Site G

The PA and APA alternatives are adjacent to Site G (the same as the Existing Condition). After dredging, side slope equilibration may mobilize the material underlying Site G, causing the site to deepen and increasing the volume capacity of Site G by the amount of material that equilibrates off the channel side slope. Note that the equilibrium side slope along this edge of the channel has an angle of 13:1. Figure 8-25 shows that the entire area of Site G will likely be subject to side slope equilibration.

Cross-sections through Site G are presented in the Engineering Appendix, Sub-Appendix 13 (*Cross Sections*), Stations 1+05+00 through 1+12+00. Site G is located on a sloped surface with its right (north) boundary at the toe of the existing channel. A representative cross section is presented in Figure 8-26. The bathymetry along most of the channel is naturally deeper than the PA channel, and the thalweg has a depth of -55 ft MLLW.

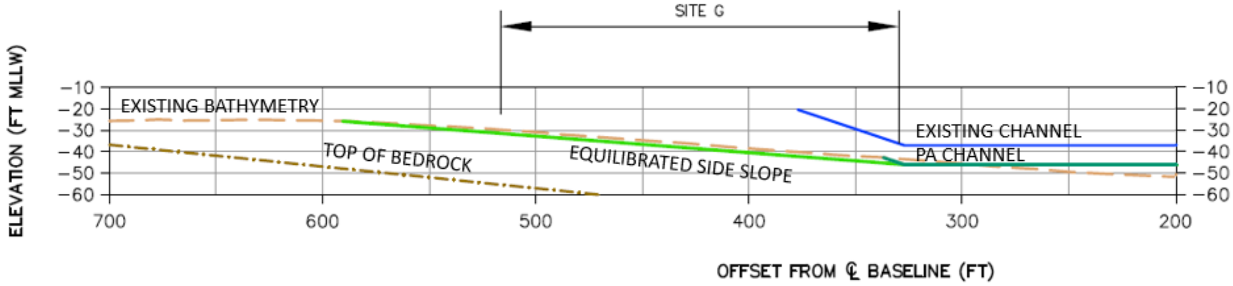


Figure 8-26: Representative Cross Section at Site G

During construction, there is no projected impact to Site G because the existing Site G is deeper than the existing FNC, therefore any maintenance material disposed by USACE in Site G during construction of the PA would be disposed below the existing FNC. Additionally, material disposed in Site G during construction of the PA or APA would continue to disperse as it presently does.

During the equilibration period side slope equilibration at Site G will continue until 6 years after capital dredging is complete. Material volumes associated with side slope equilibration at site G are presented in Table 8-11. For the purpose of definitively accounting for all equilibrated material, it is conservatively assumed that 100% of all side slope equilibration material will remain in the channel reach adjacent to Site G and must be removed during maintenance dredging, even though the historical evidence shows that this area is dispersive (Section 2.4.3) and the material will be flushed with the tide.

Table 8-11
Side Slope Equilibration Volume by Year (Site G)

Construction Phase/ Year	Side Slope Equilibration Volume (cy)
2	17,800
3	14,600
4	10,800
5	7,200
6	4,400
7	2,400
8	1,200
9	500

Side slope equilibration will deepen the riverbed at Site G by up to 8 feet. Material disposed by USACE into Site G during the equilibration period will continue to disperse as it does presently (i.e., sediment will not accumulate at Site G nor does it slough to the bottom of the channel) because the physical forces, which cause Site G to be dispersive are not affected by the PA or the

APA. As a result, USACE can continue to use Site G as it does now, with no impact on Site G or the deepened and widened FNC during the equilibration period.

After side slope equilibration is complete, it is expected that Site G will continue to behave consistent with the historical and present conditions because nothing will have been changed by the PA or APA to affect the dispersive nature of the site. Figure 8-27 shows difference plots of current velocities, comparing without-project conditions with the PA or APA, for the five conditions investigated. Under each condition, current velocities are not projected to change at Site G. Therefore, USACE will be able to place material at Site G consistent with the existing practices, and the material will disperse consistent with existing dispersal.

While it is unclear without a detailed tracer study where the material that disperses out of Site G eventually settles (i.e., in or out of the estuary or the FNC), this dispersal process will not be changed by the PA or APA. So, to the extent that some of the material may settle in some portion of the FNC, it is already included in existing shoaling rates and projected future dredge volumes. The portion of material dispersing from Site G that settles outside of the FNC, does not affect dredging quantities or the availability of Site G.

Analysis of existing and with-project bathymetry, including projected side slope equilibration (Figure 8-26), and without- and with-project current velocities (Figure 8-27) supports the conclusion that Site G will continue to be dispersive under either the PA or APA alternatives for the type and volume of material historically disposed at the site.

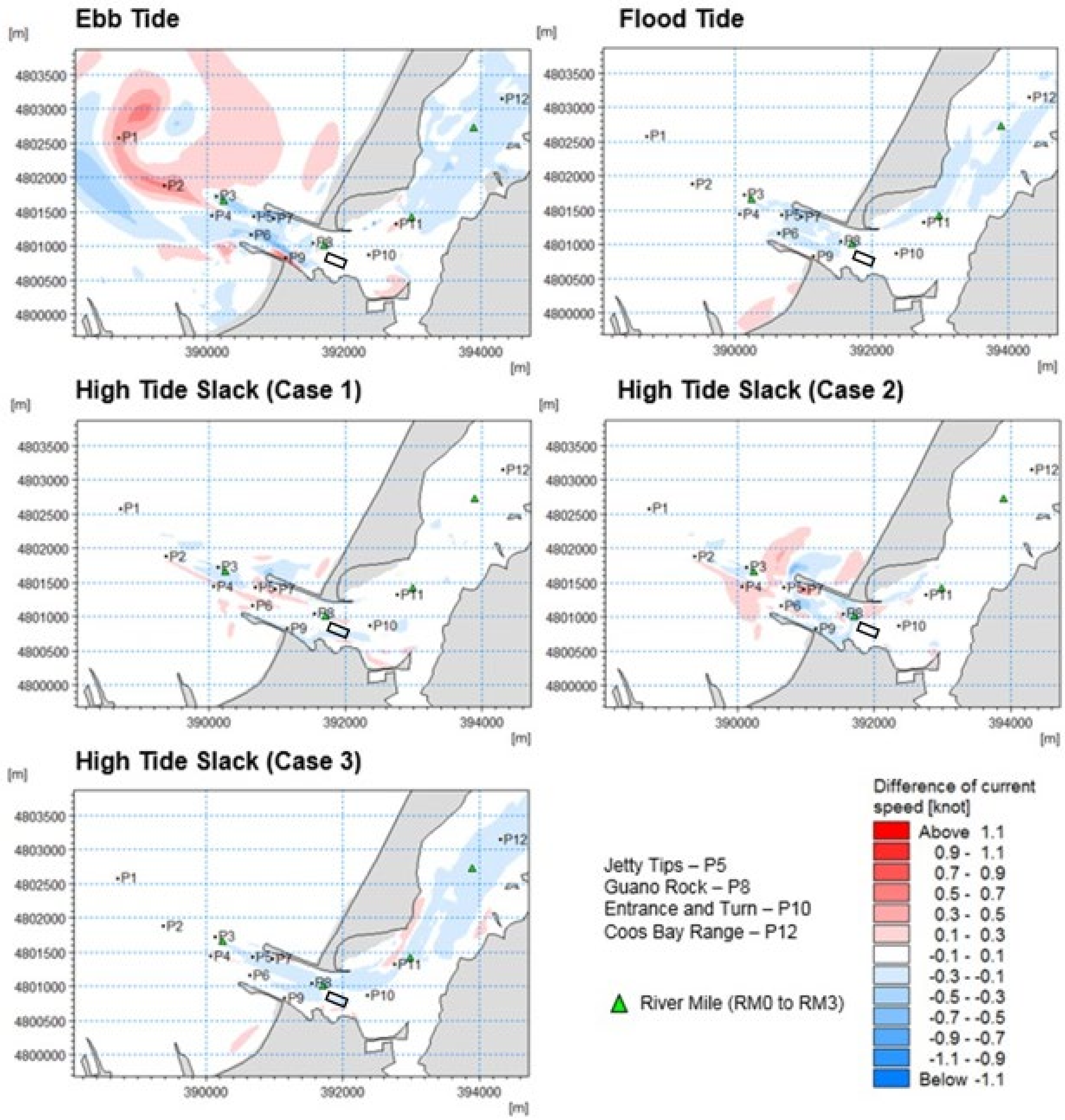


Figure 8-27: Difference Plots of Entrance Currents through the Tidal Cycle (PA minus WOP) (Site G)

8.2.7 Charleston Breakwater

The potential effects of the channel modifications on the stability of existing infrastructure, including the Charleston Breakwater, was investigated in the wave model studies as presented in the Engineering Appendix, Sub-Appendix 4 (*Offshore and Ocean Entrance Dynamics*). Model results indicate that wave heights in the vicinity of the Charleston Breakwater are expected to decrease throughout the full range of extreme wave conditions as a result of the PA or APA (Figure

3-64 through 3-67 of the Engineering Appendix, Sub-Appendix 4). There are no projected negative effects to the Charleston Breakwater under either the PA or APA alternatives.

8.2.8 Outfalls

Three outfalls existing within the project area: the Empire Outfall, the North Spit Outfall, and the Airport Outfall. Each outfall is located over 350 ft away from the side slope daylight, which is a sufficient distance from the navigation channel to avoid any impact from side slope equilibration, as described in the Engineering Appendix, Sub-Appendix 9 (*Side Slope Analysis*). Cross-sections at each outfall showing the conservative side slope equilibration angle can be seen in the Engineering Appendix, Sub-Appendix 13 (*Cross Sections*). Within Sub-appendix 13, Figures 133 and 134 show the Empire Outfall, Figures 138 through 149 show the North Spit Outfall, and Figure 178 through 180 show the Airport Outfall.

8.2.9 Buried Pipelines

A single buried utility corridor crosses the Coos Bay FNC at RM 5.3. The uppermost utility (gas HDPE pipeline) is located at a depth of -62 ft MLLW, or approximately 15 ft beneath the PA and APA design depth and 13 ft beneath the PA and APA overdepth. The depth below the improved channel is sufficient to avoid effects by mechanical dredging, which is projected for this area, and to avoid buoyancy of the gas pipeline. A sewer line (HDPE) at -72 feet and a water line (HDPE) at -90 feet are also buried in the same utility corridor.

8.2.10 Southwest Oregon Regional Airport

Airport lights are more than 2,000 ft away from the zone of equilibration associated with the PA or APA. Therefore, no effects to the airport infrastructure are expected. Upon implementation of the PA or APA, coordination between the pilots and the airport will continue to provide safe deep draft vessel navigation and air traffic. An initial airspace impacts report was prepared (Engineering Sub-appendix 14) and indicated no significant concerns.

8.2.11 William T. Rossell

The wreck of the *William T. Rossell* is located between the Entrance Channel jetties, approximately 140 ft south of the existing FNC and 85 feet south of the PA Channel Limits. The bottom elevations in the area of the wreck are approximately -45 ft to -50 ft MLLW with an existing slope of approximately 22H:1V. The maximum elevation over the highest remaining superstructure is approximately -30 ft MLLW with the elevation of most of the visible wreck in the -35 ft to -45 ft MLLW range. Since its sinking in 1957, the majority of the wreck has become buried at depths of up to 15 ft to 20 ft. The bottom of the hull at the stern (furthest from the channel) is located at an elevation of approximately -60 ft MLLW and the bottom of the hull at the bow (closest to the channel) is at approximately -70 ft MLLW. The wreck has a break in the hull at approximate mid-ship and possibly a break in the hull forward closer to the bow.

As explained in Engineering Sub-appendix 4 and Engineering Sub-appendix 6, the area in the vicinity of the *Rossell* wreck is highly depositional and experiences rapid shoaling following dredging events. The long-term equilibrated channel side slope is the resulting slope configuration after the effects of dredging no longer affect channel side slope morphology. In regions of high shoaling, such as the area around the wreck, where channel maintenance dredging occurs on an annual basis, there is no trend of material from the top of, or above, the dredge slope shifting down slope or movement of the wreck itself. Long-term slope equilibration is not anticipated to result in any significant bed lowering in the area adjacent to the wreck. Therefore, no adverse effects to wreck stability will result from long-term slope equilibration.

Cross-sections showing constructed condition and future equilibrium side slopes extending from the PA or APA near the *Rossell* are presented in Sub-Appendix 13, Stations -0+18+00 and 0+19+00. The PA or APA constructed condition side slope of 4H:1V (including advanced maintenance dredging) will daylight 50 ft or more from the wreck. Therefore, no adverse effects to wreck stability will result from construction dredge activities. While the range of future equilibrium side slopes are shown undercutting the wreck, no significant bed lowering due to slope equilibration is expected in the area adjacent to the *Rossell* wreck. However, it was determined that project effects and O&M volumes in this reach would be based on a linearized future equilibrium side slope of 22H:1V extending up and out from the dredge toe at the advance maintenance dredge depth. Although this slope is not applicable for assessment of potential effects on the wreck, the amount of undercutting represented by the future equilibrium slopes would not represent sufficient erosion to mobilize the wreck on a 22H:1V slope to a point where it would have an effect on the channel or future dredging activities.

8.2.12 T-dock

Effects to the T-dock were evaluated as a result of side slope equilibration. Engineering Sub-Appendix 13, *Cross Sections,* show cross-sections with the future equilibrium side slope angles adjacent to the T-dock and no effects to the T-dock are anticipated.

8.3 Effects on Performance of the Federal Navigation Project

Investigations into the effects of plan alternatives on performance of the federal navigation project include investigations into effects on:

- Vessel transits during construction;
- Aids to navigation;
- Dredged material disposal capacity and availability; and
- Routine maintenance capability.

8.3.1 Effects on Vessel Transits During Construction

The current proposed construction schedule assumes that all dredging will be performed during the dredging work windows that occur annually from June 15 through February 15. During construction, Coos Bay will remain an active navigation channel, with approximately 50 deep draft commercial vessel calls per year, which is an average of 2 transits through the navigation channel per week. In addition, during construction USACE will perform annual maintenance on channel reaches that have not been dredged as a part of the construction project.

There are four mechanisms through which navigation and navigational safety will be maintained during channel construction:

- Communication protocols;
- USCG Notice to Mariners;

- Safety zones; and
- Equipment relocation.

Communication will be maintained among the pilots, USCG, dredging contractors, and safety patrol boats. The commercial and recreational fleet using Charleston Marina will be notified of the radio channel to monitor for current construction information.

Daily Local Notice to Mariners will be issued by the USCG to convey temporary information of short duration that may have an impact on navigation. Data, such as dredge type, name, location, duration and likely movements, will be provided and published so marine traffic is aware of potential hazards.

Safety zones will be established and enforced by contractor-provided patrol boats. A safety zone for recreational vessels will be established around hopper dredges, cutter suction dredges, and mechanical dredges whenever they are operating.

Hopper dredges are the only self-propelled and most mobile pieces of dredging equipment to be deployed during construction. A hopper dredge can clear the channel by sailing outside of the channel limits if there is sufficient water depth or move into the anchorage and allow large vessels to pass. The hopper dredge may time its trip offshore to the ODMDS to deposit its load of material, such that the navigation channel is clear for the deep draft vessel to pass. Because the hopper dredge sails up and down the channel to collect material, it needs to constantly mind recreational traffic. However, the notice to mariners should communicate to recreational users to steer clear of the channel when near a working vessel.

The other types of equipment, such as mechanical dredges and cutter suction dredges, are not self-propelled and are stationary when working. This means they may require some type of assistance by a tug in order to clear out of the channel for large commercial vessels. The cutter suction dredge can work on the side of the channel and swing into the channel to dredge/cut the material; it is capable of swinging to the side of the channel without tug assistance to allow for vessel passage. The cutter suction dredge will also have a swing wire that will lay across the channel that will need to be "slacked off" when deep draft vessels pass. This process can happen within minutes.

Mechanical dredges will need the assistance of a tug to move out of the channel. They will have a scow alongside during dredging operations and will have a tending tug present. The mechanical dredges generally require 1 to 2 hours of notice to clear the channel. Given notice, they can clear the channel to allow channel access for deep draft vessels.

Consistent implementation of these four navigational safety mechanisms during channel construction should result in no unacceptable effects to vessel transits during construction of either the PA or APA alternatives.

8.3.2 Effects on Aids to Navigation

ATON serves mariners by helping them locate and navigate the federal channel at Coos Bay. Presently, 46 ATON are used to mark the FNC between the channel entrance and RM 8. As a part of the Coos Bay Channel Modification Project (the Project) the existing ATON will need to be removed, relocated, or supplemented with additional markers. The new ATON (lateral and range markers) have been configured and located with input from the Coos Bay Pilots Association, review of USCG design documents, and recommendations stemming from full ship simulations conducted for the Project. The proposals will be reviewed by the USCG and revised if required as the Project progresses.

ATON relocation will take place during Phase 3 of the Project and will be coordinated with the USCG, the Port, and the Coos Bay Pilots Association. The federally operated ATON may be installed by the Port based on specifications provided by USCG. The installed ATON could then be transferred to the USCG at a mutually agreeable time, likely during Phase 3 of the contract (see Engineering Sub-Appendix 1, *Aids to Navigation* for a full description of proposed ATON relocations and installations). In addition, it is anticipated that existing ATON within 50 ft of the PA or APA channel will be temporarily relocated during dredging and re-installed in their existing locations; this includes lateral markers 2, 3, 4, 5A, 6, 6A, 8, 10, 10A, 11, 12, 13, 14, 15, 16, 18, 20, 22, and 23, all of which are buoys. The contractor will remove the buoys one (1) day prior to dredging within 50 ft of the sinker and replace them no more than one (1) day after dredging within 50 ft of the buoy's location is complete. Final buoy relocation will occur during year 3 of capital dredging.

All ATON relocation will be conducted with a crane barge and supporting plant. Construction activities associated with specific ATON type are detailed in Section 5.5 of Engineering Sub-appendix 11, *Construction Implementation Plan*

8.3.3 Effects on Dredged Material Disposal Capacity and Availability

Section 10.3 of the Engineering Appendix discusses the effects on dredged material disposal capacity for each of the disposal sites that may be affected by the project. The effects on dredged material disposal capacity are limited to the 30% capacity reduction of ODMDS E, which has been used only once since 1990 because of its proximity to the channel (Section 10.3.2 of the Engineering Appendix), and the reduction of the ODMDS F lifespan to 45 years for the PA and 40 years for the APA (Table 8-10).

There are no other long-term or temporary effects on dredged material disposal site availability due to the project. The re-handling site at RM 8.4 is outside the dredging project limits and there would be no restrictions on site usage by USACE during or after construction. Coordination may be required between the OIPCB dredging contractor and the USACE dredging contractor, if USACE needs to place material in Site G while the OIPCB dredging contractor is dredging the Entrance Channel.

8.3.4 Effects on USACE Routine Maintenance Capability

Effects on USACE routine maintenance capability are evaluated for the short-term, during the side slope equilibration period, and during the long-term, which is post-equilibration.

8.3.4.1 Effects on Short-term Maintenance Capability

Short-term O&M volumes incorporate the changes to annual shoaling as well as volumes contributed by side slope equilibration. The methodology to evaluate side slope equilibration was presented in Engineering Appendix Section 6.8, Channel Side Slope Analysis and detailed in the Engineering Appendix, Sub-Appendix 9 (*Side Slope Analysis*). Side slope equilibration calculations assume that the channel side slopes will equilibrate to the future equilibrium side slope angles. This assumption ensures that all potential volume is accounted for. Table 8-12 shows total predicted side slope equilibration volumes for the APA and PA.

Table 8-12
Predicted Total Side Slope Equilibration Volumes (cy)

RM	-1 to 0	0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8.2	Total
APA	179,000	289,000	556,000	3,000	17,000	82,000	171,000	0	0	1,297,000
PA	179,000	289,000	556,000	3,000	17,000	82,000	171,000	149,000	0	1,446,000

Side slope equilibration is projected to begin after capital dredging is complete in each area. Based on analysis of previous channel improvements, the duration of side slope equilibration is projected to be 7 years after the completion of construction for the for the PA and APA– and the annual volume decreases substantially over that duration. An exception is the Entrance Channel; since this area is exposed to significant hydrodynamic forces it is likely to equilibrate in as little as two months. Based on Raaijmaker's (2005) analysis, 20% of the side slope equilibration volume is expected to be removed during capital dredging. The remaining 80% of equilibrated material must be removed from the channel during routine maintenance to ensure that project depths are available.

In general, OIPCB will assume maintenance responsibility during construction for all areas of the channel where a construction dredge is active. Similarly, OIPCB will be responsible for maintaining the PA depth until the Project has been certified as complete and accepted by the ASA(CW). During construction, USACE shall be responsible for maintaining areas that have not yet been dredged and other non-project areas of the channel (RM 8.2 to 15, Charleston Channel) to the existing authorized navigation depth (Table 8-13). After construction is certified as complete, the USACE will be responsible for maintenance associated with the selected plan.

Table 8-13
Summary of USACE and OIPCB maintenance dredging responsibilities

Year	USACE Responsibility	OIPCB Responsibility	Assumptions
Year 1 (start of construction)	Shoaling in RM -1 to 1 Shoaling in RM 8.2 to 12	Shoaling in RM 1 to 8.2	OIPCB contractor widening and deepening RM 1-2, RM 4-5 and RM 6-8.2 and widening RM 3-4 and RM 5-6. The contractor will also dredge Guano Rock. Contractor will perform O&M where capital dredging is active.
Year 2	Shoaling in RM 8.2 to 12	Shoaling in RM -1 to 8.2 Side slope equilibration of RM -1 to 8.2	OIPCB contractor widening and deepening RM -1 to 1 and RM 2-3. Contractor will perform O&M through RM 8.2.
Year 3 (final year of construction)	Shoaling in RM 8.2 to 12	Shoaling in RM -1 to 8.2 Side slope equilibration in RM -1 to 8.2	OIPCB contractor deepening RM 3-4 and 5-6. Contractor will perform O&M to AM dimensions throughout entire channel.
Year 4 (capital dredging complete)	Shoaling in entire FNC,	---	OIPCB contractor will demobilize after Year 3 or after Year 4 (to be determined). Side slope equilibration decreasing annually through end of equilibration period.

Short-term maintenance and equilibration dredging volumes are presented in Table 8-14. Note that the side slope equilibration values are conservative maximum values used to evaluate placement area effects and requirements. Expected side slope equilibration estimated are presented in Table 10-5.

Table 8-14
Maintenance Dredging Volumes: Years 1-10 (cy)

Year	APA			PA		
	Without-Project Condition	O&M - Increase	Side Slope Equilibration	Without-Project Condition	O&M - Increase	Side Slope Equilibration
1	832,000	0	0	832,000	0	0
2	832,000	25,000	311,000	832,000	47,000	647,000
3	832,000	311,000	587,000	832,000	333,000	863,000
4	832,000	312,000	1,520,000	832,000	334,000	1,997,000
5	832,000	312,000	126,000	832,000	334,000	488,000
6	832,000	312,000	78,000	832,000	334,000	326,000
7	832,000	312,000	41,000	832,000	334,000	198,000
8	832,000	312,000	20,000	832,000	334,000	109,000
9	832,000	312,000	8,000	832,000	334,000	55,000
10	832,000	312,000	0	832,000	334,000	26,000
Total	**8,323,000**	**2,520,000**	**2,691,000**	**8,323,000**	**2,718,000**	**4,709,000**

8.3.4.2 Effects on USACE Long-Term Maintenance Capability

Table 8-15 shows the projected increase in long-term annual average shoaling under each project condition, as well as the total future expected annual O&M. It should be noted that the predicted increase in shoaling reported in this table is additive to the existing annual O&M. Additionally, it should be noted that modeling did not indicate a change to sedimentation within Charleston Channel, or any other channel that is not included in this table.

Table 8-15
Increase in Annual Average O&M and Predicted O&M for Future Project Conditions by RM (cy/year)

RM	-1 to 0	0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 to 12.4	Total (-1 to 12.4)
Average Existing O&M	270,000	371,000	14,000	1,000	300	7,000	33,000	18,000	21,000	35,000	62,000	832,000
Future O&M – Future Increases from Existing O&M Values												
APA Increase	31,000	251,000	1,000	1,000	0	4,000	19,000	0	0	0	0	307,000
PA Increase	31,000	251,000	1,000	1,000	0	4,000	19,000	8,000	13,000	5,000	1,000	334,000
Total Future O&M – Expected Values												
WOP Condition	270,000	371,000	14,000	1,000	300	7,000	33,000	18,000	21,000	35,000	62,000	832,000
APA	301,000	622,000	15,000	2,000	300	11,000	52,000	18,000	21,000	35,000	62,000	1,139,000
PA	301,000	622,000	15,000	2,000	300	11,000	52,000	26,000	34,000	40,000	63,000	1,166,000

O&M is presently conducted by two USACE dredges, the *Essayons* (in the Entrance Channel) and the *Yaquina* (in the estuary), and by contract dredges. In the Entrance Channel, shoaling is expected to increase by 282,000 cy for the APA and PA. USACE dredge receipts from 1992-2016 indicate that the average production rate for the *Essayons* dredge is 31,400 cy/day. Assuming this production rate, the increased O&M volume would require approximately nine additional days of dredging relative to WOP Conditions.

In the estuary, shoaling is expected to increase by 25,000 cy for the APA and by 52,000 cy for the PA. USACE dredge receipts from 1992-2016 indicate that the average production rate for the *Yaquina* dredge is 5,200 cy/day. Assuming this production rate, the increased O&M volume under the APA would require approximately five additional days of dredging relative to WOP Conditions and 10 additional days relative to WOP conditions for the PA.

8.3.5 Annual Variability

Table 8-15, above, provides the annual average values. For planning purposes, however, USACE may also consider the range of O&M values that may occur for any given year. The variation in annual dredging can be expressed as the standard deviation (Table 8-16). To estimate the standard deviation for the future with-project conditions, the standard deviation for the Existing Condition was scaled by relative expected values.

The annual range of dredge volumes is calculated by adding or subtracting the standard deviation to the annual expected value (Table 8-17). It should be noted that in some cases, the standard deviation is greater than the expected value. In these cases, negative values were not considered; instead, a value of zero is used. It should also be noted that the largest total dredge quantities will likely correspond to periods when the upper bay (RM 9-12.4) is dredged. The historical O&M dredging downstream of RM 9 only exceeded 1 mcy in 2007. It is expected that the upper range of the total O&M estimates (1.4-1.5 mcy) will only occur in years when the upper bay is dredged.

Table 8-16
Standard Deviation of O&M by RM for Project Alternatives (cy/year)

RM	-1 to 0	0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 to 12.4	Total (-1 to 12.4)
Existing Condition	57,000	79,000	13,000	1,000	<1,000	9,000	13,000	8,000	9,000	21,000	191,000	401,000
APA	64,000	132,000	14,000	2,000	<1,000	14,000	20,000	8,000	9,000	21,000	191,000	475,000
PA	64,000	132,000	14,000	2,000	<1,000	14,000	20,000	12,000	15,000	24,000	194,000	491,000

Table 8-17
Range of Annual O&M Dredging Under Future With-Project Conditions (cy/year)

RM	-1 to 0	0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 to 12.4	Total (-1 to 12.4)
APA	237,000 to 365,000	490,000 to 754,000	1,000 to 29,000	0 to 4,000	0 to 1,000	0 to 25,000	32,000 to 72,000	10,000 to 26,000	12,000 to 30,000	14,000 to 56,000	0 to 253,000	796,000 to 1,615,000
PA	237,000 to 365,000	490,000 to 754,000	1,000 to 29,000	0 to 4,000	0 to 1,000	0 to 25,000	32,000 to 72,000	14,000 to 38,000	19,000 to 49,000	16,000 to 64,000	0 to 257,000	809,000 to 1,658,000

With the wide range in annual shoaling volumes from year to year, there is risk that there will not be sufficient budget in some years to maintain the entire channel. However, vessels will not always arrive or depart with drafts requiring full channel depth and vessels have flexibility in making use of the tide. As stated by a Memorandum for the Record[59] (MFR) signed July 16, 2018 by OIPCB and USACE:

Recognizing the limitations of modeling and relying upon past shoaling rates, and that it is possible that more extensive shoaling could occur in extreme years in the future, the Port is willing to accept the risk that occasionally the full channel depths of -45 feet MLLW may not be able to be maintained by USACE using one foot of AMD (i.e., by dredging to 46 feet MLLW, plus overdepth). The Port is willing to accept this risk with the full understanding that the impacts to commercial navigation will be negligible due to: 1) required use of the 6 foot tidal advantage by LNG vessels, 2) flexibility in use of tides by dry bulk vessels, and 3) the fact that the constraining reach from a shoaling standpoint is the entrance channel, not the inner channel. The Port is willing to acknowledge their acceptance of the minor shoaling risk that the 45-foot channel may not always be able to be maintained in the Maintenance Agreement that will be signed between the Port and USACE prior to assumption of maintenance. In addition, the full -57-foot depth in the Entrance Channel may be temporarily unavailable due to excessive shoaling, funding constraints, and dredge plant schedule limitations.

[59] Burns, J. OIPCB. 2018 Jul 16. Memorandum for the Record: Agreements Reached at the July 12, 2018 Meeting between Kevin Brice and Pat Duyck (CENWP), John Burns and Mike Dunning (OIPCB), and David Miller (DMA) Regarding Coos Bay Section 204/408 Project Channel Design Construction and Maintenance. MFR to Brice, K.

9. ENVIRONMENTAL EFFECTS OF ALTERNATIVE PLANS

[SECTION TO BE COMPLETED WITH SUMMARY OF EFFECTS FROM THE DRAFT EIS CURRENTLY UNDER PREPARATION BY USACE]

10. RECOMMENDED PLAN

The OIPCB recommends the PA to the ASA(CW) for assumption of operations and maintenance under the authority granted by Section 204(f) of the Water Resources Development Act (WRDA) of 1986, as amended by Section 1014(b) of the Water Resources Reform and Development Act (WRRDA) of 2014, and Section 1127 of Water Infrastructure Improvements for the Nation (WIIN) Act of 2016. The PA also requires approval of the NWD Commander under Section 14 of the Rivers and Harbors Appropriation Act of 1899, 33 United States Code (USC) 408 (Section 408), and the Portland District Commander for the Section 404/10 permit decision.

10.1 Description of the Selected Plan

The plan selected by the OIPCB is the Proposed Alteration. The PA is shown in Figure 10-1 and consists of the following elements:

- ***Dredging the Coos Bay navigation channel*** from the offshore extent of the improved channel at RM -1 to approximately RM 8.2. The PA has a width of 1,180 ft and a depth of -57 ft MLLW at its offshore entrance. The channel width decreases continuously to a width of 600 ft at RM 0.3. The Entrance Channel has a 600-ft width from RM 0.3 through RM 1. Upstream of RM 1, the PA tapers down to a nominal width of 450 ft and a depth of -45 ft MLLW. Proposed channel modifications will not extend upstream of RM 8.2. The total volume of material dredged under the PA is expected to be about 20.28 million cubic yards (mcy) *in situ*, of which 13.93 mcy is sand and 6.34 mcy is rock.
- ***Post Panamax Generation 3 (PPX3) Containership Turning Basin at RM 5.0.*** A turning basin at the container facility is needed to accommodate the PPX3 containership. Based on the vessel's dimension, the proposed turning basin is 2,000 feet long (parallel to the channel) and 1,600 feet wide. The turning basin's design bottom elevation is -45 ft MLLW, the same as the PA channel.
- ***Capesize Turning Basin at RM 8.0.*** A Capesize turning basin will be constructed at RM 8.0. Operationally, this turning basin will be used by inbound empty bulk vessels. Therefore, the turning basin's design bottom elevation is -37 ft MLLW. The improved navigation channel (450-ft wide at -45 ft MLLW) continues through the length of the turning basin.
- ***Dredged material placement.*** Capital dredging material will be placed within disposal sites established for this project or placed beneficially. Dredged sediment is expected to primarily include fine- to medium-grained sand with trace amounts of fines. Dredged rock is expected to be siltstone and sandstone (sedimentary rock). The majority of the dredged sediment will be placed in a nearshore Beneficial Use Site established for this project; approximately 6.6 million cubic yards (mcy) *in situ* is expected to be available for beneficial placement in this site. The remainder of the capital dredging material will be placed within a new one-time use, ocean dredged material disposal site designated specifically for this project (proposed ODMDS Site L) and approved by the Portland District Commander and U.S. Environmental Protection Agency (USEPA) per Section 103 of the Marine Protection, Research, and Sanctuaries Act. After the completion of initial construction, the additional increment of O&M dredging material produced in subsequent years will be placed in ODMDS F, where annual maintenance material from the existing channel is currently being placed.

- ***Protective measures for the North Jetty*** to alleviate potential impacts from the Entrance Channel widening and deepening. A rock apron at the toe of the North Jetty will be constructed to protect against any potential impacts of side slope equilibration and scour from currents. The rock apron will extend from the relict jetty head through a portion of the jetty trunk.
- ***Relocation of aids to navigation (ATON).*** The revised channel shifts the centerline alignment of every reach from the Entrance Range through the Jarvis Turn, which will require relocating existing range markers. Channel widening will require relocation of the majority of the fixed and floating channel markers, although no new ATON are required.
- ***Advance Maintenance Dredging (AMD).*** AMD will be increased to 6 ft in the Entrance Channel downstream of Guano Rock (RM -1 to RM 0.7), and 1 ft in areas where Guano Rock is present (RM 0.7 to RM 1). AMD will be 1 ft upstream of RM 1. An additional rock buffer is proposed in areas where rock is present, including Guano Rock and RM 2.0 through RM 6.3; this rock buffer has a depth of 1 ft and a width of 25 ft.

The above modifications are shown in Table 10-1 and Table 10-2; no dredging is proposed beyond the boundaries in these tables. These tables also contain the dimensions of the Existing Condition. Proposed Alteration Features

Figure 10-1 also shows the location of the adjacent federal infrastructure: the two jetties that run parallel to the channel from RM 0 to RM 1 and the pile dikes located along the north bank of the channel from RM 6.4 to RM 7.5.

Table 10-1
Channel Widths for Existing Project and PA

Range(s) and RM	Existing Authorized Project	PA
Longitudinal Extent		
Offshore Limit including AMD Dredging	RM - 0.55	RM -1
Offshore Limit of Navigation Channel	RM 0	RM -0.9
Channel Width (feet)		
Offshore Inlet Offshore Limit of Navigation Channel to RM 0.3	700 narrowing to 550	1,280 narrowing to 600
Entrance Range RM 0.3 to 1.0	550 narrowing to 300	600
Entrance Range RM 1.0 to 2.0 and Turn	Varies up to 740	Varies up to 1,140
Inside Range RM 2.0 to 2.5	300	500
Coos Bay Range RM 2.5 to 4.3	300	450
Empire Range RM 4.3 to 5.9	300	450
PPX3 Turning Basin RM 4.7 to 5.6	None	2,000 x 1,600
Lower Jarvis Range RM 5.9 to 6.8	300	450
Jarvis Turn RM 6.8 to 7.3	400	500
Upper Jarvis Range RM 7.3 to 8.2	300	450 decreasing to 300
Capesize Turning Basin RM 7.6 to 8.0	None	2,000×1,100

Table 10-2
Channel Depths for Existing Project and PA

Range(s) and RM	Authorized Depth (ft)		Advance Maintenance Dredging (ft)	
	Existing Condition	PA	Existing Condition	PA
Offshore Limit of Navigation Channel to RM 0.3	-47	-57	5	6
Entrance Range RM 0.3 to 1.0	-47 decreasing to -37	-57 decreasing to -45	Varies 5 to 1	Varies 1 or 6
Entrance Range and Turn RM 1.0 to 2.0	-37	-45	1	1
Inside Range RM 2.0 to 2.5	-37	-45	1	1
Coos Bay Range RM 2.5 to 4.3	-37	-45	1	1
Empire Range RM 4.3 to 5.9	-37	-45	1	1
PPX3 Turning Basin	None	-45	None	1
Lower Jarvis Range RM 5.9 to 6.8	-37	-45	1	1
Jarvis Turn RM 6.8 to 7.3	-37	-45	1	1
Upper Jarvis Range RM 7.3 to 8.2	-37	-45	1	1
Capesize Turning Basin RM 7.6 to 8.0	None	-45	None	1

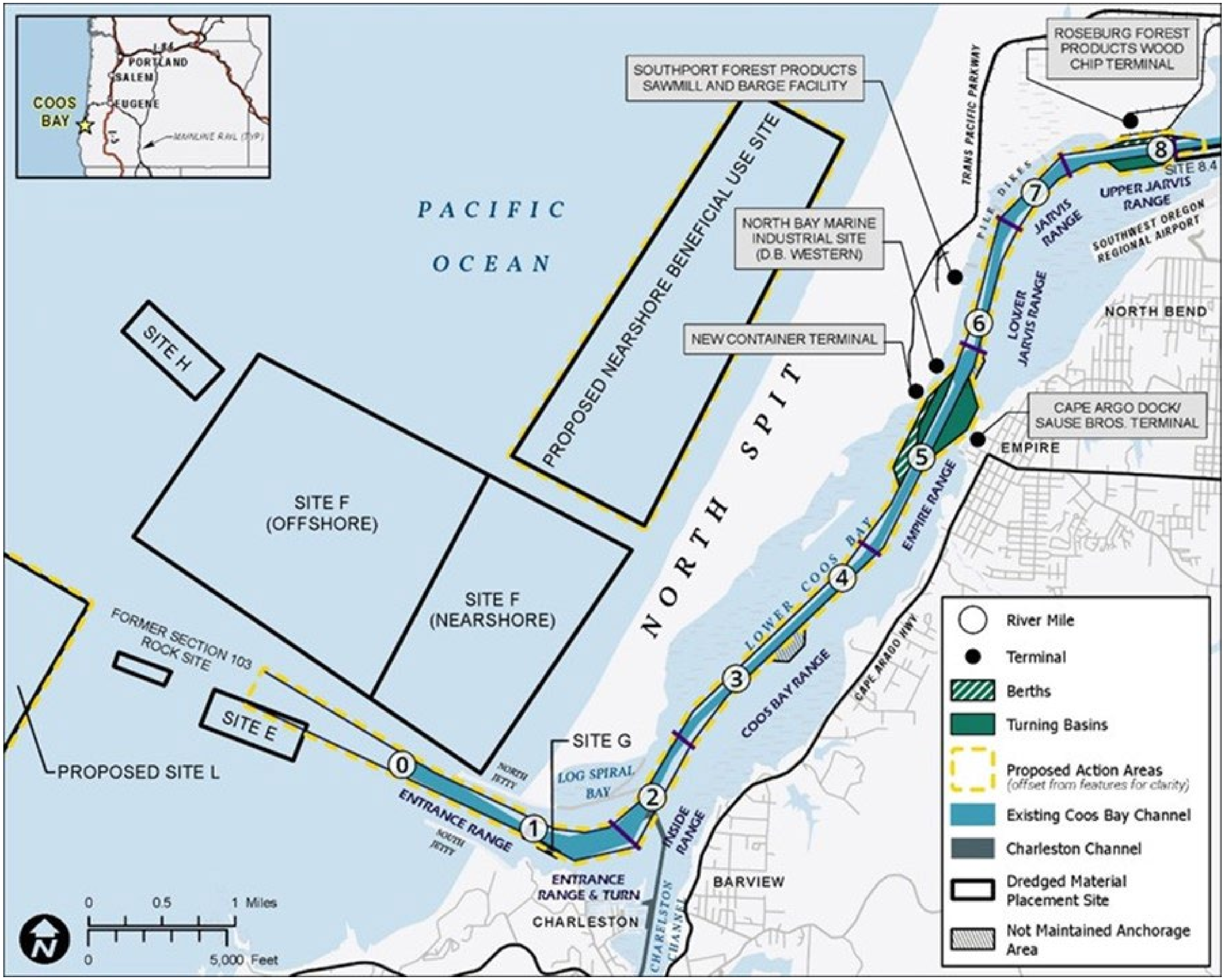


Figure 10-1: Summary of Proposed Alteration

10.2 Recommended Plan Construction

This schedule assumes that one hopper dredge, one cutterhead suction dredge loading scows, and one mechanical dredge will be working in the channel for the entirety of the 3 years (Table 6-8). The cutter suction dredge performing pre-treatment is anticipated to work within the channel only during the first two years year of the Project. It should be noted that this schedule includes contingency volumes for sand and for mechanical dredging of rock. The phasing plan does not explicitly call out survey work. However, the contractor will perform pre-and post-dredge surveys before for all sand and rock dredging (not shown in schedule) for payment purposes.

Table 10-3
PA Construction Schedule

Equipment Type	Year 1	Year 2	Year 3
Hopper Dredges	Guano Rock RM 1.0 – 7.0	RM -1 – RM1	Maintenance Dredging RM 7.0 – 8.2
Cutterhead Suction Dredge Loading Scows	RM 3.0 – 4.0	RM 2.0 – 4.0	RM 2.0 – 3.0
Cutterhead Suction Dredge Pre-treatment	RM 0.0 – 1.0 RM 4.0 – 6.0	RM 0.0 – 1.0 RM 4.0 – 5.0	
Mechanical Dredging Pre-treated Rock	RM 0.0 – 1.0 RM 4.0 – 6.0	RM 0.0 – 1.0 RM 4.0 – 5.0	RM 4.0 – 5.0
Mechanical Dredging Un-treated Rock	RM 5 – 5.75	RM 5 – 5.75	RM 5 – 5.75

Table 10-4 summarizes the source contributions of O&M dredging and the assumptions concerning maintenance dredging responsibilities during construction. The general assumption is that OIPCB will assume maintenance responsibility during construction for all areas of the channel where a construction dredge has dredged or is active. Similarly, OIPCB will be responsible for maintaining the PA depth and width until the Project has been certified as complete and accepted by the ASA(CW). During construction, USACE shall be responsible for maintaining areas that have not yet been dredged and other non-project areas of the channel (RM 8.2 to 15, Charleston Channel) to the existing authorized navigation depth. After construction is certified as complete, the USACE will be responsible for maintenance associated with the NED Plan. OIPCB will assume financial responsibility for the incremental difference in maintenance between the PA and the NED Plan to the extent determined by the Assistant Secretary of the Army.

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Table 10-4
Summary of USACE and OIPCB Maintenance Dredging Responsibilities

Year	USACE Responsibility	OIPCB Responsibility	Assumptions
Year 1 (start of construction)	Shoaling in RM -1 to 1 Shoaling in RM 8.2-12	Shoaling in RM 1-8.2	OIPCB contractor widening and deepening RM 1-2, RM 4-5 and RM 6-8.2 and widening RM 3-4 and RM 5-6. The contractor will also dredge Guano Rock. Contractor will perform O&M where capital dredging is active.
Year 2	Shoaling in RM 8.2-12	Shoaling in RM 1-8.2 Side slope equilibration of RM 1-8.2	OIPCB contractor widening and deepening RM -1 to 1 and RM 2-3. Contractor will perform O&M through RM 8.2.
Year 3 (final year of construction)	Shoaling in RM 8.2-12	Shoaling in RM 1-8.2 Side slope equilibration in RM 1-8.2	OIPCB contractor deepening RM 3-4 and 5-6. Contractor will perform O&M to AM dimensions throughout entire channel.
Year 4 (capital dredging complete)	Shoaling in entire FNC	---	OIPCB contractor has demobilized and left Coos Bay (to be determined). Side slope equilibration decreasing annually through end of equilibration period.

10.3 Dredged Material Management Plan

A DMMP was developed in accordance with USACE guidance (USACE, 2000a). The DMMP identifies more than sufficient capacity for the non-federal sponsor and USACE to place construction and maintenance dredging material generated by the PA throughout the 20-year planning period, including future equilibrium side slope equilibration volumes (see Appendix B: Dredged Material Management Plan). Dredged material placement capacity is also provided for future maintenance dredging of the federal navigation project at Coos Bay that is not modified by the Section 204 (f) project (i.e., River Miles 8.2 to 15) and for projected future maintenance dredging operations performed under the OIPCB Unified Dredging Permit.

All material dredged by the OIPCB contractor(s) during construction will be either disposed at the proposed ODMDS L (a disposal area for rock and sand) or placed beneficially at the proposed North Spit Nearshore Littoral Placement Site. All post-construction maintenance material will be disposed at the existing sites currently in use. The plan recommended in the DMMP is the Federal Standard (Figure 10-2), and consists of:

- Establishment of proposed ODMDS L sized for the entire volume of material dredged during construction of the PA. Material to be disposed at Site L may include side slope equilibration material, maintenance material dredged during construction, and construction material. A total of 32.7 million cubic yards of mobilized material (i.e., including bulking and contingency) could be disposed at Site L for the PA[60];
- Beneficial placement of construction material (sand) in the Proposed North Spit Nearshore Littoral Placement Site (6.6 mcy) and 9.9 million cubic yards of maintenance material into the littoral system based on continuation of the existing maintenance regime over 20 years; and
- Continuance of existing maintenance operations, which include, beneficial placement of maintenance material (sand) in the existing nearshore section of ODMDS F to supplement the littoral system.

[60] Note that proposed Site L is sized for capital dredged material, maintenance material during construction, and conservative side slope equilibration material. There is nothing in this DMMP that precludes USACE from selecting a larger Site L to meet additional USACE needs.

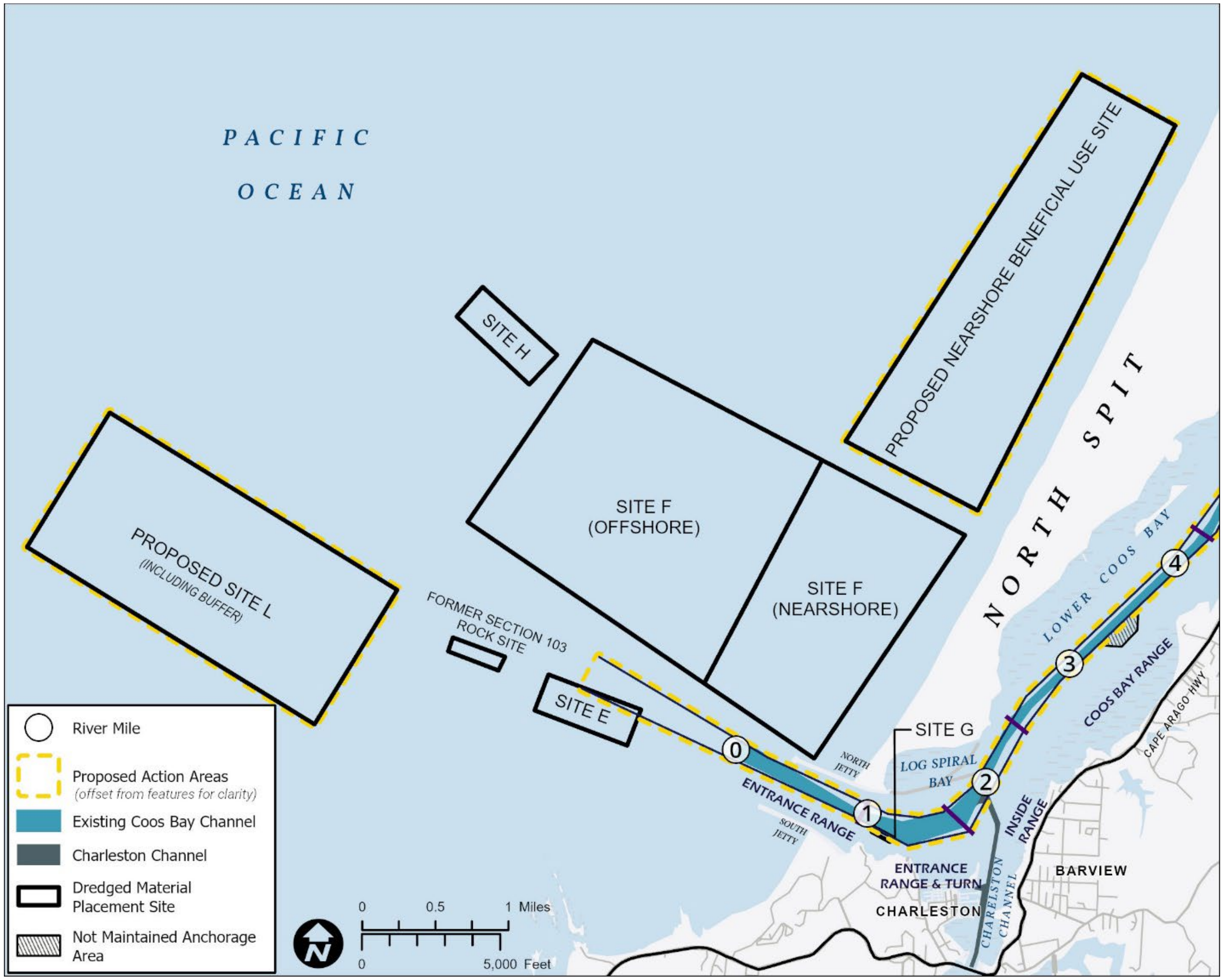

Figure 10-2: Dredged Material Disposal Sites (PA)

10.4 Recommended Plan Post-Construction Operations and Maintenance

The PA is expected to increase the amount of shoaling within the channel, which will increase USACE's maintenance burden the year after construction is complete and into the future. The PA is expected to increase annual shoaling over without project conditions in the Entrance Channel by 282,000 cy and to increase annual shoaling in the inner channel by 52,000 cy (334,000 cy total). In addition, side slope equilibration occurring after construction dredging will further increase the maintenance burden after the first year of construction through the sixth year after construction. When side slope equilibration is completed, the increased maintenance burden is projected to stabilize to 334,000 cy/year (Table 10-5).

Table 10-5
PA Additional Maintenance Material (cy)

Post Construction Year	Additional Maintenance Material	Equilibration Material	Total
1	334,000	553,000	887,000
2	334,000	119,000	453,000
3	334,000	73,000	407,000
4	334,000	41,000	375,000
5	334,000	19,000	353,000
6	334,000	9,000	343,000
7	334,000	0	334,000

Note: Post-equilibration, the long-term maintenance increase is 334,000 cy/year

10.5 Recommended Plan Real Estate Considerations

As the project progresses, property easements will be needed for the following project elements:

- Relocation and installation of ATON – summarized in Appendix A, Section 6.11 and detailed in Sub-appendix 1, Aids to Navigation;
- Modifications to the channel (activity in state waters) – summarized in Appendix A, Section 6;
- Access to the North Jetty – (Appendix A, Section 6.10); and
- Construction staging areas – discussed in Appendix A, Section 8.6 and Sub-appendix 11, Construction Implementation Plan.

10.6 Recommended Plan Mitigation

Mitigation requirements are being established by USACE as part of the Environmental Impact Statement process.

10.7 Risk Management Plan

A preliminary Risk Management Plan has been developed to address residual risk and uncertainty associated with project implementation. The Risk Management Plan supports continued functionality of federal and non-federal infrastructure and environmental resources at Coos Bay, which may be impacted by project implementation in ways that were not identified during project design. Major components of the Risk Management Plan include monitoring and adaptive management plans that specify corrective actions to be taken when monitoring results reach a pre-defined threshold.

Development of the Risk Management Plan will be further informed through the EIS preparation and ensuing environmental review and permitting process. At this stage of project development and approval, three categories of project-related risk and uncertainty have been identified. These include:

- Potential impacts to Federal and non-Federal infrastructure;
- Impacts related to offshore disposal of dredged material; and
- Impacts to environmental resources with the Coos Bay Estuary

Table 10-6 presents a conceptual Risk Management Plan that will be further developed to include specific monitoring result thresholds that trigger corrective action and definitive actions to be taken. Refinements to the conceptual Risk management Plan will be informed by the EIS, public involvement, and permit requirements.

Table 10-6
Conceptual Risk Management Plan

ISSUE OR CONCERN	PRIMARY MONITORING	MONITORING TOOLS	FREQUENCY AND DURATION OF MONITORING	TRIGGER(S) FOR ACTION	POSSIBLE RESPONSE ACTIONS
North and South Jetty Stability	Bathymetric surveys to establish baseline WOP variability	Bathymetric surveys to measure erosion and side slope equilibration	Annual to 5-year period post construction. Periodic following major storm events.	Side slope equilibration and/or erosion beyond predicted limits or encroaching on jetty structure	Temporarily suspend dredging operations; Add or enhance rock apron

ISSUE OR CONCERN	PRIMARY MONITORING	MONITORING TOOLS	FREQUENCY AND DURATION OF MONITORING	TRIGGER(S) FOR ACTION	POSSIBLE RESPONSE ACTIONS
Other Infrastructure Stability	Bathymetric surveys to establish baseline WOP variability	Bathymetric surveys to measure erosion and side slope equilibration	Annual to 5-year period post construction. Periodic following major storm events.	Side slope equilibration and/or erosion beyond predicted limits or encroaching on jetty structure	Temporarily suspend dredging operations; Add or enhance rock apron or other protective measures
Estuary Water Quality	Monitor range of WQ parameters for which baseline WOP data exists including salinity, temperature, DO, others	Utilize present monitoring programs but augment in potential areas of concern – important to establish baseline and reasonable variability for WOP conditions	Quarterly – using data retrieved from real time and periodic automated sampling stations for 5-year period.	Compare post construction WQ parameter data – trigger is exceedance of water quality standards **Temperature:** 0.5 ° Fahrenheit increase in Coos Bay waters **Dissolved Oxygen:** < 4.0 mg/L Minimum <6.5 mg/L 30 Day Mean Minimum	Adaptive mitigation and negotiated water quality enhancement projects (e.g. stormwater enhancement projects, riparian and estuary enhancement activities in basin)
Shallow Subtidal/Salt Marsh/Mudflat Habitats	Bathymetric surveys	Bathymetric surveys to determine extent of equilibration	Biennial for a 10-year period	Equilibration that extends into these habitat types where none is currently modeled to occur	Adaptive mitigation – replacement of lost habitat function and value with restoration actions in the estuary

10.8 Assumption of Maintenance

WRDA 2020 revised US Code 2232 so that the Secretary may be responsible for all operations and maintenance costs of improvements that deviate from the NED Plan, including costs in excess of the costs of the NED Plan, provided other conditions are met (US Code 2232 (f)(2)). Although not formally identified as the NED Plan, the PA provides the largest net benefit of all plans evaluated (Table 7-8). Table 10-5, above, identifies the projected long-term increase in annual O&M material and the short term increase due to side slope equilibration. Table 10-7 identifies the post-construction projected annual increase in O&M costs and the diminishing increase in O&M costs due to side slope equilibration.

Table 10-7
Additional Cost of PA Maintenance ($FY24)

Post Construction Year	Additional Maintenance Material	Equilibration Material	Total
1	$3,101,000	$6,258,000	$9,359,000
2	$3,101,000	$2,321,000	$5,422,000
3	$3,101,000	$1,424,000	$4,525,000
4	$3,101,000	$800,000	$3,901,000
5	$3,101,000	$371,000	$3,472,000
6	$3,101,000	$176,000	$3,277,000
7	$3,101,000	$0	$3,101,000

The OIPCB requests that the Secretary of the Army accept responsibility for all future maintenance of the PA, including post-construction side slope equilibration material.

In addition to bearing the full cost of construction, the OIPCB will also be undertaking maintenance responsibility for the reach from RM 1 to RM 8.2 for the three years of construction; and also undertaking maintenance responsibility for the reach from RM-1 to RM 1 during Year-2 and Year-3 of construction (see Table 10-4, shown previously).

11. REFERENCES

Adams, P. B., Grimes, C. B., Hightower, J. E., Lindley, S. T., & Moser, M. L. 2002. Status review for North American green sturgeon, Acipenser medirostris.

Assistant Secretary of the Army for Civil Works (ASA(CW)). 2022. Memorandum for Commanding General, U.S. Army Corps of Engineers, Subject: Implementation of Environmental Justice and Justice40 Initiative. Online at: https://planning.erdc.dren.mil/toolbox/library/MemosandLetters/ASACW_FinalInterimEJIG_15March2022.pdf

Assistant Secretary of the Army for Civil Works (ASA(CW)). 2023. Memorandum for Commanding General, U.S. Army Corps of Engineers, Subject: Implementation Guidance for Section 160 of the Water Resources Development Act of 2020, Definition of Economically Disadvantaged Community. Online at: https://api.army.mil/e2/c/downloads/2024/05/17/c17e5387/wrda-20-section-160-final-14-march-23.pdf

Coos Bay Rail Line (CBRL). 2023. Budget Committee Meeting Minutes 24May23. Coos Bay Oregon.

Council on Environmental Quality (CEQ). 1997. Environmental Justice: Guidance under the National Environmental Policy Act. Online at: https://ceq.doe.gov/docs/ceq-regulations-and-guidance/regs/ej/justice.pdf

Council on Environmental Quality (CEQ). 2024. Final Rule, "Bipartisan Permitting Reform Implementation Rule." National Environmental Policy Act Implementing Regulations Revisions Phase 2. Federal Register Vol. 89, No 85, p. 35442-35577. Online at: https://www.govinfo.gov/content/pkg/FR-2024-05-01/pdf/2024-08792.pdf

Cortwright, R., J. Weber, R. Bailey. 1987. The Oregon Estuary Plan Book. Oregon Department of Land Conservation and Development, Salem, Oregon.

Dott, R. H., Jr., 1966, Eocene Deltaic Sedimentation at Coos Bay, Oregon. The Journal of Geology, Vol. 74, No. 4, pp. 373-420.

Executive Order (EO). 1994. Federal Actions to Address Environmental Justice in Minority Population and Low-Income Populations. Executive Order 12898, 59 Fed. Reg. 7629. Online at: https://www.archives.gov/federal-register/executive-orders/pdf/12898.pdf

Executive Order (EO). 2021. Tackling the Climate Crisis at Home and Abroad. https://www.govinfo.gov/content/pkg/FR-2021-02-01/pdf/2021-02177.pdf

Executive Order (EO). 2023. Executive Office of the President, Executive Order, Revitalizing Our Nation's Commitment to Environmental Justice for All. Federal Register Vol. 88, No. 80, April 26, 2023. Online at: https://www.whitehouse.gov/briefing-room/presidential-actions/2023/04/21/executive-order-on-revitalizing-our-nations-commitment-to-environmental-justice-for-all/

Federal Energy Regulatory Commission (FERC). 2019. Draft Environmental Impact Statement. FERC Office of Energy Projects, Washington, DC. March 2019.

Federal Interagency Working Group on Environmental Justice & NEPA Committee (FIWG). 2019. Community Guide to Environmental Justice and NEPA Methods. Online at: https://www.energy.gov/sites/default/files/2019/05/f63/NEPA%20Community%20Guide%202019.pdfLee, W., Ward, E., Somers, K., Tuttle, V., & Jannot, J. 2016. Status Review

Update of Eulachon (Thaleichthys pacificus) Listed under the Endangered Species Act: Southern Distinct Population.

ICF International. 2010. Habitat Conservation Plan for the Western Snowy Plover. August. (ICF 06537.06.) Portland, OR. Prepared for Oregon Parks and Recreation Department.

Merkel & Associates (M&A). 2023. Oregon International Port of Coos Bay WRDA Section 204(f) Proposed Channel Modification Coos County, Oregon Baseline Eelgrass Survey. September 2023.

Moffatt & Nichol (M&N). 2012. Coos Bay Jetties: Preliminary Major Maintenance Report. Prepared for the U.S. Army Corps of Engineers, Portland District. July 2012.

Moffatt & Nichol (M&N). 2008. Oregon International Port of Coos Bay Oregon Gateway Marine Terminal Draft Excavated and Dredged Material Management Plan. March 4.

National Oceanic and Atmospheric Administration (NOAA). 2015a. Mean Sea Level Trend: 9432780 Charleston, Oregon. Viewed online at: <http://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=9432780>.

National Oceanic and Atmospheric Administration (NOAA). 2015b. Extreme Water Levels: 9432780 Charleston, OR. Viewed online at: <http://tidesandcurrents.noaa.gov/est/est_station.shtml?stnid=9432780>.

National Oceanic and Atmospheric Administration (NOAA). NOAA Fisheries, Top US Ports 2022. Accessed on 12Jun24 at https://www.fisheries.noaa.gov/foss/f?p=215:11:7878463750925:::::.

National Research Council. 2012. *Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future*. Washington, DC: The National Academies Press. https://doi.org/10.17226/13389

ODFW. 2008. Shellfish and Estuarine Assessment of Coastal Oregon (SEACOR). Findings – Coos Bay.

ODFW. 2016. Sensitive Species List 2016. Wildlife Division. Accessed April 10, 2019. URL: https://www.dfw.state.or.us/wildlife/diversity/species/docs

ODFW 2024. Commercial Landing Statistics. Accessed 12Jun24. URL: https://www.dfw.state.or.us/fish/commercial/statistics.asp

Oregon Department of Geology and Mineral Industries, 1961, Chromite in Southwestern Oregon. Bulletin 52.

Oregon Department of Geology and Mineral Industries, 1973, Geology and Mineral Resources of Coos County, Oregon. Bulletin 80.

Oregon Department of Geology and Mineral Industries (DOGAMI). 2012. "Local Source (Cascadia Subduction Zone) Tsunami Inundation Map, Coos Bay – North Bend, Oregon."

Oregon Department of Geology and Minerals Industries, 2019, Geologic Map of Oregon, https://gis.dogami.oregon.gov/maps/geologicmap/, accessed April 15, 2019.

Oregon Employment Department QualityInfo (OEDQ) 2024. Current Employment Estimates Annual Data Sheet Coos County. 2024.

OIPCB. 2016. Coos Bay Channel Modification Section 204(f)/408 Project: One-Time Authorization for Using MIKE-21 Modeling Suite. Memorandum For Record. May 26, 2016.

Partnership for Coastal Watersheds, 2019. http://www.partnershipforcoastalwatersheds.org/water-quality-in-the-coos-estuary-and-lower-coos-watershed-physical-factors accessed 08April19

Pischke, G. 2011. Email from G. Pischke. Senior Project Geologist at Oregon Department of Transportation to J. Scott, Engineer at Moffatt & Nichol, on April 25.

PSET, 2016. Portland Sediment Evaluation Team (PSET) Level 2A dredged material suitability determination for the Coos Bay federal navigation project, including the federal navigation channel (FNC) and the Charleston Channel, at Coos Bay, Coos County, Oregon. 25 January 2016

PSET, 2019. Portland Sediment Evaluation Team (PSET) Recency Determination Memorandum the proposed modification of the Coos Bay Federal Navigation Project by the Oregon International Port of Coos Bay (Port) located from deep water of the Pacific Ocean into the Coos River (river mile [RM] -1 to 8.2), Coos County, Oregon (Corps Permit No. NWP-2016-235). 20 September 2019

Portland State University (PSU) Population Research Center. 2024a. 2023 Annual Oregon Population Report Tables. Portland Oregon. 2024

Portland State University (PSU) Population Research Center. 2024b. Oregon Housing Needs Analysis. County Forecasts.xlsx. Portland Oregon. 2024

Presidential Memorandum (PM). 1994. Memorandum for the Heads of All Departments and Agencies. Subject: Executive Order on Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. Online at: https://www.epa.gov/environmentaljustice/presidential-memorandum-heads-all-departments-and-agencies-executive-order

RSET, 2018. Northwestern Regional Sediment Evaluation Team (RSET). 2018. Sediment Evaluation Framework for the Pacific Northwest. Prepared by the RSET Agencies, May 2018, 183 pp + appendices.

Siipola, M. D. 2008. Personal communication. Telephone conversation between Mark Siipola, USACE – Portland District, and Margaret Schwertner, Moffatt & Nichol, February 12.

Sounhein, B., Brown, E., Lewis, M., & Weeber, M. 2015. Status of Oregon stocks of Coho salmon, 2014. Oregon Department of Fish and Wildlife, Monitoring Program Report OPSW-ODFW-2015-3, Salem.

USACE, 2012. Coos Bay Jetties Preliminary Major Maintenance Report, USACE Portland District, July 2012

USACE, 2015. U.S. Army Corps of Engineers, Portland District. 2015. Coos Bay Federal Navigation Channel and Charleston Side Channel Sediment Quality Evaluation Report. December 23, 2015. Prepared by the USACE, 36 pp + Attachments

USACE, 2017. U.S. Army Corps of Engineers, Portland District Coos Bay North and South Jetty Site Inspections, 24-25 July 2017. Memorandum for Record.

USCG, 2008. Waterway Suitability Report for the Jordan Cove Energy Project, July 1, 2008.

USEPA, 2019 https://www.epa.gov/national-aquatic-resource-surveys/indicators-dissolved-oxygen accessed 08April19

U.S. Environmental Protection Agency (USEPA) and U.S. Army Corps of Engineers (USACE). 2006. Site Management/Monitoring Plan Coos Bay, Oregon Site E, Site F and Site H. EPA Section 102. Ocean Dredge Material Disposal Sites (ODMDS).

Zhang, Y. J. 2009. Site-Specific Tsunami Modeling Coos Bay, Oregon. Center for Coastal Margin Observation & Prediction (CMOP) Oregon Health & Science University. March 17.

Zhang, Y. J. 2008. Site-Specific Tsunami Modeling at the Jordan Cove LNG Facility Coos County, Oregon. Center for Coastal Margin Observation & Prediction (CMOP) Oregon Health & Science University. September 25.

12. ATTACHMENTS